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aquaculture Asia

Freshwater pearl culture and production in China

Culture of freshwater prawn and common carp varieties in China

Trade in live reef marine fish in Hongkong, China

Also in this issue:

AA regular columns focus on fisheries and aquaculture in China; features on STREAM and rural livelihoods; marketing and trade; book reviews and aquaculture briefs

aquaculture Asia

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NACA
An intergovernmental organization that promotes rural development through sustainable aquaculture. NACA seeks to improve rural income, increase food production and foreign exchange earnings and to diversify farm production. The ultimate beneficiaries of NACA activities are farmers and rural communities.

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From the Editor's desk

A Residual Issue

The issue of chemical residues in aquaculture products, and the use of chemicals in aquaculture in general, has had a high profile in the media recently, notably because of the detection of antibiotic residues in some aquaculture products. This issue is not new and it has dogged the aquaculture industry (and other livestock sectors) for some time. Pressure against chemical usage in food production is likely to increase as consumer awareness of such issues grows.

The issue of chemical residues is only one part of the broader issue of food safety and public health in general. Events in recent years, such as the BSE or "mad cow" disease in the beef industry, have demonstrated that consumers are increasingly intolerant of threats to food safety, whether real or perceived. A clear lesson from the BSE crisis is that food safety is an industry-wide issue involving not only the producer but also suppliers of inputs, processors and distributors. BSE has also shown that a food safety issue affecting even a small part of an industry can affect the confidence of national or even the global market. All parts of the supply chain therefore need to cooperate to produce safe products. This raises issues such as health and environmental standards, certification and auditing, labeling and ability to trace product origin, canvassed in an article on page 38 by Dr Rola.

In this issue, our Thai-language column (and English translation) takes a close look at the antibiotic chloramphenicol, its medical uses and its potential health risks. The issue of appropriate chemical usage in aquaculture and food safety will be explored in future issues of Aquaculture Asia.

In other developments, the recent NACA Governing Council meeting passed two resolutions on the Grouper Network. The first was to change the status of the network from a project to a core (ongoing) NACA activity, thereby extending the life of the network indefinitely. The second resolution was to expand the focus of the network to "Marine Finfish". This is largely in recognition of the fact that most people working on grouper are also working on a range of other non-grouper marine finfish species. I hope that you will find the new expanded network useful and enjoyable. Please continue to share your experiences with others (visit http://www.enaca.org/Grouper/index.htm for full details of how to participate).

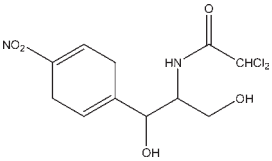
Simon Wilkinson

aquaculture Asia

In this issue

Sustainable Aquaculture

Aquatic Animal Health



Research and Farming Techniques

What's new in Aquaculture

Notes from the Publisher

Building up NACA's institutional capital with partnerships

Pedro B, Bueno, Director-General of NACA, conceived of and was Editor of Aquaculture Asia for six years. He now writes from the vantage view of the Publisher.

Work agenda drafted for the WB-NACA-WWF-FAO Consortium Program on Shrimp Farming and the Environment

A stakeholders consultation held at the World Bank headquarters in Washington DC on 27-28 March 2002, has provided guidelines to the Consortium's next work program. It includes distilling and disseminating the lessons learned from the study and assisting governments and farmers to implement better management practices in shrimp aquaculture in coastal areas. The immediate work agenda includes improving, finalizing and developing ways to implement the study on shrimp farming and the environment.

The Program conducted a study that comprised 35 complementary case studies on different aspects of shrimp aquaculture. The study, which includes case studies and thematic reviews on best management practices in shrimp aquaculture, was conducted between 1999-2001 in Asia-Pacific, Latin America and Africa with the participation of over a hundred researchers and development workers from government agencies, NGOs, academic institutions, corporate managers, and individual farmers.

The consultation in Washington identified follow-up actions and outlined collaborative arrangements to assist farmers and governments implement BMPs. It was attended by more than 30 representatives coming from the private sector in Asia and Latin America, governments in Asia and Latin America, donor organizations including US AID, Foundations, civil society, IUCN and NACA, FAO, WB, WWF, which constitute the Consortium Program.

The cases and reviews, and the synthesis report of the Programme, are available at NACA's website: www.enaca.org/shrimp. Send an email to shrimp@enaca.org for particular inquiries.

Dr Kristalina I. Georgieva, Director of the Bank's Environment Department (shown here with Pedro Bueno of NACA (left) and Ron Zweig, Senior Aquaculturist of the World Bank) in her welcome and keynote speech underlined the Bank's strategy on and support to activities in environment and poverty alleviation. She said the Bank welcomes and strongly supports a mode of cooperation exemplified by the Consortium program. The WB environment strategy emphasizes three objectives: *Improving the quality of life; Improving the quality of growth* by supporting policy, regulatory and institutional frameworks for sustainable environmental management and by promoting sustainable private development; and *Protecting the quality of the regional and global commons* such as climate change, forests, water resources and biodiversity. *"We have to consider environment as a part of development rather than a self-standing agenda,"* she said.

Pacific Island Nations set aquaculture development priorities

An action plan for developing the aquaculture of the Pacific Island Nations based on, initially, eight commodities identified as having the most potential for aquaculture development in the Pacific region, has been formulated. The eight selected from a list of 17 species, are: seaweed, corals, giant clams, pearl oysters, tilapia, *Macrobrachium* shrimp, milkfish and sea cucumber.

A five-day workshop held on 11-15 March 2002 on the neat and green campus of the University of South Pacific in Suva attended by more than 70 stakeholders representing the government, academic institutions, private sector, civil society, students, donor agencies, and regional and international organizations, established the strategic plan for developing the region's aquaculture based on eight of 17 commodities that were studied by the workshop. Largely on a profile previously developed for each commodity by experts from Oceania, the Pacific and Asia, coordinated by the Secretariat of the Pacific Community (SPC), ICLARM and ACIAR, the workshop systematically went through the list and set the priorities based on two criteria – the potential benefits of farming the commodity to the region and the feasibility of farming it. Benefits were broadly defined as the commodity's contribution to social and economic development, and feasibility was based on the availability of information on the commodity, the capability of the Secretariat to deliver the information and technology, and the ability of the region to absorb and implement the technology.

NACA and the FAO RAP took part in the workshop. NACA also provided some experts that contributed to the development of the commodity profiles (carps, shrimp and tropical abalone). An assessment of NACA as a collaborating organization and an outline of a possible framework of cooperation between NACA and the Pacific Island nations - collectively represented by the SPC - were presented at the workshop.

ICLARM, SPC and ACIAR are finalizing the action plan and refining the commodity profiles, in light of suggestions and further expert inputs from the workshop participants. What to do with the species that fell below the priority line? The exercise provided useful leads on key technological and management efforts that can be done to increase their importance. Participants came from all the Pacific Island Nations from the Palau and Marshall Islands to French Polynesia, as well as Papua New Guinea, Australia, New Zealand and the Philippines.

NACA Alumni in the South Pacific

NACA Alumni from the South Pacific are doing very well. The three in this photo, from Fiji, were participants in various NACA training courses including the Senior Aquaculturist Training Course that led to a Master's degree in Aquaculture (professional) and the Integrated Fish Farming course in Wuxi, China which has been continuously offered since 1981. From left are Ms Tavenisa Vereivalu (Integrated Fish Farming Course, Wuxi), who is now project leader for seaweed and milkfish in the Fiji fisheries department; Esaroma Ledua (seaweed course in China, economics for aquaculture course, and various others), who is now a *Macrobrachium* farmer but previously with the Secretariat of the Pacific Community and the Department of Fisheries of Fiji; and Jone Vasuca (Senior Aquaculturist Programme, Philippines and Integrated Fish Farming), head of the Naduroulou Freshwater Aquaculture Research Station where this photo was taken.

We also learned that Mr Tukabu Teroroko of Kiribati (Senior Aquaculture Programme), is his country's Permanent Secretary of Marine Resource Development. A third alumnus, Petrus Sagom of Papua New Guinea, after about three decades of service to PNGs agriculture, having been head of the Highlands Aquaculture Station for a long time, resigned from the civil service to try to serve the country as an elected official.

Alumni network

To all NACA alumni, a move is afoot to formally establish the NACA alumni network. Beato Pudadera, Jr of Brunei's Fishery Department, Ministry of Primary Industries, and Ramon Agbayani, General Manager of an aquaventure of a quasi-government agency of Brunei's Ministry of Primary Industry have volunteered to be the focal point of the alumni network. An alumni page is being constructed to be placed at the NACA website. We urge NACA alumni (all training courses) to send their brief CVs and latest mailing and electronic addresses (phone, fax and email) to Ramon Agbayani (rracva@brunet.bn) and Beato (beatojr@brunet.bn). Support to the initiative is provided by the NACA Secretariat; send messages to Zhou Xiaowei (xiaowei.zhou@enaca.org).

The priority setting workshop was an extremely well-managed and pleasant exercise. Taskmaster was planning consultant Tim Leahy of Canberra whose track record includes assisting ICLARM and various agencies of the Australian government in corporate and development planning. This photo shows some of the participants (divided into 8 working groups) wrestling with the issues.

Satya Nandlal (fourth from right) of the Fisheries Bureau of Fiji and currently a doctoral student at the Marine Studies Programme (Aquaculture) of the University of South Pacific, is a passionate and industrious worker promoting small-scale aquaculture in the Islands. He is shown here briefing participants visiting one of the project sites – an integrated fish farm and a trial mangrove crab ongrowing pond (shown below).

Left: the integrated fishpond operated by a boys' town in Suva; and below, the Naduroulon aquaculture station.

Mr Maciu Lagibalavu, Fiji's director of fisheries (left), is shown with SPC's aqua-culture adviser Ben Ponia in the photo below.

Associate Membership of the South Pacific Community, reciprocal associate membership with APAARI being negotiated

One of two amendments to the NACA Agreement endorsed by the Governing Council at its 13th meeting (on January 16-18 in Langkawi, Malaysia) was the provision of associate membership in NACA of other intergovernmental organizations, regional associations of nations/economic blocs, and regional and international donor agencies.

The other was the change in the title of the head of NACA from Coordinator to Director General.

At theSPC priority setting workshop, an assessment of the benefits of the Pacific Island nations, joining NACA collectively as associate member, represented by the Secretariat of the Pacific Community, was presented by Mr Maciu Lagibalavu, Director of Fisheries of Fiji. Further consultations between NACA and SPC will be held on the issue. Mr Lagibalavu along with SPC's aquaculture adviser Ben Ponia along with Mr Aymeric Desurmont, Information Specialist of SPC, attended the 13th Governing Council Meeting of NACA and held discussions with the NACA Secretariat in January.

Meanwhile, a reciprocal associate membership between NACA and the Asia-Pacific Association of Agricultural Research Institutes whose secretariat and information hub are in FAO RAP in Bangkok with a support staff In FAO New Delhi, is being worked out.

NACA has been invited as early as 1998, to become associate member of APAARI by Executive Secretary Dr Raj S. Paroda, formerly Director General for ICAR and currently coordinator of a regional program on agricultural research and development in the Central Asian region.

The reciprocal associate membership was also offered by Dr Paroda in a subsequent letter to the NACA Secretariat. The 11th Governing Council of NACA (Colombo, 1998) had favourably considered NACA's associate membership in APAARI. NACA meanwhile has been participating in various APAARI consultations including the development of an agricultural research information system, agricultural research priority setting for South and West Asia, and fishery research priority setting for Asia-Pacific. NACA, through APAARI, was invited to present NACA's regional coordination of aquaculture R and D as a policy case at the Global Forum on Agricultural Research held in Dresden, Germany in May 2000.

The Association aims to foster the development of agricultural research in the Asia-Pacific Region by promoting the exchange of scientific and technical know-how and information in agriculture; encouraging the establishment of appropriate co-operative research and training programs; assisting in strengthening of research and management capabilities of member institutions; and strengthening cross-linkages between national, regional and international research centres and organizations, including universities, through involvement in jointly planned research and training programmes. APAARI's associate members include eight CGIAR institutions, the Asian Vegetable R and D Centre in Taiwan, CAB International, the French-based Center for International Cooperation in Agriculture for Development (CIRAD), and AIT. It has also supportive organizations that include FAO, ACIAR, the Global Forum for Agricultural Research, CGIAR or Consultative Group on International Agricultural Research, and the International Fund for Agricultural Development.

Review of the NACA Agreement

The Committee to Review the NACA Agreement, a volunteer group composed of former and current members of the Governing Council, a representative of FAO's legal department, the former NACA Coordinator, the founder of the Asian Fisheries Society, and a representative of donor agency, recommended associate membership in NACA and came up with the following list of benefits to NACA and to the associate member:

Specific benefits to NACA

- A wider base of experience to draw from;
- Support to the implementation of the Work Programme;
- Increases the impact of NACA's work;
- Improves access to information and wider dissemination of information;
- Provides more resources;
- Increases opportunities for the funding of projects;
- Expands the footprints of the Organization;

Benefits to the Associate Member

- Access to collaborative work with NACA;
- Benefiting from NACA's professional expertise;
- Participation in exchange and training activities;
- Increases the impact of the AM's programs;
- Improves AM's access to information and technical expertise; and
- Facilitates development of collaborative projects and cooperation with other member organizations.

The major benefit to both parties is the maximizing of available resources, minimizing duplication of programs and resources, and increasing the impact on development in the region.

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Freshwater pearl culture and production in China

Hua Dan and Gu Ruobo

Freshwater Fisheries Research Center,
Chinese Academy of Fisheries Sciences
Wuxi City 214081, Jiangsu Province, China

Glittery, lustrous and colorful, pearls have been called the queen of the jewels throughout the ages. The occurrence of natural pearls in wild freshwater mussels is very rare.

The technology of freshwater pearl culture was developed in China some 2,000 years ago. However, commercial freshwater pearl culture, dates back only to the late 1960s and early 1970s. Gradual changes in technology and, most importantly, in the type of mussel used, resulted in the production of greater quantities of larger and more lustrous round, near-round, and baroque cultured pearls with a variety of colors.

Today there is a great demand for cultured freshwater pearls and China produces 95% of freshwater pearls sold in the world market. Studies on the increment of pearl quality, treatment of pearl mussel disease and the techniques for conducting nuclei and special pearl operations began in the Freshwater Fisheries Research Center (FFRC) in 1990. The successful demonstration of this technology led to the initiation of commercial farmed pearl culture in China. Over the past decade FFRC has also trained hundreds of people in freshwater pearl culture from 50-60 countries in the Asia-Pacific, African, Latin American and East European regions. In particular, FFRC specialists have successfully transferred the technology for pearl culture to Bangladesh with encouraging results – the first tiny pearls were developing after only two months of program operation.

Freshwater mussels for pearl culture

Several species of freshwater mussel can produce pearls in China. Triangle sail mussel *Hyriopsis cumingii* and wrinkle comb mussel *Cristaria plicata* are widely used for pearl production. However, the triangle sail mussel (Fig. 1) is the best for producing high quality pearls.

Fig. 1. Triangle sail mussel Hyriopsis cumingii

Triangle sail mussel is widely distributed in the lakes and their tributaries in Hebei, Shandong, Anhui, Jiangsu, Zhejiang, Jiangxi, Hubei, and Hunan provinces. They are most abundant in Dongting Lake, Poyang Lake, Taihu Lake, Hongze Lake, Shaobo Lake, and Gaobao Lake.

This species occurs in the large or medium lakes or in perennial rivers. Typically it occurs in flowing waters with slightly firm sand-mud or mud bottom. It also can live in areas that have slow currents.

Mussels feed by filtering natural food from the water. Juveniles filter the single celled algae such as diatoms, gold alga (Chrysophyceae), green alga (Chlorophyceae) and *Euglena* sp. Adult mussels filter some colonial types of algae, organic matter and tiny zooplankton along with single cell algae. Therefore, effective management of natural food sources in the water body is very important in the cultivation of this species.

Dissolved oxygen (DO), pH and other parameters are also very important to the mussel. For triangle sail mussel, the proper pH range is from 7-8, and the DO level should be greater than 3 mg/l.

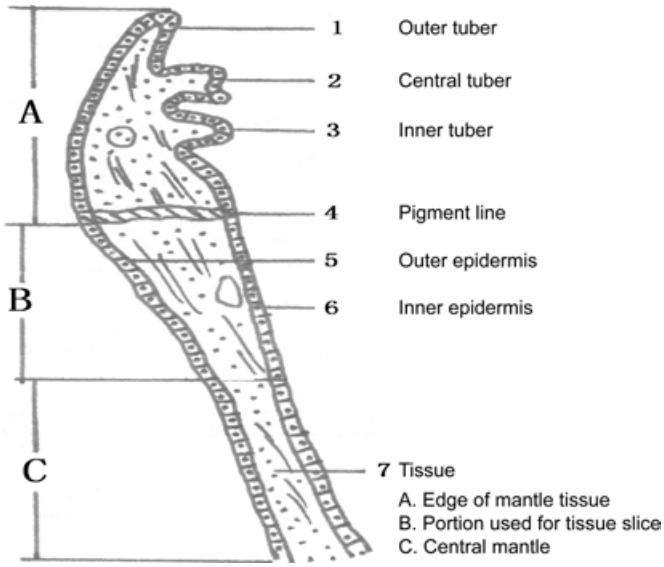


Fig. 2. Transverse section of the mantle tissue

Pearl production

Pearl production includes operation of pearl mussels and culture management.

Season for operating on pearl mussels

The best season for operating depends on the water temperature. When the water temperature is between 15-25°C, mussels have an active metabolism with high survival rate of mantle cells, recover rapidly from the operation wound, and quickly form the pearl sac and secrete nacre. These are important factors in producing good quality pearls. In China, March to May and September to October are the proper times of year for operating on the mussels.

Method for operating on the mantle tissue

The operation has two steps: making a slice of mantle tissue, and transplanting the slice. The two steps should be performed at the same time. The mantle tissue slice should be made from the edge of the mantle tissue near the pallial line. The nacre secretion capacity of this part of the mantle is the strongest (Fig. 2).

Fig. 3a - The tearing method of making tissue slices.

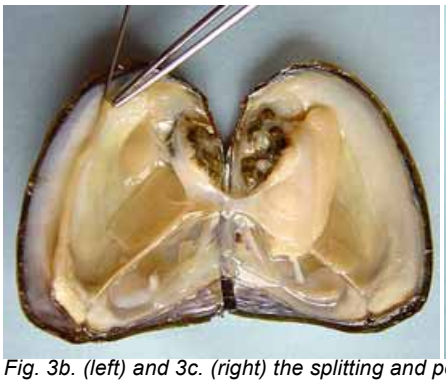



Fig. 3b. (left) and 3c. (right) the splitting and peeling methods

There are several ways to prepare the mantle tissue - by tearing (Fig. 3a), splitting (Fig. 3b), and peeling (Fig. 3c), in which the mantle tissue is separated into two parts from a cut mussel and the epidermis prepared for making a tissue slice.

The next step is to cut the edipermis of the mantle tissue strip into square slices 3 mm x 3 mm in size (Fig. 4).

The mantle tissue slice is then transplanted into the mantle tissue of a living mussel between the outer edge of the mantle and posterior part of the central mantle. The number of transplanted mantle slices used depends on the size of mussel operated on. About 25-30 slices can be transplanted into a mussel of 10 cm in length with 12-15 slices in each side (Fig. 5).

Producing nuclei pearls

Pieces of shell make the best nuclei material. They can be manufactured in different shapes (Fig. 6) to produce different shaped nuclei pearls. The nuclei, along with a piece of mantle tissue slice, are inserted into a mussels body or mantle. The mantle tissue slice will undergo cell division and multiplication to form a pearl sac surrounding the nuclei. The pearl sac then secretes nacre over the nuclei creating a nuclei pearl (Fig. 7).

Producing image (shaped) pearls

Image pearls get their shape from that of the sculpted nuclei used to create them. The sculpted nuclei become covered by the nacre forming highly attractive pieces (Fig. 8). The original sculpture can be made from wax, shell, plastic, steel or other materials with a distinct convex surface design. These sculpted nuclei are inserted into the cavity between shell and mantle of the operated mussel, producing an image (shaped) pearl.

Fig. 8. The image pearl with a sculpture of Mandarin duck.

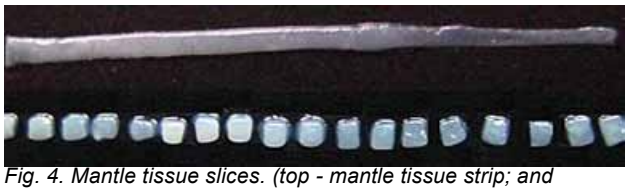


Fig. 4. Mantle tissue slices. (top - mantle tissue strip; and bottom - mantle tissue slices).

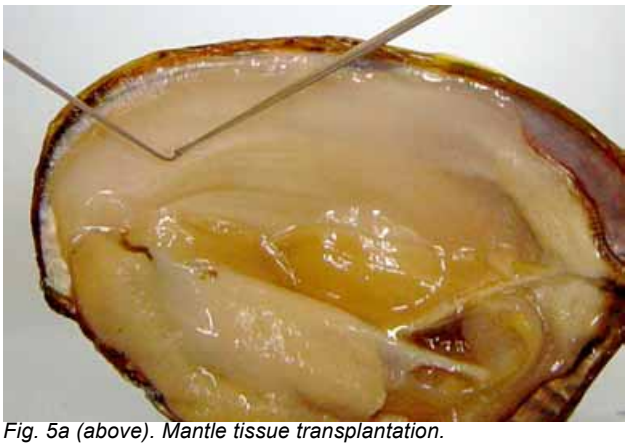


Fig. 5a (above). Mantle tissue transplantation.

Fig. 5b (above) shows finishing the operation.

Fig. 6 . Shaped shell nuclei.

Fig. 7. Shaped nuclei shells.

Care and culture of operated mussels

Operated mussels can be held in net bags, net cages and net folders. The bags, cages or folders are hung from plastic ropes. Foam, glass balls, bamboo sections and plastic bottles are used as floats to support the containers. The plastic ropes are tied with the stakes made from wood or bamboo.

Operated mussels should be reared in the water bodies (ponds, rivers, reservoirs, lakes) free from pollution and disease. Pearls will be produced within several years of culture.

Careful management is very important during this period as it affects the quality and quantity of pearls produced, particularly in terms of water quality and management of natural food production through fertilization or manuring.

Freshwater prawn culture in China: an overview

Miao Weimin and Ge Xianping
Freshwater Fisheries Research Centre, Chinese Academy of Fishery Sciences, Wuxi, China 214081

Development and present status

Freshwater prawns are one of the most recently introduced animals in freshwater Chinese aquaculture production despite the traditional preference of the people to the product in many areas of the country. Real commercial culture of freshwater prawns did not commence until the 1990s although its experimental culture was reported as early as the late 1970s. Freshwater prawn culture has grown very rapidly. This can be attributed to several factors including the traditional preference of Chinese to shrimp and prawn, the decline in the production of marine shrimp culture in the early 1990s caused by disease problems and an increasing demand for high quality products as the living standards of the Chinese people have improved through economic development.

The rapid increase in production of cultured freshwater prawn is the result of growth in the area under culture, improved culture techniques and diversification in species. There is no national data available on the total culture area of freshwater prawn at the moment. However, freshwater prawn culture has expanded very quickly across the country. For example, *Macrobrachium rosenbergii* was cultured only in 12 provinces in 1993 and there was just one province with production of more than 1000 tons. By 2000, culture of *M. rosenbergii* has expanded to 24 provinces and autonomous regions in China and 7 provinces had production exceeding 1000 tons each.

Overall, cultured *M. rosenbergii* accounted for only 0.06% of the total freshwater aquaculture production in China in 1993. By 2000, this had increased to 0.64%, nearly 10 times higher. In some areas, freshwater prawn culture has become a locally important component of freshwater aquaculture.

Production of another cultured freshwater prawn species, *M. nipponesis* was estimated to be around 100,000 tons in China in 2000, close to the total capture production of the species. In 2000, the total production of cultured freshwater prawn was estimated to be over 200,000 metric tons in China[1].

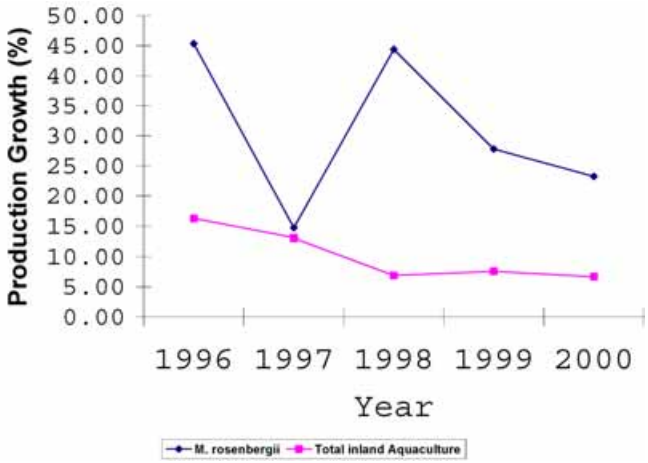


Fig. 2. Production growth of cultured M. rosenbergii and inland aquaculture, China, 1996-2000.

Fig. 3. M. rosenbergii.

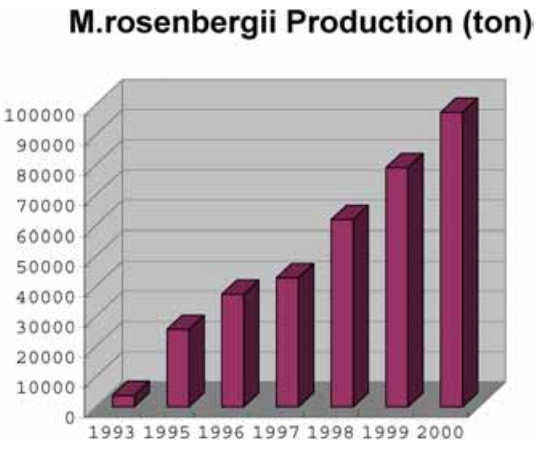


Fig. 1. Cultured production of M. rosenbergii, China, 1993-2000.

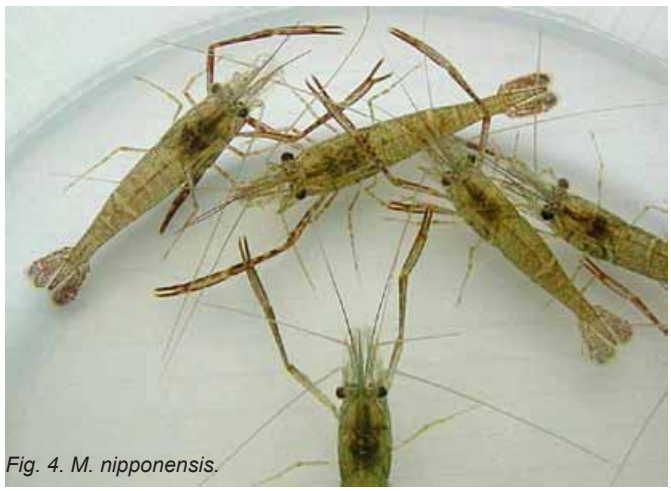


Fig. 4. M. nipponensis.

Fig. 5. Penaeus vannamei.

Species and culture methods

Cultured species

Only two species of real freshwater prawn are involved in the culture, *M. rosenbergii* and *M. nipponesis*.

M. rosenbergii (Fig. 3) is an exotic species which was cultured in limited areas in the Southern China with minimal production for more than a decade after it was first introduced in 1976. Now, it is one of two major freshwater prawns cultured in China.

Another freshwater prawn species widely cultured in China is *Macrobrachium nipponesis* (Fig. 4).

This is an indigenous species that can naturally reproduce in all kinds of freshwater bodies. Production of this species was mainly from natural fisheries. The earliest culture practice of this prawn was reported in the 1970s, the development of real commercial production of the species started at more or less the same time as *M. macrobrachium*. Currently, cultured production of the prawn accounts for about 50% of its total production in China.

Penaeus vannamei (Fig. 5) is a marine shrimp species originally distributed in South American countries along the South Pacific Ocean. It was first introduced to China for sea water culture. However, it has very recently been tried for culture in freshwater.

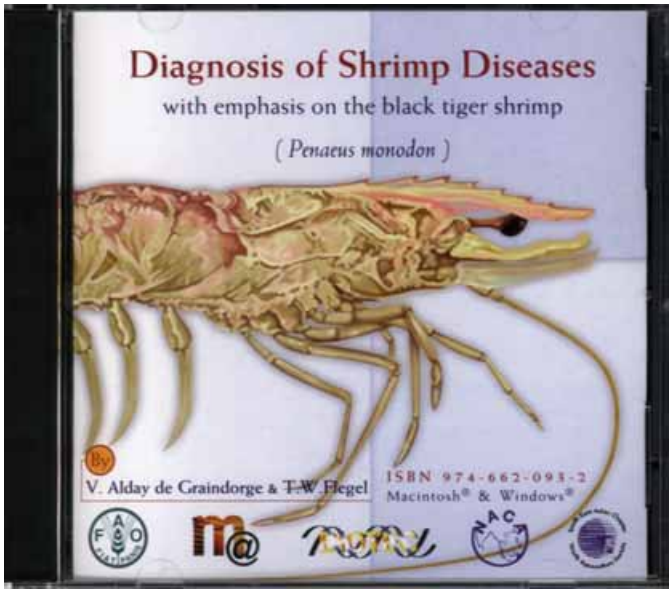
About 90% of the seed of *M. rosenbergii* now used in production are the offspring of the stock introduced a quarter century ago.

Due to its fast growth rate, longer breeding and growth period (compared with *M. rosenbergii*) the culture of this shrimp in freshwater has expanded very quickly in the last two years. It has become another important freshwater cultured prawn/shrimp species in China.

Culture methods

Earthern pond culture is commonly used for all species of prawn and shrimp cultured in freshwater in China. The practice for different species differs according to their biological characteristics. For stocking, both brood prawn or post larvae can be stocked in grow-out ponds. For *M. rosenbergii* and *Penaeus vannamei*, post larvae can only be stocked for grow-out after acclimatization to freshwater.

A single crop used to be dominant practice for the culture of all species before. However, double-crop and rotating culture of *M. rosenbergii* and *M. nipponesis* have become more popular to raise the unit production, prolong the marketing season and raise the economic efficiency. Such changes have effectively raised yield levels from 1.5-3.0 ton/ha to 5 ton/ha. This yield improvement is important to maintaining an adequate level of economic benefit to compensate for a fall in market price.



Diagnosis of Shrimp Diseases

This CD provides high-quality information, photographs and illustrations about the life cycle, anatomy and histology of shrimp and assessment of post larval quality. It covers the main pathogens of cultured shrimp including white spot virus. Laboratory and diagnostic procedures are demonstrated in animated sequences. $US 50. Contact NACA to order.

Culture in rice paddy is another method commonly adopted in the culture of *M. rosenbergii* and *M. nipponesis*. Usually only one crop of prawn is produced a year with a much reduced stocking rate (*M. rosenbergii*: 1cm PL, 150,000-180,000 pieces/ha or 2-3 cm juvenile, 60,000-75,000 pieces/ha; *M. nipponesis:* brood prawn, 15 kg/ha or 1cm PL, 300,000-375,000 pieces/ha, Shen Delin, 2001). 300-450 kg of prawn can be produced through supplementary feeding and good management in addition to the normal rice production. It is a very effective approach to improve the economic return of traditional rice cultivation. It also has a very sound environmental effect due to much reduced use of pesticides and other chemicals. Cage culture and indoor running water culture are also practiced for *M. rosenbergii* and *M. nipponesis* in some areas of the country. However, they are far less popular than pond culture and rice-paddy culture. Their contribution to the total cultured prawn production is limited.

Constraints to further development

Genetic degradation of cultured species

Although the history of freshwater prawn culture in China is rather short (about 10 years), genetic degradation of cultured species has become a serious problem affecting the yields and economic returns. This problem is mainly caused by inbreeding which is largely related to the biological characteristics of the animal and seed production practices.

The seed of *M. nipponensis* are usually self-produced on farm through natural spawning. The broodstock in the same pond/tank are very often grown from the same batch of seed. Inbreeding is unavoidable in seed production if such methods are used. Very little selection of brood stock is carried out in farm production. This has resulted in significant genetic degradation of the seed. Such degradation is typically indicated by reduced growth and smaller size at sexual maturation that leads to a smaller harvesting size. In addition to the impact on the production, the smaller harvesting size has a more serious impact on the economic return of the farming practice as the price received for different size classes can vary by more than 50%.

Although reintroduction of *M. rosenbergii* has been carried out recently by some hatcheries, about 90% of the seed currently used in production are the offspring of original stocks introduced a quarter century ago. With the limited initial stock, inbreeding is unavoidable after over 20 generations of reproduction and culture. The mature size of individuals has been significantly reduced. The variation in individual size is also greater in production. This variation eventually affects the economic efficiency of production. Although the genetic degradation of some cultured freshwater prawn species and its impacts on production have already been commonly recognized, there has been little improvement in seed production practices. This has been mainly due to the technical difficulties involved in the selective breeding of freshwater prawn.

Disease problems

Disease often becomes a key problem when the culture of an animal develops to a certain stage. A good example is the disease problem that happened in cultured marine shrimps that had great impacts on shrimp farming in many countries.

Widespread disease in marine shrimp culture caused a drastic decline in production in China in the early 1990s. At one point cultured marine shrimp production dropped to less than 50% of pre-outbreak levels.

Although freshwater prawn culture has a history of only about 10 years in China, the rapid expansion in culture area, wide exchange of seed across the regions and intensified inputs have already formed the conditions necessary to cause significant disease problems. In the past several years a number of disease problems have already arisen.

M. rosenbergii is the species most seriously affected. Several diseases are now commonly found in the culture of the species. These include black gill disease, black spot disease, rotten tail disease, parasitic disease (*Ciliata* species) and milky-white body (muscle) disease. In particular, a large-scale outbreak of milky-white body (muscle) disease was found in Southern China (Guangdong Province and Guangxi Autonomous Region) in 1998. This may cause mortalities as high as 70% of the affected prawns. The disease was recently spread to Jiangsu province through seed purchased from the affected areas. Most of the diseases affect the prawn at its early stage of culture. Various diseases often affect the production and quality in the culture of the prawn though few of them cause high mass mortality.

Disease problems in the culture of *M. nipponensis* are not as serious as in *M. rosenbergii*. However, diseases such as "black gill", "black spot" and some parasitic diseases are found in culture. Such diseases can also affect production to a certain extent although mass mortality has rarely been reported. *Penaeus vannamei* was very recently introduced to freshwater culture in China. TSV (Taura syndrome virus) disease was already found in the cultured shrimps in Pearl River Delta area of Southern China. It is likely that the disease will further spread to other areas unless effective control measures are enforced.

Issues on marketing and economic returns

The rapid development of freshwater prawn culture has been stimulated by the increasing market demand and high economic return in production. *M. rosenbergii* used to fetch a market price of US$6.0/kg very easily several years ago. The market price of *M. nipponesi*s could reach US$ 15.0/kg or even higher during the Chinese New Year period. However, the rapid growth in production caused by the expansion of culture has already had significant impacts on the marketing and economic return of the industry.

The market price of *M. rosenbergii* has dropped to around US$3.0/kg during the major harvesting season, almost half of the price before. The economic benefit of the culture has declined significantly although the price of the seed has also fallen. This has been compensated through an increase in unit production. *M. nipponesis* used to maintain a fairly stable market price. However, market pressure has resulted from the fast growth of production in 2001, causing a significant decline in the price of the prawn. A similar situation has also occurred with *Penaeus vannamei*. The market price for the shrimp was fluctuating at around US$3-4/kg during most of the harvesting season.

Cultured freshwater prawn production still accounts for a small proportion of the total freshwater aquaculture production in China although it has grown very fast in recent years.

Strategies for future development

Although freshwater prawn culture is now facing some problems and constraints, the industry is very likely to expand further in the future. This prediction is based on the two major factors. First, the potential new market for freshwater prawn is huge. Domestically, freshwater prawn is a much preferred aquatic products for Chinese consumers, not only because of its high nutritional value and good taste but also because it is easy to prepare. Freshwater prawn production is estimated at around 350,000 tons (including the wild catch), which accounts for less than one percent of the total fisheries production in China.

Per capita availability of freshwater prawn products is less than 0.2 kg. With the improving living standard, and the entry of China into the World Trade Organization, there will be a large space for the domestic demand to increase. Aquaculture products are considered among the most competitive with potential to enter the international market. Freshwater prawn is likely to take a a bigger share in the international market than finfish. It is important however to effectively tackle the problems and implement an appropriate development strategy for sustainable development and sound economic benefit of freshwater prawn culture industry. The following are among the priority strategies and measures.

Development strategy. An appropriate development strategy should be developed and implemented in line with the present status and needs of freshwater prawn culture in different parts of the country. Different development targets and priorities should be set for different areas. For instance, in the provinces where freshwater prawn culture have already developed to a certain stage, the focus should be on the improvement of the quality of the products to increase their compatibility with the international market. These provinces are mostly areas with relatively easy access to foreign markets.

In areas where freshwater prawn culture is still at the initial stage, priority should be given to expansion of the industry. The target should be to develop the local market and contribute to rural economic development and increasing the income of rural people. It is also important to encourage ecologically sound and environmentally friendly culture practice in order to meet increasingly stringent food safety and environmental standards.

Quality prawn seed production system. The quality of prawn seed is at present an important factor affecting yield levels and economic efficiency in the culture. It is important to establish an effective system for producing and distributing high quality prawn seed. Scientific research needs to be carried out on the genetic improvement of cultured prawn species. Prawn breeding techniques should also be developed to maintain the genetic quality of species at production level. Also, to maintain the quality of prawn seed in production, a certification system should be developed and implemented for prawn hatcheries. A health certificate system and inspection mechanism should be established for the trans-boundary movement of prawn broodstock and seed within and beyond the country.

Improvement of culture techniques. Freshwater prawn culture is a relatively new aquaculture practice in China. There have been few studies on the culture technology of different prawn species under different environments. The present practice is mainly based on farmer's trials and on the experience of other countries.

Improvement in marketing and processing. The long-term sustainability of freshwater prawn culture industry is ultimately determined by the economic performance of the industry. Maintenance of a reasonable level of economic benefit is vitally important to the further development of the industry. Development of an effective marketing strategy and modification of the culture system to increase the harvesting and marketing period is particularly important to release market pressure inhibiting the further expansion of the industry. New culture practices such as multi-crop production and rotating culture have proven to be effective in this aspect but, need to be refined further. Processing technology for freshwater aquatic products has long been lagging behind the development of culture. This is due to both consumers' habit and limited efforts on the technology development. However, appropriate processing technology can reduce the marketing pressure in the peak harvesting period and improve acceptability to the international market. Therefore, there is real need to invest money and human resource to develop suitable processing technology for freshwater prawn as well as for other cultured animals.

There is a lot of room for the improvement in feed and feeding, stocking models and related culture management. This is particularly important to maintain economic benefit with the presently reduced market price of the products. On the other hand, ways to ensure high product quality throughout the culture and marketing process is another important goal. Ecological culture minimizing the use of various chemicals and drugs needs to be studied to ensure the safety of the products. It is an important preparation for the products to be accepted in the international market.

Development of effective disease prevention and control measures. Disease problems are likely to become a serious constraint to the sustainable development of freshwater prawn culture industry in China. What happened to the marine shrimp culture in China ten years ago was a good lesson. It is important to take effective measures now to prevent the same thing happening to freshwater prawn culture again as there has already been early signs of a disastrous disease problem in some freshwater prawn culture practice. Efforts should be made to study the epidemiology of freshwater prawn disease already found. It is equally important to develop effective preventive and curative measures of prawn diseases. As prawn is different from fish biologically, efforts should be made to develop medicines specifically for prevention and control of disease in freshwater prawn culture. It is also important to predict the possible new health problem when freshwater prawn culture further develops based on the lessons drawn from marine shrimp culture.

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Peter Edwards writes on

Rural Aquaculture

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Some thoughts on integrated farming in China

The photo shows one major area of integration: An integrated agriculture / aquaculture system (IAAS) in Vietnam with a pond manured by pigs to produce green water.

With the World Aquaculture Society annual meeting to be held soon in "China, the home of aquaculture", according to the catch-words or slogan for the event, the column in this issue is devoted to integrated farming, a major feature of traditional Chinese aquaculture.

Traditional aquaculture practice may be considered as having been developed by farmers or local communities themselves using locally available resources in integrated production systems because these were the only nutrients available. In contrast, modern aquaculture is based on the fruits of science and industrial technology, in particular often sole use of manufactured pelleted feeds, with global trade in ingredients, and growing concerns about adverse environmental impacts.

There is a clear need for the intensification of aquacultural production to meet increasing demand for fish because of limited supplies of on-farm and locally available nutrients; and because there is a relatively low yield ceiling in semi-intensive systems depending mainly on natural food produced by fertilization and its augmentation by supplementary feeds.

But intensification of freshwater fish production implies serious threats to sustainability. In fact, it is generally agreed that none of today's intensive methods of food production is ultimately sustainable. Bridging the gap in feeding practice between traditional integration and use of manufactured feed by using more ecologically designed systems in the intensification process may lead to increased sustainability of production.

Traditional aquaculture in China is characterized by integration with other human activity systems such as agriculture, animal husbandry, sanitation and reuse of cottage-level industrial by-products from distilleries and soybean processing. There is a polyculture of mainly herbivorous, omnivorous and detritivorous species integrated with locally available nutritional inputs. Ponds receive vegetation, manures and agricultural by-products. The central species in the basic model is the macrophagous grass carp, which fertilizes the pond through inefficient digestion of plants. This produces protein-rich natural food in situ for column filter feeding and benthic omnivorous and detritivorous fish.

The second major area of integration: An integrated fisheries / aquaculture system (IFAS) in Cambodia with caged fish fed with small freshwater

Another model relies primarily on manuring to produce natural food for filter feeders and detritivores. The

principles are integration, polyculture, fish feeding low down in the food web, waste or by-product and nutrient reuse, and water reuse. These principles as well as the practice of Chinese traditional integrated aquaculture continue to have relevance for socially and environmentally sustainable aquaculture, both within and outside China, for contribution to both national food security and the sustainable production of high-value produce for local luxury markets and export.

Traditional feeding practice may be considered as three types of integration with:

(1) agriculture in integrated and aquaculture systems (IAAS) with usually limited on- or near-farm sources of vegetation, manures and agricultural by-products;

(2) fisheries in integrated fisheries/ aquaculture systems (IFAS) using small freshwater or marine fish or "trash fish";

(3) peri-urban areas in integrated peri-urban/aquaculture systems (IPAS) using wastes of cities and industry such as wastewater or sewage, waste vegetables from markets, waste food from canteens and restaurants, and factory processing wastes from the food industry, including offal from slaughterhouses and fish processing factories.

Traditional Chinese practice involves IAAS and IPAS. Engineered wastewater-fed aquaculture, a type of IPAS, was developed first in Germany almost a century ago, decades before China, but pond rental in peri-urban areas in China was directly correlated with the degree of eutrophication of the pond from diverse nutrient sources.

There is controversy over the origin of cage culture but grow-out in cages probably first developed in the Great Lake of Cambodia more than a century ago in IFAS through fishers holding and transporting their catch in "live boats" with water and fish filled holds, which were fed with small wild fish. However, a small suspended cloth enclosure to hold wild seed caught from rivers has a thousand year history in China. It is the forerunner of the hapa, which is now in widespread use in seed production. The culture of snakehead in ponds in Central Thailand with marine trash fish is a more recently developed example of an IFAS.

Traditional Chinese practice continues to provide the basis for the production of relatively low-cost, staple food fish in China and similar practice is the best entry point for countless small-scale households with potential to farm fish in integration with locally available resources in IAAS in other developing regions of the world. Although modern agriculture is based mainly on inorganic fertilizers, a product of science and agroindustry, they are used in aquaculture to a surprisingly limited extent considering that research into pond fertilization began in Germany almost a century ago. A case can be made for cost-effective use of inorganic fertilization to produce even globally traded fish such as tilapias, at least in the early phase of the growth cycle, following the Chinese principle of feed production in-situ in semi-intensive ponds.

The third major area of integration: An integrated peri-urban / aquaculture system (IPAS) in Thailand with pond fish fed with offal from a slaughterhouse.

This process was aptly referred to as the "sun-lit rumen" by Schroeder because of the analogy between the microbial production of high-protein feed in situ in the rumen part of the stomach of ruminants (cattle, goats) and in a manured fish pond.This principle of in situ high-quality feed production in the pond has been taken a step further by another Israeli scientist, Avnimelech who has also been inspired by Chinese traditional practice. Intensive culture of fish and shrimps at high density is constrained by the build up of nitrogenous metabolites because of the large amounts of formulated feed that are used.

Avnimelech discovered that the inorganic nitrogen accumulating in the water column can be converted, in situ in intensely aerated and mixed water systems, to bacterial protein by adding a low value source of carbon in the form of carbohydrate-rich supplementary feed. Such aerated microbial reuse (AMR) systems are expected to lower feed costs significantly because the bacterial detrital floc is rich in protein and minerals. Recently, The Oceanic Institute, Hawaii has set up a research programme to define interactions in shrimp nutrition between formulated feeds and detrital flocs.

The theme of the contribution of traditional Chinese aquaculture is a keynote presentation at the Beijing meeting entitled "Traditional Chinese Aquaculture and its Impact Outside China," during which the outcome of further reflection and examples will be presented.

. . . . a small suspended cloth enclosure to hold wild seed caught from rivers has a thousand-year history in China. It is the forerunner of the hapa, which is now in widespread use in seed production.

Topical issues in genetic diversity and breeding

Genes and Fish

Graham Mair

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Chinese researchers have carried out a lot of interesting research and development of red strains of common carp, like this glass red, which have been selected not only for colour but also for growth and body shape (picture courtesy of Dr Li Sifa).

As this issue is intended to be in circulation during the forthcoming World Aquaculture Society meeting in Beijing and the theme of the issue is distinctly Chinese, I thought I should write something in the column about the highly significant contribution made to fish breeding and fish genetics by Chinese researchers and aquaculturists.

My first problem is that I've spent very little time in China and feel quite ignorant about Chinese aquaculture, and indeed I'm really looking forward to my visit there to try to learn more of the story behind the extraordinary aquaculture production that is coming out of China. However, I do know enough about the history of aquaculture to know the important impact that early Chinese research on induced spawning of fish has had on aquaculture production, particularly carps in Asia. It was back in 1921 that Chinese ichthyologists first experimented with artificial fertilization in carps. It was not until the early 1950s that work on artificial induction of spawning, or "estrualization" as it was then called, began using carp pituitaries and human chorionic gonatropin (HCG). By the late 1950s and early 1960s Chung Ling and his colleagues had successfully induced spawning in all the important Chinese major carps. This work was mirrored shortly afterwards by Indian researchers with the Indian major carps.

This technology, which became known as the Linpe method (after the names of the two principal researchers, Lin Hao-Ran and Richard Peter), is today the standard technology for induction of spawning in a wide range of aquaculture species and has thus contributed very significantly to the spread of aquaculture of these species worldwide. Together with a Canadian scientist, Chinese researchers were also instrumental in the development of improved, more sophisticated and effective methods of hypophysation using Leutinizing Hormone Releasing Hormone analogues (LHRH) alone and later in combination with dopamine antagonists.

Induced spawning has enabled the lifecycle of many fish to be completed within artificial environments, effectively permitting the domestication of a large number of finfish species. As discussed in previous columns, domestication itself has significant impacts on the genetic status and, long term, on the performance characteristics of aquaculture species. In the case of the carps, which are generally highly fecund, induced spawning methods, combined with effective artificial incubation and larval rearing techniques, enables us to produce very large numbers of fry from relatively few numbers of broodstock, encouraging low effective population sizes and thus promoting inbreeding with its negative consequences.

Chinese researchers have also been at the forefront of the application of genetic based technologies to cultured species. Considerable work has been done on characterising the broad diversity of fish fauna in the country both at the level of species diversity (the Yangtze river for example has the largest diversity of species in Asia with over 314 recorded) and at the level of genetic diversity. Genetic diversity has been characterised at the cytogenetic, biochemical and molecular level for populations of most of the commercially important cultured species.

However, it is in genetic improvement programmes, only possible since the successful domestication of the species, that many significant and in some cases unique advances have been made in China.

The priority species for aquaculture genetics to date in China has been the common carp. A number of red varieties have been developed through selective breeding for traits such as colour, growth rate and body shape. These various selected strains are also used in hybrid crosses, many of which have been certified as good varieties by the National Certification Committee on Wild and Bred Aquatic Varieties. In perhaps a unique example of a combined breeding program, family selection, crossbreeding and gynogenesis were combined in the development of the Jian carp, now one of the most widespread cultured common carp in the country.

In addition to the major carps recent attention has been focused on the blunt snout bream or Wuchang bream (*Megalobrama amblycephala*),

Above: Early Chinese research on induced spawning has impacted on seed production world-wide (Photo: D.C. Little).

Below: The blunt snout bream or Wuchang bream (Megalobrama amblycephala) is an increasingly important species in Chinese aquaculture and a focus for recent research on genetic improvement.

A Jiang farmer carrying red Chinese carps to the market.

an increasingly important aquaculture species with a production of over 400,000 MT per annum. A mass selection programme from 1986 to 1999 produced a 29% increase in daily weight gain. Efforts have now focused on trying to induce tetraploidy in this fish with the medium term objective of using these as broodstock to produce high yielding sterile triploids.

Genetic improvement has not been limited to indigenous species, and indeed some of the work done in China on the introduced tilapia is close to my heart. I spent part of my early career developing a breeding program for the production of YY supermales in the Nile tilapia *Oreochromis niloticus* for the mass production of all-male progeny without the need for hormonal sex reversal. Whilst the principles behind this technology are relatively simple, we initially believed that we were doing original science. A few years into the research I unearthed some data from a paper, originally published in Chinese, demonstrating that Chinese scientists had developed the same ideas for *O. mossambicus* more than a decade earlier! The Chinese were successful in developing YY "supermale" *O. mossambicus* but do not appear to have taken this up to the scale of mass production of all-males. Perhaps I'll learn differently again when I'm in Beijing in April!

Some particularly innovative genetics research was carried out in the 1960s and 80s. This work developed nuclear transfer methods which involves transferring the nucleus from a germ cell of one species to the cell of another (from which the nucleus has been removed). This creates fish with different and uniquely combined nuclear and cytoplasmic genotypes. Three generations of common carp–crucian carp nuclei-transfer fish have been produced and have exhibited faster growth rates than the parental common carp strain. It is however not clear whether this method could ever lead to commercial applications.

China is also leading the way in the development of transgenic fish (issues related to which were discussed in this column in the July-September 2001 issue of this magazine) having carried out some of the earliest research of this type on common carp. Priority species for this research are again the common carp, crucian carp and the blunt snout bream.

China is however not only focused on genetic improvement to increase fish productivity but is also conscious of the need to conserve its key aquatic resources. Live gene banks are maintained for most of the commercially important cultured species and recently a fish sperm cryopreservation gene bank has been established at the Yangtze Fisheries Institute where sperm from the major culture carp species is stored.

There is no doubt that Chinese research in fish breeding has had worldwide impact and their genetics research is undoubtedly contributing significantly to aquaculture production within China. As a geneticist and a fish breeder I'm very much looking forward to my forthcoming trip to China and have little doubt that important new innovations in the field will be on show there.

Xingguo red common carp, photo courtesy of Dr Li Sifa-

Farmers as Scientists

This is a series anchored by M.C. Nandeesha. It describes farmer-driven innovations and experiences.

Cambodian farmers innovate cost-effective variations on Chinese hatcheries to suit local conditions

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Fig. 1 (left): Silver barb is popular among fish farmers and can easily be bred in small Chinese hatchery systems. Fig. 2 (right): Silver carp is another popular species. This species has also been bred successfully by farmers using small size breeding pool

Cambodia is making good progress in many spheres, including fisheries. Improvements in the collection and interpretation of catch statistics has revealed that Cambodia is poised to become one of the largest producers of fish in the inland fisheries sector. The total fish production during 1999 was reported to be 284,100 tonnes, while in 1998, it was (likely) under-reported as 122,000 tonnes.

The improvement in catch statistics has been made through a joint research effort between the Department of Fisheries and the Mekong River Commission on capture fisheries. These improved statistics will help the fisheries sector gain the status it deserves in the national economy and demand allocation of adequate resources for the further development of the sector.

Although the improved 1999 catch statistics show substantially higher production, estimates indicate that the actual production could be as high as 430,000 tonnes from the freshwater sector alone. In addition, some of the results of the MRC project suggest that the fish consumption of some of the communities living around the Great Lake could be as high as 71 kg/person/year, placing Cambodia as one of the major fish consuming countries in the world. Although production has now been shown to be much higher than previously thought, discussion with farmers all across the country, including farmers around the Great lake, clearly indicate that fish catches are declining and that there is a need to explore alternative ways to enhance fish availability.

Aquaculture is considered as one such alternative and attempts have been made by a number of organizations to develop small-scale aquaculture appropriate to the farming systems of the country.

I had an opportunity to work in Cambodia and initiate some of the aquaculture development activities between 1992-1997. Recently, I was in that country for a short period under a World Bank funded fisheries project. This gave me an opportunity not only to assess the sustainability of some of the work initiated by us earlier, but also learn more on the continuing efforts made by farmers to innovate new systems that are economical and appropriate to them. This article focuses on the innovations made by farmers in developing simple and cost-efficient fish seed production systems essentially based on the principle of Chinese hatcheries.

Small-scale aquaculture systems using the locally available species like silver barb (Fig.1) with tilapia, Chinese and Indian carps have been developed during the past 6-8 years.

The first Chinese hatchery was built during the 1980s with the support of Vietnam in some of the Government stations to cater the seed requirement of farmers. These Chinese hatcheries have breeding pools of 6-9 m diameter and hatching pools of 3-4 m diameter. They are useful for large-scale seed production with a capacity to hold more than 100 kg of brood fish at a time (Fig.2).

However, these centralized hatchery systems have not proved to be useful in ensuring seed availability in rural areas. To procure seed from these hatcheries, farmers generally have to travel a long way and the poor condition of the roads result in high mortality during transportation. To overcome these problems, development agencies have promoted the establishment of small-scale hatcheries in rural areas.

Fig.3 (left) A simple hatchery system designed by Mr Ean Sak for breeding of common carp in Prey Veng district.

Mr Ean Sak

During the late 1990s, Mr Ean Sak, a farmer from Prey Veng Province, initiated breeding of common carp and silver barb using ordinary cement jars as water storage tanks and a polythene-lined pool, erected with the support of bamboo as breeding cum hatching chamber (Fig.3). With the support received from PADEK (Partnership for Development in Kampuchea), he built a circular breeding-cum-hatching pool. The unit established by this farmer was used to train other farmers interested in establishing small scale breeding units. Though the system established by Ean Sak was useful, the height of 0.5 meter was found to be too low, particularly for the species like silver barb due to their jumping habit. However, the facilities established by Mr Ean Sak served as good place to educate other farmers on the opportunities that exists in establishing small-scale seed production units (Fig. 4). This farmer continues to be involved in fish seed production and nursing, though fish culture activities have suffered in his area due to frequent floods during the past two years.

Fig.4. A group of trainees visiting Mr Ean Sak's hatchery as part of the training program on village based seed production.

The case of Mr. Sambot

Mr Sambot from Mesong district of Prey Veng Province took the initiative to build a hatchery with the support provided by MCC (Menonite Central Committee). This hatchery was built on a 2.5 ha plot of land and has four breeding tanks of 1.6 meters diameter and 0.7 meters height. He has also built a water storage tank to ensure continued water supply. This enthusiastic farmer, with a total commitment to the activity, has been successful in developing breeding strategies for carps using hormones and plastic fibers as adhesive material for common carp (Figs 5 and 6). With the continued support provided by MCC, this hatchery has successfully catered to the seed requirements of more than 700 farmers in the district over the past five years. There are more than ten secondary seed producers who buy seed mainly from Sambot's hatchery, nurse the seed and sell to other farmers in the village. The species that he breeds include common carp, silver barb, silver carp and tilapia. The demand for Pangasius seed is very high and during last year, he was able to buy Pangasius fry from traders, nurse and sell them to other farmers at a higher price. According to Sambot, the problems are mainly created by some of the seed nursers, who are just acting as seed traders, buying seed from the hatchery and distributing them to farmers, instead of nursing them to a good size before selling them to farmers. The survival of small seed is lower and so the supply of small seed to farmers reduces their fish production.

Inspired with the success achieved in Mesong District in fish seed production, initiatives were taken to establish another small scale hatchery in Prey Veng district by Mr Phoung Phun. After gaining experience in fish culture, Mr Phoung Phun moved in to fish seed nursing, and encouraged with his profit and with the demand for fish seed, he built a hatchery (Fig.7). Although he has been able to make good profit for the past five years, he has begun to experience a decline in the sale of carps and tilapia. However, he has been experiencing heavy demand for Pangasius seed (table 1).

Mr Pheng Vy in Prey Veng district has found fish seed nursing to be a profitable

Fig. 5. (Below) Mr Sambot - an enterprising farmer from Mesong district being trained in breeding of fish.
Fig. 6. (Centre) plastic fibres being used as egg collectors for common carp in Sambot's hatchery.
Fig. 7. (Bottom) Chinese circular hatchery being constructed by Mr Phoung Phun in Prey Veng district.

Top to bottom:
Fig. 8. Pheng Vy has constructed an improved version separating breeding and hatching pools.
Fig. 9. Mr Sok Saroon has built a Chinese hatchery system combined water circulation and aeration device.
Fig. 10. Mr. Thien Vanna of Ta Saang Village, Svay Chrum district, has built a modified version of the Chinese hatchery.
Fig. 11. Mr Keo Sim has built a Chinese hatchery complex and uses ground water for hatchery

Table 1.

Year	Total national fishery production	Production of inland fishery	Production of freshwater culture	Farm production of common carp
1991	1572.99	562.98	462.59	59.45
1992	1824.46	632.88	533.79	70.81
1993	2152.31	760.33	648.26	89.16
1994	2516.69	916.45	789.66	112.76
1995	2953.04	1091.78	940.76	139.86
1996	3280.72	1269.19	1093.76	159.15
1997	3601.78	1425.36	1236.66	176.13
1998	3906.65	1549.93	1321.91	192.80
1999	4122.43	1650.51	1421.97	205.08

venture. However, he has had difficulty obtaining spawn for nursing at the right time to meet the market demand. According to him, primary producers tend to capture as much of the existing small market as they can, by delaying seed supply to the nursers.

To overcome this problem, Mr Vy decided to build his own hatchery last year. He has constructed a small hatchery complex consisting of a water storage tank of about 6m^3, a breeding pool of two-meter diameter and 0.8 m height and a hatching pool of 1.5 m diameter and a height of 0.6 m. For breeding of common carp, he has built a rectangular tank with a surface area of 3.75 m^2, in the available space. He has spent about US$300 to build these facilities (Fig.8). Although he was able to produce a good number of fingerlings (>50,000) during 2001 breeding season, he was able to sell only 12,000. He says that poor extension support to farmers is one of the reasons for declining seed sales, aside from the poor survival of seed noticed in the pond.

First among trainees: Sok Saroon

Mr Sok Saroon is another successful farmer from Prey Veng district. He was able to establish the hatchery with support provided by a European Union funded project. Mr Saroon stood first among a batch of trainees on fish seed production and he was given construction materials as gift to allow him to build a breeding pool. Currently, he has two breeding pools, a water storage tank and six nursery ponds (Fig. 9). He too has been experiencing declining seed sales since last year.

The Asian Institute of Technology took initiative from the very beginning of their involvement in aquaculture development in Cambodia to promote farmer based small-scale fish seed production systems, particularly for the species like tilapia, common carp and silver barb. Their outreach activities are carried out in three Provinces - Svay Rieng, Takeo and Kompong Speu. Mr Thien Vanna of Ta Saang village of Svay Chrum district of Svay Rieng province is one of the successful fish farmer and seed producer, with whom AIT began working since 1995. He has established a Chinese hatchery (Fig. 10) and supplies several secondary seed producers who are involved in fish nursing activities.

Last year, he sold more than 100,000 fingerlings, but this year he has only sold about 30,000. He says that the drought-flood cycle, which has been prevalent over the past three years, is the main cause for his declining sales.

Looking back at a success story: Mr. Bunthon of Svay Rieng

In the Romeas Hek District of Svay Rieng Province, fish culture was initiated in 1994 by PADEK. Mr and Mrs. Bunthon from the district were chosen as the best family for not only demonstrating highest fish production from their pond of less than 100m^2, but also for their selfless service to the community in promoting fish culture activity. This farmer has also been successful in producing seed of silver barb, common carp and tilapia and sell to more than 300 farmers in the area. However, since last year, he too has begun experiencing a decline in seed sales. According to him, most farmers are interested in continuing fish culture but wish to switch to hardy species like Pangasius. Poor survival and production experienced by farmers has been one of the main reasons for the declining interest of farmers.

Very interesting developments are taking place in Takeo province, where the Asian Institute of Technology is operating an outreach project through the Department of Fisheries. Mr Keo Sim is one of the poor farmers who have benefited largely both from fish culture and fish seed production activities. With the successful results obtained with fish culture, the farmer decided to undertake fish seed nursing in the subsequent year. Recognizing his entrepreneurial nature, a grant of US$170 was provided by the project to build a hatchery. Combining his own resources with the project support, he has been able to build hatchery facilities (Fig. 11). The farmer has effectively used locally available resource like bamboo to build a hatchery with a plastic lining (Fig.12) and rectangular tanks for breeding of common carp (Fig.13).

Mr. Som Hak from the same district has also been successful in breeding fish using the modified Chinese hatchery systems. To meet the high demand for fish seed, he has also dug out the earth and used plastic lining for hatching of carp eggs, particularly for large-scale production of silver carp (Fig. 14). During 2001, he sold more than 100,000 fingerlings of different species as well as fry to other farmers for nursing. The creativity of these farmers in modifying Chinese fish seed production systems not only indicate their innovative skills, but also indicate the need to develop systems that are appropriate to farmers in different areas, instead of promoting duplicates of systems that work well elsewhere.

Mr Som Hak does not have a refrigerator to store the hormones used for breeding such as LHRH. Instead, he has taken advantage of the temperature differences that exist between different layers of water in the pond. He stores his hormone on the pond bottom where it is cooler (Fig.15).

The vial with hormone is tied to a rope and attached to a stone to serve as a sinker and is lowered to the pond bottom after usage. For temporary storage of hormone, this method has been found useful and practical. If you need more details on the hatchery design and operational efficiencies some of these hatcheries in AIT project area, contact Mr Hav Viseth, Project Manager, AIT Outreach project, Phnom Penh, Cambodia (e-mail: small fish@bigpond.com.kh).

There are similar innovations in hatchery devices in other areas where fish culture is gaining popularity. However, the major constraint experienced by farmers is the poor survival of fish seed. This has been shown to be due to the small size of seed stocked by farmers. These seeds are easily eaten by snakehead and other predatory fishes common throughout the country. It is necessary to encourage farmers to stock larger seed or adopt the hapa nursing technology developed by AIT to overcome this poor survival problem. This poor survival is a common problem noticed almost throughout the country. There is an urgent need for different agencies to make a coordinated effort to educate farmers adequately on this to avoid setbacks to the increasing popularity of aquaculture.

Top to bottom:
Fig. 12. Mr Keo Sim uses a bamboo frame as a temporary measure to build a hatchery with polythene lining.
Fig. 13. Rectangular tanks are used for breeding of common carp eggs by Mr Keo Sim.
Fig. 14. Mr Som Hak of Tropheaung Kabus Village has developed another version of the Chinese hatchery model by building at the ground level with polythene lining.
Fig. 15. Mr Som Hak of Tropheang Kabus Village, Tromkhot district preserves hormone by storing it in a vial at the bottom of the pond to keep it cool.

The trade in live reef foodfish: a Hongkong perspective

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The trade

In 1999, a total volume of 14,000 metric tons (mt) of live reef food fishes was imported into Hong Kong China according to the official government import figures from the Census and Statistic Department (CSD) and the Agriculture, Fisheries and Conservation Department (AFCD). However, this figure looks to have been underestimated because local fishing vessels are exempt from making trade declarations required by the CSD.

The actual amount of live reef fish imported annually has been estimated at around 30,000 to 35,000 mt[1] (with a total wholesale value of US$490 million). Despite the enormous volume and monetary value, the trade is not well understood and what little information is available is out of date, particularly since fish prices from 1997 or before are still being quoted[2]. In fact, fish prices tumbled by nearly 50 percent following the onset of the 1997 Asian financial crisis.

Although the economy of Hong Kong is recovering - the stock market rose to a level near its pre-crisis high and since slipped again - the prices for live reef fish remain low when compared to the prices before the crisis.

International Marinelife Alliance - Hong Kong (IMAHK) has been established for two and a half years and was officially incorporated with the Hong Kong Government in November 1999. The IMAHK provides data on the dynamics of the live reef food fish trade from an importing country perspective, on import, wholesale and retail levels.

The IMAHK has been working with the Hong Kong Chamber of Seafood Merchants (HKCSM; the live fish importers' trade association) since its conception in 1998, and provides crucial links with the AFCD and other government departments, commercial companies, non-government organizations (NGOs) concerned with the live reef fish trade.

The objectives of this article are twofold. The first is to determine the values of imports, and countries of origin, of live reef food fish into HK in 1999 till August 2000 by compiling government statistics.

The second was to investigate the wholesale and retail prices of 10 common species by monthly market and restaurant surveys.

In general, the retailers, who in turn control the market distribution, purchase the fish from wholesalers (take a profit of 24 to 35%) and the restaurants are the main end users (mark the fish up to 100 to 150%)[1].

Import figures

Import figures on live marine fish are collected by the HKSAR Government through the CSD. The data are taken from Trade Declaration forms, with trade recorded in kilogrammes. However, Hong Kong registered vessels are not required to declare their catches as imports, excluding a significant proportion of imported fish from the official import statistics. Fortunately, monthly estimates of live marine fish transported into Hong Kong by Hong Kong vessels are available from the AFCD although the figures from the CSD and the AFCD cover only about 50% of all shipments of live reef fish imported into Hong Kong.

Figures from the CSD are divided into 13 categories under the Harmonized System (HS), with 12 categories relating to particular reef species and one to 'other marine fish. This harmonized system is being looked at by overseas governments for possible use or implementation.

Prior to 1999, the Hong Kong Imports and Exports Classification List (HS) used

for trade declaration purposes did not list some species. The new system gives more detailed information (quantity and countries of origin) on the trade of live reef fish which are susceptible to cyanide fishing.

In Hong Kong, there are approximately 800 Chinese seafood restaurants selling live reef fishes. A survey has been carried out on the monthly live reef fish (LRF) retail prices since November 1999 based on 726 seafood restaurants in 18 districts around Hong Kong.

Apart from the preliminary study last November (only 10% of restaurants were visited because of time constraint), 20% of the total number of restaurants per district were selected randomly.

The prices of 10 common species (*Cromileptes altivelis, Epinephelus coioides, Epinephelus fuscoguttatus, Epinephelus lanceolatus, Epinephelus polyphekadion, Plectropomus areolatus, Plectropomus laevis, Plectropomus leopardus, Cheilinus undulatus and Lutjanus argentimaculatus*), where available, were recorded for every restaurant.

Market survey

Kwun Tong Wholesale Fish Market is the only indoor live reef food fish market operated by the Fish Marketing Organization (FMO), while the markets in Aberdeen and Sam Shing (Tuen Mun) are adjacent to the Aberdeen Wholesale Fish Market and Castle Peak Wholesale Fish Market respectively.

Apart from these wholesaler-aggregated areas, some wholesalers (or distributors) operate in urban areas. In our survey, the wholesale prices of the 10 species were updated twice a week for the markets in Kwun Tong and Aberdeen.

For the wholesalers/distributors in Quarry Bay, Sam Shing and Wancha, prices were recorded once a month. The monthly Average Wholesale Price of Live Marine Products prepared by the AFCD Aquaculture Development Team (Au Tau) in which the prices were obtained from Aberdeen and Mong Kok) were also used as a reference for comparison.

Table 1. Imports (monthly) of live marine fish into Hong Kong by country in 1999.

Exporting country	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (kg)
Australia	7,469	76,065	40,253	19,410	15,756	18,470	20,830	33,662	39,778	48,803	40,807	68,103	429,406
Brunei	-	-	91	140	204	3,153	2,851	1,836	1,867	1,003	566	213	11,924
Cambodia	1,330	1,854	644	1,917	596	949	2,663	2,247	1,320	3,654	2,482	738	20,394
Fiji	-	-	-	-	-	-	-	-	200	-	-	-	200
France	974	1,776	400	890	-	-	-	-	-	-	-	-	4,040
India	-	-	-	-	8,960	-	-	391	436	1,045	-	-	10,832
Indonesia	77,529	57,042	83,666	59,935	91,134	65,525	97,015	90,860	152,904	99,092	129,352	96,910	1,100,964
Japan	-	-	492	-	-	-	-	-	-	-	-	251	743
Kiribati	-	-	15,000	-	-	-	-	-	-	-	-	-	15,000
Korea	210	420	-	320	220	330	330	220	330	310	210	315	3,215
Mainland China	233,140	228,702	234,630	325,022	295,399	268,998	392,406	247,469	218,348	277,350	222,857	204,425	3,148,746
Malaysia	49,638	68,573	43,994	46,670	89,786	44,037	114,803	38,063	97,513	71,289	85,038	31,486	780,890
Maldives	-	-	14,500	-	18,000	16,500	-	-	17,500	-	-	-	66,500
Morocco	-	-	-	-	-	-	-	-	-	97	-	-	97
Myanmar	6,387	-	-	-	-	-	1,676	-	-	-	160	49	8,272
Philippines	50,322	39,583	44,619	30,987	57,722	38,422	78,306	49,637	65,960	79,890	66,010	56,376	657,834
Singapore	-	-	13,300	-	-	1,428	964	16,200	-	-	-	10,000	41,892
Sri Lanka	-	302	-	-	326	-	-	-	98	-	-	-	726
Taiwan	47,562	135,320	159,977	113,047	81,600	77,818	132,004	69,616	75,374	66,986	56,646	65,191	1,081,141
Thailand	541,512	374,502	345,875	292,251	327,302	214,708	272,491	261,592	214,258	242,819	217,407	232,070	3,533,974
Vietnam	5,476	18,699	16,305	12,688	19,993	15,264	13,295	20,037	32,540	12,608	15,465	4,957	187,327
Total (kg)	1,021,549	1,002,838	1,013,746	903,277	1,006,998	765,602	1,129,634	831,830	918,426	904,946	837,000	771,084	11,106,930

Table 2. Imports (monthly) of live marine fish into Hong Kong by country from January to July 2000.

Exporting country	Jan	Feb	Mar	Apr	May	Jun	Jul	Total (kg)
Australia	45,234	48,114	52,741	57,265	78,851	48,857	78,184	409,246
Brunei	-	84	168	368	1,631	924	574	3,749
Cambodia	1,556	2,325	3,096	1,397	6,592	3,586	3,909	22,461
Canada	-	-	-	103	-	-	-	103
Iceland	-	-	-	-	-	456	-	456
Indonesia	97,633	122,583	99,664	106,895	118,709	81,808	57,608	684,900
Japan	-	-	672	5,639	6,737	6,749	6,432	26,229
Korea	210	220	220	228	214	200	100	1,392
Mainland China	228,592	236,507	234,208	386,194	388,913	449,043	350,228	2,273,685
Malaysia	43,737	37,401	46,894	29,108	31,386	36,216	55,620	280,362
Maldives	-	-	-	18,500	-	-	-	18,500
Myanmar	-	-	118	-	95	-	-	213
Nauru	-	-	-	-	-	-	282	282
Philippines	71,743	87,191	91,812	76,633	105,108	125,154	119,524	677,165
Seychelles	-	25,000	-	-	-	-	-	25,000
Singapore	-	120	217	-	-	10,000	-	10,337
Taiwan	97,933	211,962	173,620	127,747	93,602	72,819	51,219	828,902
Thailand	188,935	236,304	184,853	216,932	326,642	274,582	272,206	1,700,454
Togo	-	-	-	-	-	-	840.00	840
Vietnam	11,565	14,729	21,587	34,244	12,604	10,097	9,301	114,127
Total (kg)	787,138	1,022,540	909,870	1,061,253	1,171,084	1,120,491	1,006,027	7,078,403

Table 3. Total imports of live marine fish into Hong Kong by species in 1999.

Species	Volume of import (kg)		Total (kg)
	CSD	AFCD	
Giant grouper	14,636	12,900	27,536
High-finned grouper	4,574	11,462	16,036
Green grouper	1,788,306	273,158	2,061,464
Tiger grouper	60,098	372,724	432,822
Flowery grouper	316,589	383,904	700,493
Leopard coral trout	1,439,185	271,296	1,710,481
Spotted coral trout	75,520	234,284	309,804
Other grouper	1,598,111	439,240	2,037,351
Humphead wrasse	4,587	85,442	90,029
Other wrasses & parrotfish	748	178,750	179,498
Snooks & basses	1,972,811	--	1,972,811
Mangrove snapper	566,115	1,079,260	1,645,375
Other marine fish	3,284,763	278,166	3,562,929
Total (kg)	11,126,043	3,620,586	14,746,629

Table 4. Total imports of live marine fish into Hong Kong by species from January to June 2000.

Species	Volume of import (kg)		Total (kg)
	CSD	AFCD	
Giant grouper	12,854	2,014	14,868
High-finned grouper	2,648	6,291	8,939
Green grouper	1,004,102	1,019,127	2,023,229
Tiger grouper	47,585	56,461	104,046
Flowery grouper	112,958	68,450	181,408
Leopard coral trout	994,090	224,612	1,218,702
Spotted coral trout	25,375	71,961	97,336
Other grouper	757,191	162,908	920,099
Humphead wrasse	36,249	23,206	59,455
Other wrasses & parrotfish	723	79,430	80,153
Snooks & basses	1,080,103	--	1,080,103
Mangrove snapper	165,061	207,210	372,271
Other marine fish	1,832,502	723,920	2,556,422
Total (kg)	6,071,441	2,645,590	8,717,031

Fish cage survey

From 16 March to 30 August 2000, IMAHK carried out regular field survey around the holding cages in 2 mariculture zones in Hong Kong by a 17-feet boat "So Mei" (So Mei is the local common name of the Humphead wrasse). The boat allowed IMA to access these areas to determine what quantities, countries of origin and species composition of fish are being held there at any time

Volume and sources of imports

Import figures in 1999 and 2000 (until October) are shown in Tables 1 to 4. In 1999, 14,727,516 kg of live marine fish were imported into Hong Kong (11,126,043 kg from the CSD and 3,620,586 kg from local fishing vessels). According to the CSD import data, live marine fishes were consigned to Hong Kong from 21 exporting countries, namely Australia, Brunei, Cambodia, Fiji, France, India, Indonesia, Japan, Kiribati, Korea, China, Malaysia, Maldives, Morocco, Myanmar, the Philippines, Singapore, Sri Lanka, Taiwan, Thailand and Vietnam. (Tables 1 & 2).

In 1999, Thailand (37%, 1,305,492 kg, of the imported fish from Thailand was the Green grouper) and China (63%, 1,972,811 kg, of the imported fish from China were the snooks and basses) were major suppliers of live marine fishes, followed by Indonesia, Taiwan, Malaysia, the Philippines and Australia (Table 1).

Until October 2000, imports totalled 14,256,298 kg (9,830,418 kg from the CSD and 4,425,880 kg as shown in Table 4). Based on the CSD import figures, 4 new exporting economies imported fishes into Hong Kong in 2000, namely, Iceland, Nauru, Seychelles and Togo. However, it is questionable whether the declared 456 kg of Leopard coral trout came from Iceland or somewhere else in June 2000.

Apart from *E. areolatus* and *E. bleekeri*, the Green grouper (sometimes mixed with the Malabar grouper, *E. malabaricus*[2]) is the most common cultured grouper in Hong Kong. The wild-caught fish costs about 35-43% more than the cultured one. In restaurants, plate-sized individuals are usually sold per tail instead of per weight as this species is considered to be cheaper (like *L. argentimaculatus*) than other live food fishes.

The wholesale price was around HK$ 120 per kg with the lowest ($88.5 per kg) occurring in May 2000 (Table 5). The retail prices varied slightly from HK$197.7 per kg to HK$237.0 per kg (Table 6). The greatest difference was 143.8.0% in May 2000 while the least (85.3%) was in April 2000. Based on these findings, it appears that generally a bigger profit can be made from cheaper species.

Tiger grouper *(Epinephelus fuscoguttatus).* Individuals of size less than 3 catties (1.8 kg) are more popular than larger ones because of the assumed lower risk of contacting ciguatera and they are a better size for consumption (plate-sized). In fact, many restaurateurs claim that the Tiger grouper has a better taste than the Leopard coral trout and they prefer eating the Tiger grouper.

. . . . it appears that generally a bigger profit can be made from cheaper species

Wholesale price ranged from HK$171.4 per kg in May to HK$237.5 per kg in November (Table 5). Retail price peaked at HK$413.4 per kg in January, with the lowest at HK$ 332.6 per kg found in November (Table 6).

Giant grouper *(Epinephelus lanceolatus).* The Giant grouper is preferred by local people. Having a big (more than 10 catties, or 16.53 kg) Giant grouper for sale in a restaurant seems to be a striking issue and a restaurant usually posts an advertisement by its entrance. However, as the supply and demand for big individuals has decreased and consumers are now more interested in eating plate-sized fish, juvenile Giant groupers (less than 5 catties) are available in some premium-priced restaurants. It is not often found for sale in the seafood restaurants. There may be one on the display tank, the fish is not for sale because of "fung shui" purposes. From April to June, no Giant grouper was observed for sale in 400 randomly selected restaurants. The wholesale and retail prices varied from HK$136.1 per kg to HK$314.2 per kg (Table 5) and HK$368.7 per kg to HK$ 749.0 per kg (Table 6), respectively. The remarkable difference between wholesale and retail prices in March (276.0%) was due to the average retail price being based on small individuals while the wholesale price was estimated from both small (1.3 kg) and large (heavier than 3 kg) individuals. One of the largest importers in Hong Kong (P.S.W. Chan - Chair of the HKCSM, pers. comm.) claims that about 95% of the Giant groupers in the market are cultured (juveniles are available from hatchery e.g. in Taiwan) rather than wild-caught as suggested elsewhere[2].

Flowery grouper *(Epinephelus polyphekadion).* The Flowery grouper seems to be one of the cheapest wild-caught grouper in the local seafood market although a few wild-caught Green grouper are sold at similar price. Generally speaking, both wholesale and retail prices of the Flowery grouper are lower than the Tiger grouper. The prices of the Flowery grouper did not vary much from November 1999 to September 2000. Its wholesale price was about HK$200 per kg (Table 5) while retail price fluctuated slightly at HK$350 per kg (Table 6). The profit (percentage difference) made from this species ranged from 45.8% (November) to 107.0% (May).

According to the Explanatory Note No.5: Adjustments, "The trade figures are subject to adjustments. For example, goods declared may be subject to correction later. Errors affecting individual headings may also arise from various sources, such as misclassification of commodity or country/territory of consignment in the original document, wrong reporting of value or quantity, and lodgment of more than one declaration for the same consignment. Adjustments relations to earlier months of a particular year are incorporated in the cumulative totals of that year only. It follows that the sums of the monthly figures may differ from the cumulative totals". As a result, the sums of monthly figures in 1999 and 2000 (see Table 1 & 2) are different from the cumulative totals (see Table 3 & 4). In this study, the more cumulative totals were used except where specified.

Table 5. Monthly variations in the mean and standard deviation of the wholesale prices (HK$ /kg) of 10 common species in Hong Kong from November 1999 to September 2000, with comparisons to the mean wholesale prices in 1997 (Lau & Parry-Jones, 1999).

HK$ /kg	Species																			
	C. altivelis		*E. coioides*		*E. fuscoguttatus*		*E. lanceolatus*		*E. polyphekadion*		*P. areolatus*		*P. laevis*		*P. leopardus*		*C. undulatus*		*L. argentimaculatus*	
Month	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Nov-99	**583.5**	139.2	**122.6**	21.4	**237.5**	66.8	**314.2**	143.2	**207.7**	32.6	**206.7**	11.7	**297.6**	140.3	**331.4**	90.9	**554.5**	169.5	**48.6**	3.4
Dec	**532.3**	76.5	**135.0**	36.2	**193.5**	75.3	**148.8**	--	**212.4**	45.8	**248.0**	70.2	**198.4**	--	**376.5**	57.8	**495.7**	109.8	**74.7**	39.0
Jan-00	**526.1**	97.7	**103.3**	17.0	**213.6**	47.3	**278.1**	182.1	**185.7**	43.5	**256.7**	45.6	**238.2**	22.3	**362.0**	41.5	**531.2**	81.9	**46.8**	9.5
Feb	**526.4**	100.4	**122.0**	60.5	**180.5**	64.2	**205.3**	94.8	**201.9**	60.2	**222.9**	55.1	**192.9**	19.5	**356.9**	87.6	**468.7**	152.3	**58.9**	33.5
Mar	**457.5**	94.5	**106.3**	34.6	**201.6**	69.8	**164.2**	25.4	**177.9**	74.4	**199.8**	87.1	**163.8**	38.3	**296.5**	64.2	**420.5**	139.7	**59.4**	26.3
Apr	**494.4**	107.0	**116.3**	51.7	**189.8**	66.3	**171.6**	42.3	**170.9**	66.3	**156.8**	36.7	--	--	**265.9**	77.5	**398.8**	143.1	**54.5**	13.1
May	**512.2**	82.5	**88.5**	21.7	**171.4**	74.9	**201.0**	44.6	**164.6**	72.9	**180.2**	74.2	**396.8**	--	**266.6**	89.7	**402.8**	160.0	**55.3**	2.8
Jun	**522.3**	56.7	**94.6**	23.9	**173.5**	49.8	**201.6**	51.4	**167.2**	66.5	**217.3**	77.8	--	--	**290.0**	88.5	**437.2**	173.2	**66.4**	18.1
Jul	**529.3**	89.6	**100.1**	30.6	**185.4**	69.8	**201.6**	51.4	**178.9**	73.9	**155.0**	56.1	--	--	**295.5**	96.2	**417.9**	157.2	**69.0**	16.5
Aug	**493.8**	24.3	**100.0**	30.5	**194.4**	54.5	**201.6**	51.4	**169.5**	74.5	**140.9**	47.5	**--**	**--**	**261.0**	81.3	**397.4**	149.5	**55.3**	2.8
Sep#	**522.8**	26.4	**92.9**	22.5	**173.9**	33.6	**224.7**	78.1	**136.1**	62.8	**177.9**	54.7	--	--	**254.5**	85.0	**358.5**	137.3	**55.3**	2.8
WWF 97*	**708.4**		**177.1**		**284.9**		**581.4**		**234.9**		**308.0**		--		**400.4**		**423.5**		**138.6**	

Statistics in September calculated from data from Kwun Tong Wholesale Fish Market.
* Lau, P. & Parry-Jones R. (1999). *The Hong Kong Trade In Live Reef Fish For Food*. TRAFFIC East Asia and World Wide Fund For Nature Hong Kong, Hong Kong.

Table 6. Monthly variations in the mean and standard deviation of the retail prices (HK$ /kg) of 10 common species in Hong Kong from November 1999 to August 2000, with comparisons to the mean wholesale prices in 1997 (Lau & Parry-Jones, 1999).

HK$ /kg	Species																				No. of
	C. altivelis		*E. coioides*		*E. fuscoguttatus*		*E. lanceolatus*		*E. polyphekadion*		*P. areolatus*		*P. laevis*		*P. leopardus*		*C. undulatus*		*L. argentimaculatus*		restaurants
Month	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	surveyed
Nov-99	**782.8**	259.0	**200.9**	65.6	**332.6**	87.9	**749.0**	86.5	**302.8**	72.6	**368.0**	95.4	**489.4**	18.7	**411.9**	113.8	**728.1**	301.6	**140.4**	43.8	96
Dec	**804.1**	282.1	**234.7**	78.0	**362.5**	91.5	**575.1**	196.0	**355.9**	81.6	**390.4**	101.4	**412.9**	121.8	**481.6**	162.0	**787.6**	319.5	**166.6**	56.8	173
Jan-00	**801.2**	229.9	**229.3**	61.9	**413.4**	83.6	**436.5**	108.3	**367.0**	83.0	**426.8**	78.7	--	--	**560.4**	139.3	**859.4**	270.6	**139.7**	34.4	165
Feb	**820.7**	237.5	**237.0**	56.7	**408.9**	69.0	**525.8**	116.9	**389.7**	78.9	**479.8**	115.8	**466.6**	13.2	**591.0**	146.2	**811.6**	279.4	**135.4**	25.4	154
Mar	**843.5**	344.7	**230.6**	66.6	**410.5**	82.5	**617.6**	--	**342.9**	74.7	**432.4**	83.8	**463.0**	93.5	**499.5**	166.9	**841.6**	350.6	**131.0**	30.5	112
Apr	**835.7**	284.3	**215.5**	57.0	**372.3**	75.1	--	--	**324.5**	66.8	**361.8**	111.5	**386.4**	101.4	**440.5**	151.6	**812.9**	278.9	**128.5**	31.7	128
May	**782.1**	230.5	**215.9**	56.5	**374.0**	70.6	--	--	**340.7**	58.3	**350.6**	83.5	**502.7**	121.2	**467.4**	178.2	**847.5**	315.3	**130.0**	43.8	137
Jun	**848.8**	313.7	**216.1**	65.8	**350.7**	79.8	--	--	**339.5**	89.7	**397.6**	87.5	**484.5**	--	**458.5**	153.6	**859.7**	375.0	**123.5**	20.8	135
Jul	**680.3**	219.7	**200.7**	40.6	**356.4**	76.6	**368.7**	35.1	**342.8**	80.9	**374.8**	47.7	**469.0**	28.1	**448.5**	159.3	**737.6**	237.0	**132.1**	26.0	132
Aug	**811.1**	343.8	**197.7**	49.7	**379.4**	73.9	--	--	**334.4**	72.1	**388.1**	80.2	**471.4**	60.3	**496.3**	177.9	**935.2**	350.7	**120.7**	25.6	135
WWF 97*	**1239.7**		**369.6**		**381.2**		**897.1**		**342.7**		**754.6**		--		**823.9**		**1024.1**		**192.3**		

* Lau, P. & Parry-Jones R. (1999). *The Hong Kong Trade In Live Reef Fish For Food*. TRAFFIC East Asia and World Wide Fund For Nature Hong Kong, Hong Kong.

Table 7. Average wholesale price of 9 fish species from November 1999 to August 2000 prepared by the AFCD.

Species	Nov 99	Dec	Jan 00	Feb	Mar	Apr	May	Jun	Jul	Aug
C. altivelis	484.0	520.9	536.3	521.4	523.9	517.0	544.5	525.3	561.0	567.6
E. coioides	117.6	106.8	124.2	117.5	114.7	104.0	114.6	116.2	109.5	117.9
E. fuscoguttatus	152.6	129.5	154.0	154.4	148.5	146.1	145.0	149.8	166.7	188.9
E. lanceolatus	187.0	160.9	163.4	154.7	162.3	170.5	166.4	187.0	176.6	158.4
E. polyphekadion	165.6	177.4	191.1	191.4	165.0	172.1	184.6	184.3	202.7	209.6
P. areolatus	179.9	201.1	273.4	222.8	186.5	185.0	197.1	207.6	201.5	229.6
P. leopardus	299.8	325.9	400.7	330.0	281.9	285.2	301.6	272.3	287.6	307.6
C. undulatus	420.8	458.7	508.2	495.0	489.5	470.3	519.8	495.0	523.3	570.9
L. argentimaculatus	69.6	76.7	69.2	62.3	53.1	74.0	72.5	67.8	65.4	62.2

Prices obtained from Aberdeen and Mong Kok.
Prepared by Aquaculture Development Team (Au Tau) & Fisheries Resources and Claims Section.

Spotted coral trout Plectropomus leopardus

Similar to the Green grouper, the Mangrove snapper is the most profitable cultured fish in the restaurants in Hong Kong.

Spotted coral trout *(Plectropomus areolatus).* Apart from the Leopard coral trout, the Spotted coral trout seems to be the second most well-known *Plectropomus* species sold in restaurants. It is usually sold at a lower price than the Leopard coral trout, but at the same price as the Tiger grouper.

The wholesale price varied from HK$140.9 per kg in August to HK$256.7 per kg in January (Table 2). The retail price peaked at HK$479.8 per kg in February while the lowest occurred at HK$ 350.6 per kg in May.

Blacksaddled coral trout *(Plectropomus laevis).* The Blacksaddled coral trout is not commonly seen in the tanks of the restaurants. Its retail price lies between that of the Spotted coral trout and the Leopard coral trout.

It was not seen in the restaurants in January and no data was found in the wholesale market in April and from June to September (Table 5).

The wholesale price ranged from HK$186.7 per kg to HK$396.8 per kg while the retail price was between HK$386.4 per kg in April and HK$502.7 per kg in May.

Leopard coral trout *(Plectropomus leopardus).* The Leopard coral trout is the most common and famous grouper among local consumers. Most restaurants have this species in their tanks for sale. Because of its attractive body coloration (red skin with white meat), it is a very popular fish for banquets, especially at weddings.

In one restaurant in February, these were sold at a higher price (HK$17 per tael) than those with pale red coloration (HK$13 per tael). From November 1999 to September 2000, wholesale prices in December (HK$376.5 per kg) and January (HK$362.0 per kg) were higher than in other months (Table 5).

Similarly, the retail price increased remarkably in January (HK$560.4 per kg) and February (HK$591.0 per kg) (Table 6), mainly due to increased demand and reduced supply (cold season) for this popular species in banquets for the Chinese Lunar New Year.

From late last-March till May, a company with about 20 restaurants in Hong Kong sold this species at HK$6.8 per tael (equivalent to HK$174.1 per kg). In late April, another restaurant group launched a promotion for this species, sold at HK$4.8 per tael (equivalent to HK$ 122.9 per kg) which is even lower than the average wholesale price in April.

Humphead wrasse *(Cheilinus undulatus).* The Humphead wrasse and the Giant grouper are the two well-known 'giants' sold in the local seafood market. Nowadays, plate-sized (below 5 catties) Humphead wrasse is more preferable than large individuals. Together with the Highfinned grouper and the Red grouper (*E. akaara*), the Humphead wrasse is one of the most expensive live reef food fish in the local seafood market. Wholesale prices for Humphead wrasse varied from HK$358.5 per kg in September to HK$554.5 per kg in November 1999 (Table 5). Its retail price ranged from HK$728.1 per kg in November to $935.2 per kg in August (Table 6). The percentage difference between retail and wholesale prices was lowest (31.3%) in November 1999, highest (135.3%) in August.

Mangrove snapper *(Lutjanus argentimaculatus).* As with the Green grouper, Mangrove snapper is another commonly cultured species that has a low market price and is usually sold per tail instead of per weight. The wholesale price of the Mangrove snapper was around HK$60 per kg (Table 5) and retail price was about HK$130 per kg (Table 6). The profit seems to be highest among 10 species (percentage differences ranged from 85.9% in June to 198.3% in January). Similar to the Green grouper, this species is the most profitable cultured fish in the restaurants in Hong Kong.

Comparative wholesale and retail prices, 1997-2000

Wholesale and retail prices for the 10 common species in 1997 and September 2000 are listed in Tables 5 and 6. When compared with the average wholesale prices in 1997 (Lau & Parry-Jones, 1999), the September 2000 prices for all species are much lower (38.6% to 84.7% of the prices in 1997). For retail prices, apart from the Tiger grouper and Flowery grouper which show little deviations, those in August 2000 for the other 7 species are lower than in 1997 (41.1% to 99.5%). This may be due to the prior economic crisis; people now are not so willing to eat expensive fish in restaurants.

Mariculture activities in 2 Hongkong mariculture zones

The Average Wholesale Price of Live Marine Products" was prepared by the Aquaculture Development Team (Au Tau), AFCD, with prices obtained from Aberdeen and Mong Kok. Our findings are similar to those of AFCD (Table 7).

However, the AFCD states the wholesale prices are originated from captured Giant grouper. This is unlikely to happen because the species sold in the local market are mostly cultured. Moreover, *P. laevis* is not in the AFCD list.

From 16th March to 30th August 2000, 10 regular visits to 2 mariculture zones (Sok Kwu Wan and Lo Tik Wan, Lamma Island) were carried out by the IMA boat "So Mei". Based on observations and conversations with the local mariculturists, the most common species being reared are:

- the snappers (e.g. *Lutjanus argentimaculatus, L. malabaricus, L. johnii, L. russellii, L. stellatus*),
- the Pompano (*Trachinotus blochii*),
- groupers (e.g. *Epinephelus areolatus, E. bleekeri, E. coioides*),
- sea-breams (e.g. *Acanthopagrus berda, A. latus, A. macrocephalus, Rhabdosargus sarba*),
- the Head grunt (*Pomadasys kaakan*),
- White spotted rabbitfish (*Siganus canaliculatus*),
- grunts (e.g. *Parapristipoma trilineatum, Plectorhinchus cinctus*),
- emperors (e.g. *Lethrinus haematopterus)*,
- the Cobia (*Rachycentron canadum*),
- the Red drum (*Sciaenops ocellatus*) and
- the Greater amberjack (*Seriola dumerili*).

Some mariculturists held more valuable species like the Humphead wrasse and the Leopard coral trout in their fish rafts or cages mainly for temporary storage. Guard dogs were found on the fish cages.

During most of our visits, poor water quality (i.e. poor water flow, low visibility, many dead fish) was found in these two culture zones. Also, fish are usually kept under stressful conditions (e.g. over-crowding and disease) and fed with trash fish so that the efficiency of mariculture is further lowered.

Current status

Hong Kong is an important consumer of live reef food fish in the Asia-Pacific region. Although it was recorded that there were only 14,728 mt of live reef fish imported into Hong Kong in 1999, the actual volume was believed to be about 30,000 to 35,000 mt.

Of this, about 55 to 60% was re-exported to the People's Republic of China (PRC)[1]. Estimates of 1997 imports are that there was a total of 32,000 mt imported into Hong Kong with only 13,994 mt declared[3]. The exemption of local fishing vessels to making trade declarations resulted in the 50% under-reporting of the quantity of fish imported into Hong Kong.

After the follow-up meeting on "the Hong Kong Trade In Live Reef Fish For Food" on 25th September 2000, a joint programme with the IMAHK, AFCD and HKCSM is now developing a better scheme for more accurate measures and monitoring of the trade.

A recently published WWFHK (World Wide Fund For Nature Hong Kong)[2] suggested that the Giant grouper and Humphead wrasse were popular species among local people, and that the latter was one of the most popular live reef food fish (the other 4 species were *Plectropomus leopardus, Lutjanus argentimaculatus, Epinephelus coioides* and *Lutjanus russellii*).

However others have stated that "Humphead Wrasse and Giant Grouper were the least common species in the restaurants" and it was quite rare to see the Humphead wrasse and Giant grouper in the display tanks in the restaurants during our restaurant survey.

The word "popular" in the WWF 2000 report should be understood and used with care. Currently the most commonly seen fish include the Leopard coral trout, Flowery grouper, Tiger grouper, Green grouper and Mangrove snapper with the latter two species are common cultured fish.

An in-depth report on the current status of the live fish trade industry in Hong Kong has been produced that addresses several difficulties experienced in the trade from wild-caught fish supply and prospects for mariculture development[4]. In 1999, public concern about the safety of eating ciguatoxic fish arose which directly affected the consumption of live reef food fish.

In fact, this has helped the mariculture industry which produces virtually ciguatera-free food fish. However, because of red tides, the small mariculture sector only produced just over 1,000 metric tonnes of fish (through grow-out of wild-caught, imported juveniles in net cages) which has an annual production of 3,000 metric tonnes normally[4].

Misconceptions (e.g. that all fish imported are caught with cyanide) about the live reef food fish industry also create an adverse effects on the development of the live reef food fish and aquarium fish trade industry in Hong Kong.

Recommendations and future activities

It is important to let everyone involved in the live reef fish trade know the most up-to-date situation instead of using old information (e.g. Humphead wrasse used to fetch US$120/kg wholesale prior to 1997, but in January 2001 was only fetching US$ 57/kg wholesale). Putting the monthly wholesale and retail prices on the world wide web may be a good idea for this (at least for those who have accesses to the web).

Secondly, the existing mariculture ordinance should be revised in order to save this potential solution to global problem of overfishing. The development of hatcheries to produce vaccine-treated fry/fingerlings instead of buying wild-caught juveniles overseas along with consideration of on-land grow-out facilities, production of cheap, good-quality pellet fish feed, and reduction on the consumption of wild-caught fish for fish-feed purposes could also be of benefit[4]. The growing market for live reef (food and aquarium) fish in PRC is another concern for the industry.

On 25th July 2000, IMAHK visited the seafood wholesale market in Huang Sha, Guangzhou, finding that there were at least 200 shops selling live reef fishes, shellfishes, crustaceans and freshwater fishes. The price (wholesale) resembled the retail price in the restaurants in Hong Kong, and the species composition was very similar to that of Hong Kong. IMAHK is planning to investigate other wholesale markets in other cities of PRC in the future. While not a big market in global terms, Hong Kong is the second largest importer of marine aquarium fish in Asia after Japan.

Chan and Sadovy (1998) estimated a sum of HK$57,453,780 was valued in the trade in 1997, involving 342 marine aquarium fish species from 49 families. IMAHK has developed links with one of the largest marine aquarium trade in Hong Kong, Yat Wong aquarium. Yat Wong import and re-export marine aquarium fish and the Managing Director is strongly against cyanide fishing. Yat Wong has proposed that the company purchase fish from fishers trained in barrier-net collection under the Indo-Pacific Destructive Fishing Reform Initiative (DFRI) program.

IMAHK also hopes to persuade Yat Wong to label the various display tanks in the shop, stating that the fish are cyanide-free and caught using non-destructive techniques. This small step will help inform the aquarists to a side of their hobby they may not be aware of and play a leading role which other marine aquarium shops can follow.

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Status of common carp varieties under culture in China

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Common carp culture

China is vast country where a complex interaction of climatic and geographical conditions has led to the evolution of a diversity of common carps (*Cyprinus carpio*).

Common carp culture has a very long history in China, having taken place for more than 2,500 years. Ranked fourth in terms of cultured species, it is a highly important species in terms of economic value, area under culture and overall production. In 1999, the national production of farmed common carp reached 2.05 million tons. It is also an important component of fisheries in natural waters.

Common carp has many favorable characteristics. It grows fast, it has a high protein content and its production cost is relatively low. It has a low feed coefficient, is highly resistant to disease and widely adaptable, besides being suitable for various farming systems. The culture techniques are simple and require a low input from farmers, who can benefit easily from its culture. It is a good source of animal protein.

Economically important varieties under culture in China

China is rich in common carp genetic resources. Many morphological variations have been developed through both artificial breeding and natural selection. The Chinese Government has placed a lot of emphasis on the economic development and genetic improvement of common carp.

Local common carps

Cyprinus carpio yuankiang, C. carpio chilia, C. carpio pellegrini, C. carpio rubrofuscus and *C. carpio haematopterus* are some major indigenous common carp sub-species cultured in local waters.

Artificially selected varieties

C. carpio var. *wuyuanensis*, *C. carpio* var. *singuonensis*, *C. carpio* var. Crystallos and Jian carp (*Cyprinus carpio* var. *jian*) are varieties that have been developed through selective breeding of local common carps or offspring of crossbreeds. The growth rate and other productive performances of these varieties have been improved through selection.

Exotic varieties

China has introduced some varieties of common carp from other countries for culture and breeding. These include mirror carp from Germany and scattered mirror carp from Russia.

Hybrids

Some crossbreeds have good characteristics such as a high growth rate, low feed conversion ratio or high fishing rate. These are becoming the main varieties of common carp cultured throughout China. They include: Feng carp (*C. carpio* var. *singuonensis* x

Scattered mirror carp), Heyuan carp (*C. carpio* var. *wuyuanensis x C. carpio* var. *yuankiang*), Yue carp (*C. carpio* var. *wuyuanensis x C. Carpio*), Lotus carp (Scattered mirror carp x *C. carpio* var. *singuonensis)* and Tri-crossed carp (Heyuan carp x Scattered mirror carp).

Some improved new varieties

Xiangyun carp, a triploid common carp, shows fast growth, good meat quality and strong disease resistance. All-female common carp grow faster than male fish and mixed groups. Both of these varieties have been used in aquaculture. A transgenic common carp has been developed that demonstrates improved growth. It will be utilized in the near future.

Jian carp: A good breed for culture

Jian carp is a variety developed through selective breeding. It has excellent characteristics including fast growth, a fine body shape, grayish color, delicious taste and high flesh content. Its weight increment is 30% higher than other native common carp and introduced breeds. It also has a low feed coefficient, a docile temperament, strong disease resistance, wide adaptability and high catching rate making it convenient to culture in different systems. Over 660,000 ha of this species are under culture in China with annual production exceeding 1,000,000 tons.

Technology of common carp culture in China

Artificial propagation

Breeding normally takes place from April to May when the water temperature has reached 18°C. Both artificial induction and natural pond spawning techniques are used. The inducing hormones used are HCG, LRH-A and PG in different combination and concentrations depending on circumstance. The fertilized eggs are collected on palm fiber and removed to hatching ponds. The fertilized eggs take 3-5 days to hatch at a water temperature of 18-20°C.

Rearing of fry and fingerling

Rearing fry and fingerlings involves nurturing 3-4 day-old post-larvae, which have begun to feed, into fingerlings for pond stocking. Natural food (plankton) and soybean milk, soybean dregs, soybean cake and formulated feed are given to fry and fingerlings according to their size.

Rearing is generally divided into two stages. (1) Fry are cultured for 18-25 days until they become juvenile fish about 3 cm long. (2) They are reared for another 3-5 months until they become fingerlings with a body length of 8-20 cm. Most "grow-out" ponds are stocked with such fingerlings; some are stocked with 2-year-old fingerlings.

Grow out

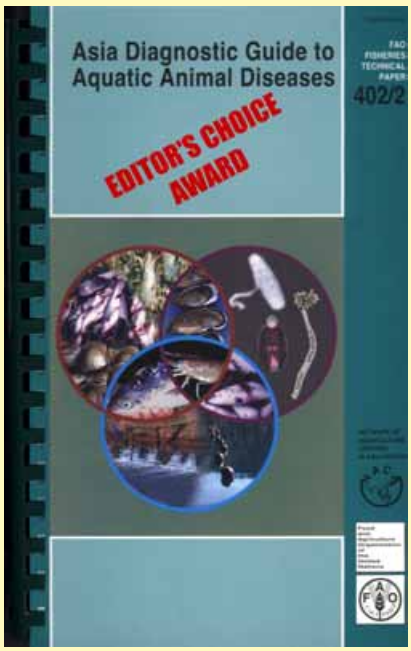
Fry and fingerlings are mainly stocked in ponds, cages and rice-fields for rearing. Stocking, feeding, growth, water quality and disease control are important parameters in grow-out management. Both monoculture and polyculture techniques are used in ponds. In monoculture, the stock density of common carp fingerling accounts for over 70% of the fish with the rest being silver carp and bighead carp.

In polyculture, the common carp makes up only 10% of the stock and is reared with grass carp, silver carp, bighead carp and other Chinese carps. Soybean cake and formulated feeds are provided.

Cages are set in open waters in lakes and reservoirs. A typical cage is about 60 m^3 in volume. Fingerlings are generally stocked at around 50-70g and at a density of 5-10 kg / m^3. Formulated feeds are the main food used in cage culture.

Rearing common carp in rice fields is of benefit to both the fish and the rice and leads to a substantial reduction in the application of pesticides. Common carp fingerlings are stocked in rice fields at around 3000-5000/ha. After 4 months of rearing they can be sold.

For more information contact Zhu Jian at the Freshwater Fisheries Research Center, Chinese Academy of Fishery Sciences, Wuxi, 214081, China, email: zhuj@ffrc.wx.net.cn.



Asia Diagnostic Guide to Aquatic Animal Diseases

The Asia Diagnostic Guide is a comprehensive, up-datable diagnostic guide for the pathogens and diseases listed in the NACA/FAO and OIE Quarterly Aquatic Animal Disease (QAAD) Reporting System including a number of other diseases which are significant in the Asia region. It jointly published by FAO and NACA under the Asia-Pacific Regional Programme on Aquatic Health Management.

This 240 page volume contains a general introduction on health and aquatic animals and the roles and levels of diagnostics. Section 2 to 4 cover Finfish Diseases, Molluscan Diseases and Crustacean Diseases. Each host section commences with a chapter on "General techniques" which covers essential starting points that will enable prompt and effective response(s) to disease situations in aquatic animal production. These chapters are not disease specific and emphasize the importance of gross observations and how and when they should be made, including information on environmental parameters worth recording, general procedures for sampling and fixation and the importance of record-keeping. The guide is illustrated with more than 160 colour photos. Limited hard copies and a CD version are available for cost of postage. A free electronic (PDF) version is available from the NACA website (http://www.enaca.org/aapqis/ - visit the publications link).

Marine finfish section

The Grouper Section has taken on a new and broader name beginning this issue: it has become the Marine finfish Section to take account of other species. This Section is almost wholly based on the Grouper Electronic 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).

Training Course on Grouper Hatchery Production

Organized by the Gondol Research Institute for Mariculture, Bali, Indonesia in cooperation with NACA, JICA and the Asia-Pacific Grouper Network, Bali, Indonesia, 1–21 May 2002.

A Grouper Hatchery Production course will be held in Bali, Indonesia, for hatchery operators, technicians and researchers involved in grouper aquaculture hatchery production, research, development and extension.

The training course is organized and supported by the Ministry of Marine Affairs and Fisheries, Indonesia, NACA, the Australian Centre for International Agricultural Research (ACIAR) and the Asia-Pacific Economic Cooperation (APEC). It is one of the activities of the Asia-Pacific Grouper Network (http://www.enaca.org/grouper/).

The Gondol Research Institute for Mariculture (GRIM) has extensive experience in short and long term training for Indonesian farmers and technical staff, in cooperation with Japan International Cooperation Agency (JICA). Such activities have contributed to the development of grouper hatchery in Indonesia. This is the first time that GRIM offers a grouper hatchery course for participants from the Asian region, in cooperation with NACA and the Asia-Pacific Grouper Network.

The objectives of this regional training course are to provide practical hands-on training on the following topics:

- Grouper broodstock management techniques, including handling, feeding, broodstock nutrition, control of the reproductive cycle, spawning techniques and egg collection and incubation.
- Larval rearing, including feeding and hatchery practices.
- Mass production of live food (phyto and zooplankton).
- Grouper diseases and health management, including viruses (VNN), and common diseases of marine fish.

The target grouper species for this training course will be mainly on *Cromileptes altivelis* (mouse grouper), but participants will gain experience with handling *Epinephelus fuscoguttatus* (tiger grouper) and other marine finfish species.

The training course will provide participants with a unique opportunity to visit private sector hatcheries and nurseries in the Gondol area, and some information on mariculture development in Indonesia.

The training course involves mainly practical hands-on teaching supported by short lectures and workshop discussion sessions. The course is intended for technicians and scientists from the private sector, NGO and government who are actively involved in grouper aquaculture development, research and extension. The course will be conducted in English.

The training course will involve: 40% lectures and small workshops, 50% practical work in the laboratory and on-station hatcheries and outdoor activities and 10% field trip.

The topics include management of broodstock, management of larval rearing, feed and feeding technique for broodstock, larvae and juveniles, fish diseases, prevention and control, mass production of live food for larvae, transportation of seed and broodstock, grow-out at floating net cages (brief introduction) and brief overview of mariculture development in Indonesia.

The fieldwork will be conducted around the island of Bali, at small-scale backyard hatcheries and private grouper hatcheries at Negara and grow-out and trading facilities at Denpasar.

All participants will be awarded a certificate of completion to certify that minimum performance requirements have been met, as evaluated by the Resource Persons, the Course Coordinator and the Board of Directors at GRIM. Performance will be based on the trainees' participation in class discussions and activities in the laboratory and outdoors.

All participants are required to complete the application form and send to the NACA Secretariat.

Selected participants are required to have a valid passport and an entry visa for Indonesia at least for the duration of the training course. Travel documents including passport, visa, fiscal and exit fee are to be arranged by the applicants at their own cost.

NACA will assist with visas, if required, in collaboration with GRIM and Indonesian authorities. Application for registration in the training workshop should be sent to the NACA Secretariat.

Qualified participants will be required to pay a course fee of US$1,500. This fee will cover the cost of training materials and supplies, administrative cost and local travel associated with the training.

Costs of accommodation and food at a nearby hotel will be the responsibility of the participant. Only one local hotel is available (see below), but participants will be advised of alternative options that may become available.

Accommodation will be at the Taman Sari Bali Cottages. This pleasant beachside resort hotel is 10 minutes drive from the Gondol station. Room rates for an air-conditioned room with hot water are around US$35 (to be confirmed) including breakfast. Details of the hotel can be found at www.balitamansari.com.

Payment of course fee can be made by either credit card or bank draft (details of payment are shown in the Registration Form). For further information, contact:

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Marine finfish section

Mass Mortalities Associated with Viral Nervous Necrosis in Hatchery-reared Groupers in China

L. Lin, J.G. He, K. Mori, T. Nishioka, J.L. Wu, S.P. Weng, K. Mushiake, M. Arimoto, T. Nakai-2001, Fish Pathology, 36(3): 186-188 (from Current Contents)

The viral etiology of mass mortalities of groupers, *Epinephelus coioides* and *E. akaara,* cultured in the People's Republic of China was examined.

Disease outbreaks occurred in 7 to 45 day-old fish with erratic swimming motion and marked vacuolation was observed in the brain and retina of the affected fish. The piscine nodavirus (the Betanodavirus), the causative agent of viral nervous necrosis (VNN), was detected in the affected tissues by electron microscopy, indirect fluorescent antibody test and reverse transcription-polymerase chain reaction. This paper is the first record of the agent in China.

The Potential for the Restoration of Marine Ornamental Fish Populations Through Hatchery Releases

D.A. Ziemann-2001, Aquarium Sciences and Conservation, 3(1/3): 107-117

Populations of tropical and subtropical marine fish are being depleted worldwide to supply increasing demands of the aquarium industry and fresh seafood market. Overfishing and destructive harvest techniques have left some marine fish populations virtually extirpated in a number of primarily underdeveloped countries.

In situations where only small remnant populations and significantly degraded habitat remain, population recovery even under the complete absence of collection will be slow, with the high potential for population loss due to natural environmental and recruitment variability. Stock enhancement, supplementing natural recruitment with hatchery produced fry, has the potential to significantly increase the rate of population recovery while maintaining population vigor.

Stock enhancement research on Pacific threadfin has demonstrated measurable positive impacts on recreational and commercial fisheries for this species in experimental scale releases; similar successes can be expected for enhancement efforts directed toward species of ornamental value.

The major technological barrier to ornamental fish enhancement, the development of appropriate culture capabilities, is being addressed in research directed to the commercial production of fish for the aquarium trade. (The Oceanic Institute 410202 Kalaniole Highway, Waimanalo, HI 96795, USA).

Application of Marine Foodfish Techniques in Marine Ornamental Aquaculture: Reproduction and Larval First Feeding

A.C. Ostrowski, Ch.W. Laidley-2001 Aquarium Sciences and Conservation, 3(1/3): 191-204

The long-term sustainability of the marine ornamental industry is being threatened by environmental pressures that are severely degrading the health of coral reef ecosystems. There is now a compelling need to practice resource conservation through the development of 'reef friendly' aquaculture technologies as an alternative to wild collection practices and to restore degraded wild populations. The commercial culture of marine ornamental finfish is very much in its infancy, but advances can be made more rapidly using insights from years of research and development with marine foodfish species.

Many of the bottlenecks and constraints to developing marine ornamental fish culture are those now being addressed with the more challenging species of foodfish being attempted. The two key bottlenecks that currently limit expansion of the marine ornamental industry are the control of captive maturation and spawning and the identification of appropriate first-feed items for marine ornamental fish larvae.

This paper highlights basic principles and recent achievements in marine foodfish culture that might be applicable to rapid development of controlled reproduction and propagation techniques for marine ornamental finfish. (The Oceanic Institute Makapuu Point Waimanalo HI 96795, USA).

Methods for Mass Rearing Stages I-IV Larvae of the American Lobster, Homarus americanus H. Milne Edwards, 1837, in Static Systems

B.F. Beal, S.R. Chapman-2001 Journal of Shellfish Research, 20(1): 337-346 (from Current Contents)

We conducted a series of five laboratory experiments (7-18 days in duration) to test the interactive effects of stocking density, aeration rates, and food types on survival of American lobster (*Homarus americanus*) larvae through their first three planktonic stages (I-III) to the postlarval stage (IV). Experimental units and culture protocols were designed to replicate a 1:100 scaled-down version of equipment used in association with a fishermen sponsored, stock enhancement lobster hatchery located in Cutler, Maine. The first four trials revealed that extremely high rates of aeration (ca. 240 mL air sec^{-1} were necessary to distribute larvae and food sufficiently to reduce cannibalistic encounters; however, the best survival from stage I-IV (at stocking densities of 7-26 L^{-1} fed ad libitum with enriched Artemia) was only 24%. The final experiment (stocking density = 20 L^{-1}) yielded a mean survival rate (+/- 95% CI) of 75.8 +/- 10.2% (range = 62.7% to 90.7%; n = 6). One important difference between the last and first four experiments was how stage I larvae were managed prior to their culture. In the first four trials, unfed larvae were collected from a relatively small (46 cm x 30 cm x 20 cm), screened capture basket located near the discharge pipe of a broodstock holding tank at the hatchery where they may have resided for > 12 hr. Larvae used in the final laboratory experiment were collected directly from the broodstock tank within 30 min after being liberated from the mother's swimmerets. Larvae, at relatively high densities within the screened box, likely had many more cannibalistic encounters prior to their culture than those collected directly from the broodstock tank and, therefore, suffered high rates of mortality during the first four laboratory trials. Mass rearing methods for larval American lobsters developed in conjunction with these laboratory experiments were used successfully by staff at the Cutler Marine Hatchery from

Marine finfish section

1988 to 1992. During this period, survival from stages I-IV averaged 44%, and approximately 875,000 stage IV animals were released to the wild. These culture methods have withstood the test of time as a private lobster hatchery in Maine adopted our protocols in 1993, and they continue to be in use. Further, the general techniques described here have been used since 1994 to culture European lobsters (*Homarus gammarus*) at a commercial lobster hatchery in the southeast of Ireland.

Vaccination of the Grouper, Epinephelus awoara, Against Vibriosis Using the Utrasonic Technique

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c South China Sea Institute of Oceanology, CAS, Guangzhou 510301, People's Republic of China

A novel ultrasonic technique was used to facilitate the vaccination of fish against Vibrio alginolyticus. To establish the safety parameters, the effects of ultrasound treatment on juvenile groupers, *Epinephelus awoara* was first tested. Results showed that, at an intensity of 400 mW/cm^2, 10 minutes of cultrasound treatment were safe, whereas an ultrasound intensity of 600 mW/cm^2 produced a certain degree of damage to the experimental groupers. The ultrasound frequency had little effect on the survival of the treated fish. Next the protective effect of the ultrasound-facilitated vaccination was tested. A low frequency ultrasound (35kHz) with an intensity of 175 mW/cm^2 was used for vaccinating fish against vibriosis. Different ultrasonic vaccination methods were examined; each contains a total of 2-min continuous or pulsed ultrasound combined with or without 2-min imersion in the presence of vibriosis vaccine. Of all the eight ultrasonic inoculating methods tested, pulsed ultrasound followed by immersion and immersion, pulsed ultrasound and immersion again provided the best protection from bacterial challenge. Compared to other traditional methods, the protective effect provided by ultrasonic vaccination is comparable to that by the intraperitoneal injection method, and the operation convenience is comparable to that by the immersion method. Thus the ultrasound-facilitated vaccination provides an effective and practical approach for vaccinating fish on a large scale.

Effects of Varying Dietary Fatty Acid Composition on Growth and Survival of Seahorse, Hippocampus Sp., Juveniles

M. Chang, P.C. Southgate-2001
Aquarium Sciences and Conservation, 3(1/3): 205-214

Three commercially available fatty acid enrichment emulsions (DC Selco, DC DHA Selco and DC Super Selco) were used to enrich *Artemia* nauplii fed to seahorse, *Hippocampus* sp. fry. The emulsions varied in their n-3 highly unsaturated fatty acid (HUFA) composition. Total n-3 HUFA content ranged from 200 to 450mg g^{-1} between the three emulsions while levels of eicosapentaenoic acid (EPA, 20:5n-3) and docosahexaenoic acid (DHA, 22:6n-3) ranged between 47–220 and 80–190mg g^{-1}, respectively.

Survival and growth of seahorses at the end of the 30-day growth trial were greater in treatments receiving enriched Artemia. Seahorses receiving *Artemia* enriched with DC DHA Selco and DC Super Selco showed significantly ($p < 0.05$) greater mean survival (71.6 ± 6.0% and 78.3 ± 6.0%, respectively) than those receiving unenriched *Artemia* (48.3 ± 6.0%).

Mean standard length was also significantly greater ($p < 0.05$) in fry fed DC DHA Selco and DC Super Selco enriched *Artemia* (20.2 ± 0.3 and 19.7 ± 0.3mm, respectively) compared to those fed unenriched *Artemia* (18.1 ± 0.3mm). The results show that dietary n-3 HUFA are essential for optimal growth and survival of *Hippocampus* sp. and, based on the fatty acid compositions of the enriched *Artemia* used in this study, indicate that the level of dietary DHA supporting optimal growth and survival is greater than 9.3mg DHAg^{-1} dry weight. (School of Marine Biology and Aquaculture, James Cook University, Townsville, Queensland 4811, Australia).

Clove oil used as an anaesthetic

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Clove oil has been used for a number of years to anaesthetise fish in seawater. In fish farming, this is essential for basic procedures such as weighing, tagging, experimental work and for transport. It considerably reduces pathology risks from stress, injury and accident during handling (Keene et al. 1998). It has also been recently proposed as a better alternative to cyanide for the capture of live reef food fish (Erdmann 1999). Clove oil is distilled from *Eugenia caryophyllata* stems, buds and leaves. In Indonesia, it has been used on humans for centuries as a local anaesthetic (Soto and Burhanuddin 1995). The active ingredients are phenol derivatives, essentially the $C_{10}H_{12}O_2$ eugenol compound (Taylor and Roberts 1999).

In a study conducted on coral fish farming on Reunion Island using wild-caught juveniles, a clove oil experiment protocol was required to find a means of handling fish regularly and efficiently. A series of experiments on two fish species was carried out so as initially to determine the optimum clove oil quantity for use on fish weighing less than 10 g and, subsequently, the effect of fish weight and the species under consideration.

Material and methods

The method used consisted of introducing the active ingredient of clove oil into the fishes' gills through the water, i.e. 'anaesthesia by immersion' (Brousse 1974). The substance is absorbed through the gills and travels through the bloodstream to the central nervous system. The fish then goes through several anaesthesia stages ranging from balance loss to total motionlessness and ventilatory arrest (McFarland 1960).

In the first part of the study, clove oil from an agricultural cooperative was mixed with seawater at rates of 0.025, 0.050, 0.1 and 0.2 ml · l^{-1}. Ethanol, which is normally used as a solvent, was not used in these experiments. The anaesthetic was simply prepared by vigorously shaking a small flask of clove oil and seawater to obtain a whitish emulsion.

A total of 100 fish were anaesthetised in four batches of 25 corresponding to the four clove oil doses: 0.025, 0.050, 0.1 and 0.2 ml l^{-1}. The average and standard deviation were calculated for each set. A Krusskal-Wallis non-parametric test conducted on all four batches demonstrated that induction times differed significantly ($H = 55.5$; $P < 0.01$). Mann-Whitney mean difference tests were then carried out on pairs of batches, revealing significantly different induction times for 0.025 ml. l^{-1} doses as compared with the others. They fell by more than half from 0.025 ml l^{-1} to 0.050 ml l^{-1} but did not differ significantly thereafter as the dose increased. It should be pointed out that two specimens died at 0.2 ml l^{-1}, which may indicate the upper limit in this experiment. A 0.050 ml. l^{-1} dose was subsequently selected for the remaining experiments. It had the advantage of anaesthetizing the fish quickly with a small dose.

Induction times in terms of fish weight and species

The study on induction times in terms of fish weight was conducted using a 0.050 ml · l^{-1} dose of clove oil on 100 specimens weighing from 0.05 g to 9.7 g. The induction times observed ranged from 13 to 56 seconds with an average of 30.4 ± 9.9 s. A Pearson correlation test indicated that there was no significant link between induction times and anaesthetized fish weights ($Cp = 0.13$; $P = 0.09$). The weight factor, therefore, had no effect on induction times when a 0.050 ml · l^{-1} dose was administered to fish weighing less than 10 g.

Induction times were then compared for two species, *Valamugil cunnesius* and *Monodactylus argenteus* (Fig. 2). An average of 30.1 ± 10.8 s was obtained for 67 Valamugil cunnesius and 30.7 ± 7.9 s for 33 *Monodactylus argenteus*. A Mann and Whitney mean difference test revealed that the difference between samples was not significant and clove oil should, therefore, have the same effect on both species ($U = 1052$; $P = 0.23$).

Conclusion

Clove oil proved to be highly effective and easy to use on juvenile tropical marine fish. The 0.05 ml · l^{-1} dose selected in this experiment anaesthetised the fish in less than a minute and made it possible to handle them without any losses. Weight did not appear to have any effect on induction times in juvenile fish (< 10 g) and clove oil could even be used on small specimens weighing less than 1 g. No induction time difference was observed between the two species considered.

These observations may also apply to other juvenile fish. Methods that suit local conditions are becoming increasingly necessary for developing tropical marine fish breeding from spawners' eggs or wild-caught post-larval and juvenile fish. Clove oil, which is not well known or widely used, could become an alternative to the standard MS-222, Phenoxyethanol, Quinaldine or Benzocaine, which are hazardous, expensive, hard to come by in developing countries and sometimes less effective (Munday and Wilson 1997; Erdmann 1999). The results obtained may vary according to clove oil quality and active ingredient content, but this product has some potential in tropical aquaculture.

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What is STREAM?

STREAM is the acronym for *Support to Regional Aquatic Resources Management*, a rural livelihoods oriented initiative that will support government's poverty alleviation programmes. The STREAM Initiative was founded by the Department for International Development (DFID) of the UK; NACA, FAO and the Voluntary Service Overseas (VSO), and with significant partners in AusAid and DFID NRSP.

STREAM became operational in November 2001 with the appointment of its Director, Graham Haylor (author of the article on the next page and former Programme Manager of DFID SEA's Aquatic Resources Management Programme which was hosted by NACA). During this period, start-up activities included the formal entry into partnership agreements with the Governments of Vietnam and Cambodia. Pilot activities were done, focusing on assessment and capacity building, before the planned expansion to other NACA member countries.

With the start of 2002, STREAM has moved on to a wider sphere. UK's DFID had provided the seed money for a Trust Fund for STREAM's initial period; and this was followed up by research funds from DFID NRSP to study their improved policy on aquaculture service provision for poor people in India. An AusAid grant in support of STREAM, to begin on 8 April 2002, will see the expansion of the Programme to include, aside from Cambodia, Vietnam and India, the Philippines, Nepal, Laos, Yunan in China, Myanmar and some others. A regional TCP project has been formulated and will be submitted to FAO in April 2002. It will provide support and catalyze wider regional activities to enable greater regional participation and sharing in STREAM.

While planning for the launch of the Philippine and Nepal STREAM Country Offices and implementing the planned activities for Cambodia and Vietnam, the author and Project Consultants S.D. Tripathi and W. Savage went on an inception mission to India in March as a preparatory activity for the DFID NRSP Project. This article, while including a pictorial on what they saw, and the rural folk and environment in which they will implement the Project, summarizes the other locations of STREAM.

Threading the STREAM Components

Graham Haylor

Improving rural livelihoods in Cambodia, Vietnam, Nepal and the Philippines

Cambodia

Cambodia has a Human Development Index of 0.517; 4.3 million live on less than US$113 per year. In Cambodia, fish provides 70-80% of all animal protein intake and foraging for fish, crabs, shrimps, snails, frogs and green vegetables occupies nearly 90% of households. 36% of households live below the poverty line and every year a huge migration takes place within Cambodia to the Tonle Sap to trade rice for Trey Riel (*Henicorhynchus sp.*– a small cyprinid) and other small fish species to make prahoc (fish paste), a key component of seasonal food security for poor rice farmers.

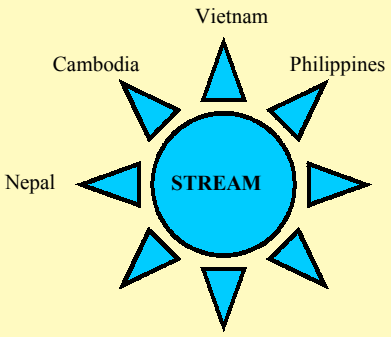
Until recently, millions of poor Khmer people who rely on capture fisheries for their livelihood and food security were excluded from the country's massive inland fishery.

Cambodia is radically changing the way it manages its fishery, including the creation of the Community Fisheries Development Office (CFDO) to manage the provision of greater access for poor resource users.

The Department of Fisheries has requested support in this process from the STREAM Initiative. A partnership agreement has been signed between STREAM, the Department of Fisheries (CFDO) and the NGO SCALE to support people, who are (potential) beneficiaries of new government service provision to play a role in the definition and development of those services.

STREAM has built national and provincial capacity in participatory and livelihoods approaches, piloted a process for learning about the livelihoods of farmers and fishers in order to support the reformulation of policy on fisheries management, established a communications hub to share lessons from and with others; provided a Management Consultant from Accenture, through the VSO business partnership scheme to help establish the new office and is providing digital literacy training through the Asia Pacific Regional Technology Centre.

Within this process, STREAM will provide examples of approaches and practices being discussed or implemented in other parts of the region, building links and contacts with other key policy development players and support lesson learning pilots.



STREAM partnerships

STREAM is an Asia-Pacific-wide communications and learning platform, promoting participation, communication and policies that support the livelihoods of poor aquatic resource users. Through its network of service providers, alliances and partnerships STREAM helps to find solutions to partners most complex and critical challenges. STREAM communications involves a suite of web-based initiatives, linked national communication hubs and physical networks.

STREAM has been established by a partnership between the Network of Aquaculture Centres for Asia Pacific (NACA) - an Intergovernmental organisation of 15 Asia-Pacific governments, the UK Government, Department for International Development, the UN Food and Agriculture Organisation, and the International NGO, Voluntary Service Overseas; with financial support from DFID South East Asia, the DFID Renewable Natural Resources Programme (NRSP), AusAID and FAO. STREAM is beginning to work in Cambodia, Vietnam, the Philippines, Nepal and India.

Vietnam

Between 30 and 45% of Vietnamese people are poor. Fish and aquatic resources play a key role in their diet, and aquaculture and fisheries management is receiving increased attention in efforts to eradicate hunger and reduce poverty. The Ministry of Fisheries , together with provincial organisations, donors international agencies and STREAM has developed a new poverty focused approach to support poverty alleviation through support to aquatic resources management (Sustainable Aquaculture for Poverty Alleviation - SAPA). The Ministry of Fisheries has entered into a partnership agreement with STREAM, to help support people who are (potential) beneficiaries of government service provision.

STREAM has built national and provincial capacity in participatory and livelihoods approaches, piloted a process for learning about the livelihoods of farmers and fishers, established a communications hub to share lessons from and with others; and is providing provided a Management Consultant, through the VSO south-south partnership scheme to help establish the new office and is providing digital literacy training through the Asia Pacific Regional Technology Centre. Through this, STREAM will provide examples of

DFID NRSP/STREAM 's focus on an improved policy on aquaculture service provision for poor people in India

approaches and practices being discussed or implemented in other parts of the region, building links and contacts with other key policy development players and support lesson learning pilots.

Philippines

More than 40% of Filipinos live below the national poverty line. Millions rely on capture fisheries for their livelihood and food security. The use of dynamite and poisons in fish capture is common, especially where few livelihood alternatives are available. The decentralisation of power has dislocated the Fisheries line agency from local development, sometimes impacting on sustainable management. The Bureau of Aquatic Resources and Fisheries (BFAR) and SEAFDEC AQD have discussed with STREAM the need for support to help tackle poverty and unsustainable practices. A partnership will soon be implemented between STREAM and BFAR to support people, who are (potential) beneficiaries of government service provision.

STREAM has commissioned a study of Aquatic Resources and Poverty in the Philippines and has agreed to support lesson sharing through a Communications Hub in Iloilo. Within this process, STREAM will provide examples of approaches and practices being discussed or implemented in other parts of the region, building links and contacts with other key policy development players and support lesson learning pilots.

India

About 500 million people in India live on less than US$1 per day representing one third of the world's absolute poor. The Eastern Plateau region of India is characterised by poverty and inequality, land alienation and seasonal migration. The scheduled castes and tribes are amongst the poorest communities in India.

Over the last six years, appropriate forms of aquaculture have been identified, introduced and tested with representative groups of poor people in Eastern India (by the Eastern India Rainfed Farming Project and the DFID Natural Resources Systems Programme "Integration of aquaculture into the farming systems of the eastern plateau of India" project. Multipurpose use of water resources including fish culture is now a dynamic part of people's livelihoods of 193 groups of poor men and women (over 4500 farmers) in the communities where the research was undertaken. These are poor women and men, typically belonging to scheduled tribes or castes, and many lack the means to produce sufficient food throughout the year. Their livelihoods are characterised by seasonal migration, exploitation and underpayment.

Aquatic resources management and its role in rural development especially amongst tribal groups is receiving increased attention from Indian government and the support schemes are being reformed in the 10th 5-year plan. The Fisheries Commissioner has invited the DFID NRSP project R8100 "Investigating improved policy on aquaculture service provision to poor people" under the STREAM initiative in association with NACA to play a role in reforming the Fish Farm Development Association scheme or suggesting a new "tribal" Rain fed fish farming component.

STREAM will work with tribal women and men, EIRFP (now Gramin Vikas Trust), the Department of Fisheries and elements within state and national governments to facilitate poor peoples to have a voice in the process of shaping policies from which they are to benefit.

Nepal

Nepal ranks 77th out of 90 developing countries on the UN Human Development Index (HDI), poverty is most acute in the rural areas, especially the western Tarai, hills and mountains (HDI 0286-0.414). Aquatic resources management and its role in rural development is receiving increased attention from His Majesty's Government Nepal, which has requested support from the STREAM Initiative. STREAM has commissioned a report on Aquatic Resource and Poverty in Nepal, and discussions were held in Khatmandu in March with Department of Fisheries Development (DOFD), the Nepal Agricultural Research Council, and the Agricultural Information and Communication Centre regarding their role and work, government policy and the formulation of the 10th 5-year plan. There was discussion of STREAM, especially the role of a Communications Hub Manager, National Co-ordinator, Country Strategy, and a regional overview of STREAM, including stakeholder networks and livelihood analysis work.

Government policy on fisheries and aquaculture is framed within a series of recent reports, plans and policy seminars. These include the 1996 report "Fisheries and Aquaculture in the economic development of rural Nepal", Nepal Fisheries Society; the 9th 5-yr plan (1997); a seminar proceeding (1999) Prospects for fisheries Development under the Agriculture Perspectives plan DOFD, and a Report on the Symposium on Cold Water Fisheries (2001). The government is now formulating its 10th 5-year plan, the sole objective of which is poverty alleviation. Fisheries receive about 1% of the agriculture budget. The National Planning Commission has also commissioned Special Programmes in 5 priority areas (Fisheries, Horticulture, Forestry and Herbs, Livestock and Watershed Management).

The potential for STREAM to add value to the on-going policy changes, especially the Special Programme in Fisheries Plan 2002, and in particular the component, which aims to provide opportunities for ultra-poor and displaced communities, was discussed, including logistics, a timeframe and our potential roles and responsibilities.

From left to right: Dr S.D. Tripathi, Dr Graham Haylor & Mr Bill Savage on their inception visit to Ranchi, Jarkhand.

Colleagues from Gramin Vikas Trust participate in the opening ceremony of a farmers fair in a village in Purulia, West Bengal.

Villagers enjoying a fun moment during speeches at the farmers fair

Farmers at a stall exhibiting GVT projects in the tribal village.

Village girls performing a dance for the audience

The men and boys bringing in the catch.

Dr Tripathi has a key informant discussion with the villagers

Mr Prabhakar Mahato, the village "jankar" (expert), Mr Savage & Mr Gautam.

The Federation of European Aquaculture Producers (FEAP) is a forum that brings the industry together to debate issues of mutual interest. The forum allows industry to develop a unified position on important issues and to communicate effectively with relevant authorities.

Could a similar federation be beneficial in Asia ? We asked Mr Courtney Hough, President of FEAP to speak about the potential role and benefits of such an organization. This is what he had to say.

Organising and Operating a Regional Federation of Aquaculture Producers

Courtney Hough

A regional Federation is very different from a local or National Association in both its goals, its scope of activities and, hence, its organisation and direction. Inevitably, the first question posed is "Why create a Federation" where the answer can only be provided once one knows the framework of action, the goals and the chances of attaining these because of the existence and work of a Federation.

The Federation of European Aquaculture Producers (FEAP) is currently composed of 30 National Aquaculture Associations from 22 European countries, having developed from only four members of four countries in 1968.

The core goal of the FEAP is to provide a forum for the debate of issues common to its members and to communicate the results of such discussion to the appropriate authorities. Providing this possibility for fair and equitable debate to sectoral representatives gave the basis for the initial development of the Federation, reinforcing the potential for efficient communication between the Member Associations and developing clear opinions and arguments on matters of importance to the profession. One of the key objectives is the effective communication of these opinions to the authorities, which vary, dependent on the topic, and cover all aspects of aquaculture operation.

For example, one of the most important authorities for the FEAP is the Commission of the European Community, particularly the Directorate General (DG) for Fisheries, which has a specific brief concerning European aquaculture. However, other DGs, which have responsibility for Sanitary and Consumer issues (DG SANCO), the Environment (DG ENVIRONMENT) and Trade (DG Trade) also have direct relations with the aquaculture sector.

A National Association will have privileged links to its own National authorities and bodies, such as Universities and Environmental agencies. A regional Federation rarely has these privileges partly because of the absence of corresponding regional structures but also because its initial reason for being is usually less directly practical in nature and more one of communication and liaison with its members. Defining goals and scope of action for a regional Federation is quite difficult, since it is only by its achievements that it will inevitably be measured by its members and interlocutors. Growth and the development of influence takes time and effort.

It is important for a regional Federation to recognise the interlocutors that are appropriate to its function and to take the steps necessary for the establishment of its own contribution and authority. For example, outside of the links established with the European Commission, the FEAP also maintains liaison status with the FAO of the United Nations, particularly for the purposes of the European Inland Fisheries Advisory Committee and the Aquaculture section of the General Fisheries Council of the Mediterranean. The establishment of the Aquaculture sub-Committee of the Committee on Fisheries is of evident interest. These links enable the Federation to be informed on many of the wider issues affecting the sector and often allow access to specialist professional input.

There has been a significant increase in the requirement for consultation with the professional aquaculture sector in recent years, reflecting changes in government policies and the requirements of governance, for which a recent White Paper was published by the European Commission, where the higher involvement of stakeholders and the move towards self-regulation are important issues. This attitude is also reflected in the development of international and interprofessional networks, which may be thematic or specific in nature and where input from the professional sector is required.

More recently, it has been realised that market expansion and globalisation imposes better understanding of the markets and increased marketing efforts, particularly for the attainment of improved market stability and where the public image of a sector is increasingly important within an overall development scheme. When issues such as international trade and market stability, sustainability, development of standards (including organic farming and ecolabelling issues), governance and self-regulation have to be debated, with the professional point of view in mind, this cannot be done in a vacuum.

These are topics that pass frontiers and need consultation within the profession on an international basis. For the voice of the producer to be heard, it is essential to be able to provide a defendable sectoral opinion that has authority and cannot be accused of simply defending national interests. A Federation must be able to provide apolitical positions, based on science and/or good sense, that support the sector and its development.

Structure

A Federation can only be made up of members who have a similar or identical legal status and who share common goals and activities. In the case of the FEAP, only National Aquaculture Associations can be considered for membership. This statutory position excludes individual companies and local Associations.

Meetings of the Federation

For its basic purpose, the FEAP organises 2 statutory meetings for its members each year, one of which is the Annual General Meeting. These meetings are held on a rotary basis in the countries of the Member Associations, the host assisting the organisation of each meeting.

Within each meeting, different Commission meetings (open to all Members) that treat specific sectors or subjects that are represented by members (e.g. Salmon, Trout, Environmental issues, Fish Health, Marketing). This allows improved international understanding of species, topic or country-specific issues. It is perhaps worth remembering that it is not the role of a Federation to interfere in any issues of a National nature since these are the responsibility of the National Association and this hierarchy must be respected.

Where continuous attention is required or a specific problem is identified, Working Groups may be created. As an example, the FEAP currently has Working Groups for Large Trout, Mediterranean Aquaculture and Fish Health. A previous Working Group was charged with the development of the FEAP's Code of Conduct for European Aquaculture (approved and published by the FEAP in June 2000).

Additional actions

Research, Training, Development

Within Europe, the existence of several important RTD programmes, grouped within the European Framework Programme for Research, has allowed the FEAP to develop an active role within a range of projects. The common point to these is that the goals and results are applicable to the whole of the European fish farming sector, as represented by the FEAP.

Such projects include:

- *Aquaflow* – the dissemination of the results of EU sponsored research projects on aquaculture (EU RTD project);
- *Maraqua* – a review of environmental legislation and issues affecting European aquaculture (EU RTD project); and
- *Assisting the development of training programmes and skill developmen*t (AquaTnet and Pisces) (EU Leonardo da Vinci programme).

While the FEAP has been the manager of some projects, generally it is incorporated as a partner in order to assure communication to the production sector, as an information dissemination activity. Providing this facility, access to and communication with the profession is an increasingly important role for a Federation.

Federation-led actions

The FEAP led the development of a project for managing price and production data within the European aquaculture sector – an action that was partly financed under the Common Fisheries Policy – in order to collate the data from the different countries under common conditions (condition and value). Data from this facility is used for the development of the FEAP reports on this subject. The FEAP website (www.feap.org (which is currently being redeveloped)) provides a window on FEAP activities for professionals and the public alike. This is an essential part of the public presence required of a Federation.

Perhaps the most important element developed recently is an action entitled 'Aquamedia', a project which is being developed for the purpose of informing the general public of what aquaculture really is, does and contributes. This project has been started using finance solely from within the industry and is a truly international action. Its activities will be wider-ranging and cover 'products' that will be provided on the Internet as well as paper and CD-ROM support.

Benefits of a Federation

The benefits of establishing a Federation are not immediately clear at the start since its actions tend to be more general and medium to long term in effect. For the FEAP, the immediate benefits to the Member Associations include the ability to meet and discuss issues of common interest on an international basis.

The key benefit of a Federation is to be able to give to its members the facility for informed debate and a platform for unified opinion. The cornerstone of any Association or Federation is the statutes; these have to demonstrate equity in structure and decision, enabling the authority of opinion.

The advantage of providing a common voice for a Regional sector is self-evident, particularly in Europe where the European Commission plays such an important role in determining legislation and actions that directly affect aquaculture within the European Union.

The creation by DG Fish of the Advisory Committee on Fisheries and Aquaculture (ACFA), a body that allows direct consultation with the Commission, has placed increased importance on the views of the FEAP, which in turn has imposed increased responsibility on the Establishing and maintaining links with international organisations involved with aquaculture provides the information and awareness of important topics that affect (or will affect in the future) the profession. Providing information on these to members should also be seen as a priority for a Federation, preparing for debate where necessary.

The involvement in research and training programmes is made for a similar reason, while improving the speed and efficiency of the transfer of results to the profession must be seen as a key goal.

As the sector has developed in Europe, it has been increasingly recognised as an important player and contributor to the fisheries sector. It is the sector's responsibility to 'stand and be counted' and it is the FEAP's responsibility to facilitate this position. This means knowing what has happened, is happening and is going to happen.

A Federation also allows the achievement of projects or work of a scope that a National Association cannot undertake. Projects such as 'Aquamedia' or international information dissemination are typical of this position and it is the role of a Federation to identify such actions and whether they are appropriate to follow.

There is no doubt that by widening the activity of the FEAP to include practical, wide-ranging actions as a supplement to its forum activities has increased its strength and influence.

Lessons learnt

Establishing, operating and managing a Federation requires commitment, finance and results. Since seed finance has to come from within the sector, a Federation of Associations has to be financed from the individual Association budgets.

This means that the Federation budget is unlikely to be important – at the beginning. While this may limit the fixed structure of the Federation, it should not inhibit the basic goals targeted.

The provision of a common voice is one of the important benefits of a Federation but this can only be obtained within an equitable forum. Providing the opportunity for the smallest Association to voice its opinion alongside the largest has to be respected.

It should also be noted that within the FEAP, whose members speak 17 different languages, the meetings are held in one language (English). Although this can create some difficulties and misunderstandings, it has proven to be a cost-effective and efficient way of working.

The development of projects that involve the Federation can provide additional finance but a Federation's existence cannot be based solely on projects. It is essential to have a good balance between core activities and projects in order to respect the basic reasons for creating the Federation. Development has to be placed after achievement of the initial goals.

It is important to recognise the actions and the links that can provide a service to the Members and which they could not obtain themselves individually. As an example of this, the FEAP has established strong links with the European Aquaculture Society and AquaTT (Aquaculture Technology and Training) which are reflected in a number of different ways – participation in joint network projects, distribution and dissemination of information, participation and development of workshops and conferences.

The success of a regional Federation can also be measured in terms of participation, encouraging the involvement of Member Associations and their representatives, without aspiring to be competitive to their function. Maintaining a complementary balance between objectives and actions and providing the services anticipated are integral to successful operation.

After 33 years of existence, the forefathers of the FEAP have recognised the benefits of their foresight. The Federation provides their platform for developing and resolving international issues that affect their activity, it gives them a common and important voice of opinion and allows the sector to move forward in ways they did not envisage at the time. While no crystal ball is perfectly accurate, one has to foresee that the global aquaculture sector must change and adapt to new circumstances, on many different fronts, and that effective and successful regional Federations are needed by the profession in order to assist the long term sustainability of the aquaculture profession.

A Note on Enhancing Access to, and Meeting, Market Requirements for Aquaculture Products*

The aquaculture sector in Asia-Pacific has been making significant contributions towards alleviating poverty by promoting food security and providing livelihood opportunities particularly in rural areas. In many countries, the sector has been a provider of foreign exchange earnings. There is every reason to believe that the sector could increase the above-mentioned contributions to even higher levels. Given appropriate enabling conditions, producers and exporters could gain access to markets for aquaculture products and/or enhance their competitiveness in both local and export markets.

Issues and recommendations

Most of the relevant issues relating to market access and market requirements were raised during the deliberations on Thematic Session 3 (Aquaculture products: quality, safety, marketing and trade) at the *Conference on Aquaculture in the Third Millenium.* Following its deliberations, the *Conference* recommended the following:

- For long term viability and sustainability, commercial aquaculture development must be market driven, taking into account consumers' requirements.
- Trade in aquaculture products should be further liberalized, including the elimination of barriers and distortions to trade, such as duties, quotas and nontariff barriers in accordance with the principles, rights and obligations of the WTO Agreements and other international agreements.
- The creation of efficient marketing systems, in which prices are determined by supply and demand in order to ensure economic efficiency and sustainability, should be facilitated.
- Standards applicable to international trade in aquaculture products should be harmonized in accordance with relevant internationally recognized provisions. On a national level, safety management systems including Good Agricultural Practice (GAP) and Good Manufacturing Practice (GMP), should be in place to ensure that aquaculture products are suitable for human consumption.
- Collection, analysis and dissemination of relevant information should be facilitated to enable producers and industry operators to make informed decisions and ensure consumer confidence in the food safety of aquaculture products.
- Fish trade measures to protect human or animal life or health, the interest of consumers and the environment, should not be discriminatory and should be in accordance with internationally agreed-upon rules.
- Industry at each stage in the market chain must take primary responsibility in the production and distribution of safe aquaculture products and by-products, with due consideration of the polluter-pays principle.
- Production systems must allow traceability of product ingredients, including information on packaging, processing, harvesting, growing conditions and water quality, aquaculture stock, feed and health programmes.
- Labeling of aquaculture products should follow recommendations and codes of practice in line with e WTO and *Codex Alimentarius* requirements.
- Labels of aquatic feeds should include complete information on additives, growth promoters and all other ingredients, including the possible use of genetically modified organisms.
- Safety assessment based on risk analysis and the precautionary approach should be carried out prior to market approval, including products from modern biotechnology.
- International and interregional cooperation in the field of safety, quality and trade in aquaculture products should be encouraged.
- Alternative market approaches, such as fair trade and organic farming, should be encouraged on a national and international level.

Related recommendations emanate from a recent survey on Asian and Pacific fishery trade undertaken by the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP).* These include the following general recommendations:

- Appropriate measures to overcome difficulties and to develop the fishery trade should include sustainable development and utilization of available resources, diversification

of products and markets, value addition, and joint ventures in processing and marketing.
- Simplification of trade policies and procedures.
- Standardization of product quality.

The survey also included the following specific recommendations:

- Aquaculture has proved to be a lucrative sector provided environmental management is sound and there are no serious disease, feed and fry constraints.
- Despite improvements in infra-structure and upgrading in processing and packaging policies, especially for frozen and chilled products, the majority of Asian and Pacific producers are still exporting raw materials and semi-processed products. Processing facilities in these countries need improvement and their personnel need to be trained in stringent quality control measures in order to capture a better share of export markets.
- In most Asian countries, fish inspection programmes are basically used as a means to assure the quality of exports, with little emphasis on products marketed locally. Tightening of import inspection system in developed markets, as well as a growing awareness and demand for quality in the home markets of the Asian and Pacific region, will provide the impetus to more industries in the region to upgrade their processing facilities to serve both local and overseas markets. The pace of investment in the modernization of processing facilities in many countries would also need to be increased in order to upgrade these facilities.
- As the Asian and Pacific region is a growing, dynamic market, the potential for producers/exporters of fishery products exists and this requires in-depth study.
- To encourage better flow of products within and outside the region, it is necessary to review existing tariff levels, export-licensing policies, export duties and other non-tariff barriers that still exist in a few countries.

Proposed action

It is clear from the above that, in order to realize the growth potential of their aquaculture sector, Asia-Pacific countries will have to ensure that their products gain access to and be competitive in the domestic and export markets for aquaculture products. To achieve these, their products should meet international standards of quality and safety as well as conform with country specific import regulations designed to protect the environment or particular interest groups such as the national industry or the consumers. The key role of the farmers and aquaculture entrepreneurs in maintaining high levels of product quality and ensuring good practices, appropriate labeling, among others, is evident. Certainly, enabling support should be provided by the government which should include continued collaboration with the rest of the world in developing and setting aquaculture product quality and safety standards and in ensuring implementation of international agreements in this regard. Governments will also have to take an active part in international cooperation on issues relating to either ease of access to markets or trade distortions caused by tariff and non-tariff barriers, subsidies and the like. Finally, the need for research, training and advisory services has been included among the recommendations, indicating that specialized agencies and other intergovernmental organizations would have key supportive roles to play.

In this regard, the NACA secretariat is well-placed to initiate action to draw up a project proposal on the topic of this paper and implement the project as soon as funding is secured. The project envisaged should include a combination of research, analysis and consultations at national and regional levels leading to the development and/or strengthening of national capabilities in gaining access to and in meeting the requirements of markets for aquaculture products and in dealing with trade-related issues covered by international trade agreements and negotiations particularly those falling under the WTO umbrella as well as environmental agreements. These activities should be implemented by the NACA Secretariat in collaboration with the national focal agencies and Collaboration Centres and other concerned stakeholders including the fish farmers and fishery products producers/ exporters. Appropriate inputs should be solicited from FAO, UNEP, WHO, WTO and other concerned national and international organizations including ADB, ASEAN, ICLARM, Infofish, SEAFDEC, UNDP, and others.

This article was prepared by Dr. B.R. Rola, adjunct professor at the UPLB Institute of Strategic Planning and Policy Studies, College of Public Affairs, Philippines, retired ESCAP social development officer, and Friend of NACA, following the Regional AquaBusiness Seminar held by NACA in collaboration with the Malaysian Department of Fisheries in Langkawi last January 2002. Dr. Rola may be reached at jessrola@hotmail.com.

*Footnote: * UNESCAP (1996). Promoting exports of fish and fishery products in selected island developing countries of the ESCAP region (ST/ESCAP/1677). UN, Bangkok. pp. 19-57.*

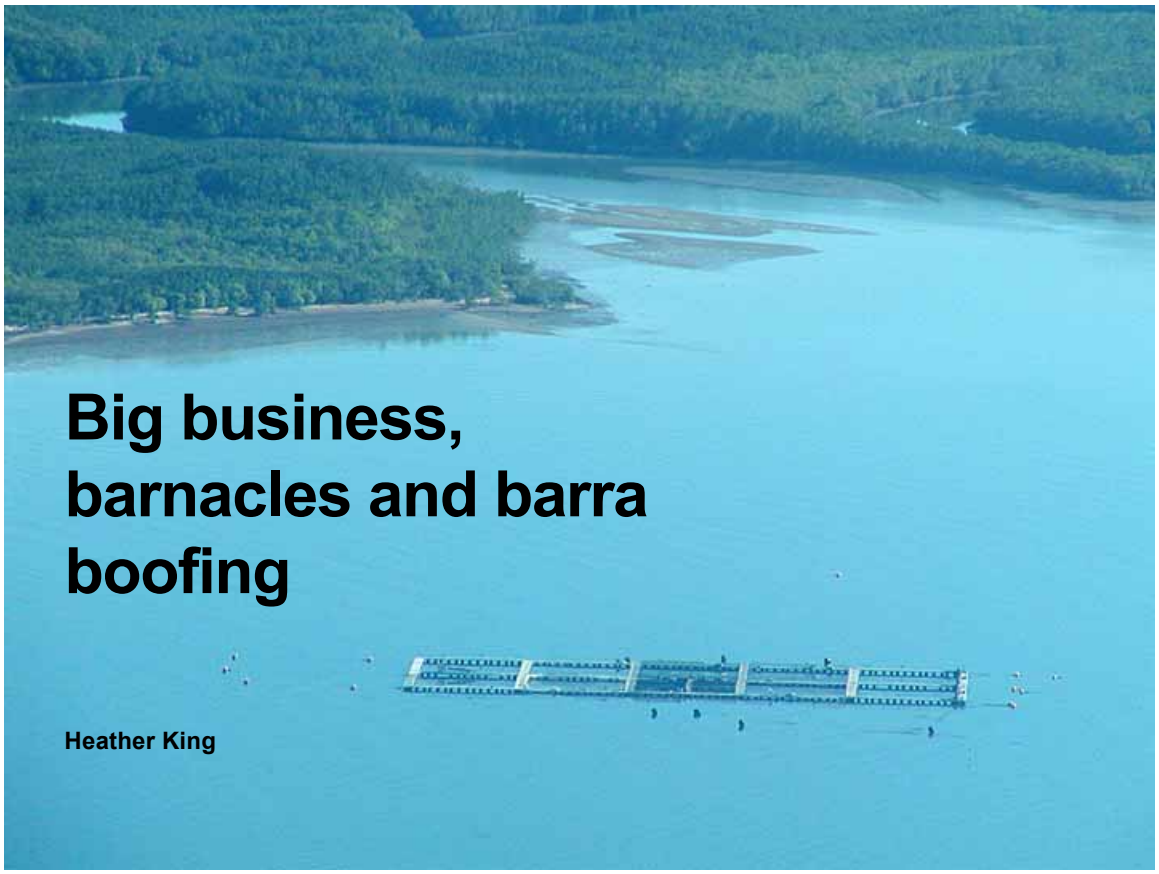
Fishtech abalone feed trials

In the mid 1990s Anne E. Fleming and Patrick Hone published a paper "The Development of Artificial diets for Abalone", an exhaustive account of the work in this field at the time which was largely research-based. The paper reported, "Before further development of artificial diets can occur, both economically and nutritionally, it is important to establish an understanding of the composition of existing artificial diets and the motive for the source and level of inclusion of the respective ingredients". At that time the lowest cost of the "artificial" abalone food was well over US$4/kilo (most were higher) and FCRs were generally poor.

After nearly 40 years of developmental work and experimentation, manufactured abalone food has, just in the last few years, arrived as a viable and profitable alternative to feeding wet and dried kelp. There are more than 8 large, upwards of 20 smaller, and countless "on farm" abalone food producers worldwide. Many of these are in China and are not easily or readily available for shipment. South Africa, Australia, Taiwan, New Zealand and Iceland make up the majority of viable producers today. The C&F price has come down from US$4/kilo to nearly US$2/kilo, while at the same time the formulations, protein sources, energy sources and quality of the pellets are allowing FCRs down to 1.3:1. At these levels of cost and performance, in most worldwide locations, manufactured abalone feed can and does hold its own alongside wet or dried kelp, after consideration of higher labor, lack of automation, waste, and disease often associated with wet kelp.

There is no one diet best for all abalone species or all water temperatures, however formulations are now available from a combination of manufacturers to range from tropical to cold water abalone and from 3mm seeds to150mm grow-out. In California FISHTECH has been testing available abalone foods since 1994.

They recently completed what they believe to be the most exhaustive commercial comparison tests of available abalone feeds (in this case the on-growing of red abalone), testing those made in South Africa, Australia, Iceland, Chile, China and Taiwan. These comparisons continued from May of 2000 through July 2001. The results of these growth trials are summarized in the chart (all food producer names removed as our tests are as yet unpublished). However, Fishtech claims that the top line represents a proprietary FISHTECH formulation. Contact abalone@ix.netcom.com.



Big business, barnacles and barra boofing

Heather King

Fish farm manager Steve Matthews sports a big grin as he says, "it's called barra boofing, because that's exactly what it sounds like." It's the end of the day, and as the sun is setting over the steel cages of the first tropical sea farm in Australia, the prize barramundi (the Australian term for Asian seabass) attack another school of sardines that have made the mistake of swimming through the steel mesh.

"It's like dessert for them" says Steve, who speculates that the caged barramundi's diet is supplemented each day by "literally thousands of sardines."

The ten steel cages form Nutreco's Northern Territory Sea Farm. The farm is located in a large pristine inlet called Port Hurd, on the western side of Bathurst Island. Bathurst and Melville Islands are two of Australia's largest islands located 100 kilometres north of Darwin.

The islands are owned by the Tiwi, an indigenous community that has been proactive in attracting business to their islands in an effort to release their people from dependency on the welfare system. The relationship between Nutreco and the Tiwi Land Council was established in 1998 when Dr Craig Foster, Nutreco's Australian manager, progressed an idea to farm finfish in tropical waters.

Dr. Foster had extensive involvement with the development of the salmon industry in Tasmania. His vision involved transferring salmon sea cages technology to tropical waters where growth rates are high. He considers that the selection of Bathurst Island as the optimum environment for a pilot project was relatively simple. Port Hurd offered

Top photo: The farm consists of ten pens, this will be increased to 12 to achieve 100 tonnes production per year. The pens are 24 by 24m with a volume of 3500 cubic meters each. One of these pens has been split into 4 x 12m x 12m pens for nursery use. The fish come from the hatchery in Darwin at around 100mm and go into a nursery pen. After 3months they are then transferred to the grower pens.

Feed being loaded onto the work barge.

year round water temperatures of 28 degrees, masses of tidal water, proximity to Darwin as a major service centre, and the support of the Tiwi Land Council who were cooperative with an established land base available for lease.

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The Northern Territory Government embraced the Nutreco initiative as it provided a catalyst to further develop the Darwin Aquaculture Centre. At that time the centre was primarily a research facility, but with the establishment of the sea farm a 4 year contract was signed for the centre to supply enough fingerlings to meet the projected target of 1000 ton of harvested barramundi each year.

The journey to the sea farm takes the fingerlings 14 hours by road and barge in a modified milk tanker. Cohorts of 100,000 fish are put to sea every two months, and as at February 2002 the farm houses 350,000 barramundi ranging in size from 20 grams to 3 kilograms. The transport system works well, with fingerlings adapting quickly to their new environment. Health issues of nodavirus, enteritis and blood fluke have been identified, but have been managed successfully to date.

One of the resident saltwater crocodiles. A 4.5 metre specimen called "Elvis" lives in the vicinity.

Even before the first fish were put to see in March 2001, Nutreco staff were abruptly reminded that systems needed to be specifically adapted to deal with the environmental conditions of the site. The area is exposed to monsoons for 5 months of the year, and cyclones can occur. In addition to this, Northern Territory Manager Jim Smith says that the bay has "extremes of tide and current." While this water flow is fantastic for fish health and vigour, it was the power of these currents that resulted in the initial mooring system being inadequate. The system was completely overhauled, and reinstalled with support that will hold in extreme cyclonic conditions.

The net system too has evolved in response to site conditions. The Tiwi warn seafarers about "Elvis" a 4.5 metre salt-water crocodile that is regularly sighted off Cape Helvetius at the mouth of Port Hurd. Elvis hasn't been seen near the sea farm to date, but many of his relatives have. It was these crocodiles, as well as the presence of tiger sharks, that dictated the need for the fibre nets to be modified with a steel mesh system. "The predator nets weren't predator nets," said Smith, relaying a story about a 3 metre shark that was caught inside the pens.

Rapid fouling of nets was another issue that was not anticipated. The eco-system that has taken up residence in and around the farm comprises sea creatures of all shapes and sizes. At the smaller end of the scale are barnacles and amphipods, which rapidly took up residence and muddied the nylon netting. "The nets were fouling within a week period, and creating enormous workload for staff", says Smith. The evolution to steel nets has addressed the rapid fouling problem, and made net management a simpler and less time consuming task. The sea farm is serviced from Barra Base. The leasing of this land station is the key formal agreement binding Nutreco and the Tiwi Land Council, although there are options in place for further

The farm's workboat.

involvement by the Tiwi once the project has been proven. From the outset of the project it was clearly understood by Nutreco that employment and training of Tiwi was a priority.

At the current time, five Tiwi and four European Australians are employed. Smith says, "The company does what ever it can to support the community, particularly in relation to vocational training, island services and coastal issues."

Barra Base is an open troppo style building on stilts nestled on a white sandy beach, surrounded by coconut palms. The constant hum of the generator and equipment noise belies the isolation of the place. Accessible only by water, it takes the farm staff that work week on, week off, an hour by air and sea to reach their destination.

Tiwi ceremonial Pukimani' pole in front of the lodge where staff live while working on the farm.

Staff feeding fish in one of the steel nets. The feeder is driven by a 5HP Honda 4 stroke engine coupled to a firefighting pump. The feeder has the capacity to feed up to one tonne of pelleted feed in 20 minutes.

Visitors to the Base are often in awe of the worker's environment. Barra Base was previously a fishing resort, and in this idyllic environment, Nutreco provides all meals, cleaning and laundry. "We need to look after our staff," says Smith, "they work long hours in a harsh environment." Indeed, staying overnight exposes you to a bevy of biting insects, relentless heat, an endless stream of ants invading all things sweet and wet, and sets of the spooky red eyes of Elvis's relations watching quietly from the water line.

The work on the farm is dictated by the tides. The extreme currents associated with spring tides dictate that most water work needs to be done during the neap tides, when 12-hour days are not uncommon. Such long hours and physical work are challenging for the farm staff. Despite this, the farm has a stable workforce, and Steve Matthews says that the Tiwi workers find "pleasure in working on the water, particularly in witnessing the impressive food chain attracted to the outside of the pens". "They are quiet, polite, amicable people," says Steve, "who never complain when mundane tasks are expected of them."

The Tiwi Land Council is involved in the selection of workers, and priority is given to Tiwi from the local clan, in the hope that the affinity they traditionally have with their land will be invigorated. "Whenever they get the chance they go off doing their thing," says Paul Basher, leading hand, "looking for turtle eggs, pig shooting or fishing." Farm worker Josh Pautjimi says he spends most of his spare time mud crabbing or fishing in a place he describes as "his home."

All this happens under the watchful eye of traditional owners, who were contracted during the developmental stage of the project to provide a part-time presence at the Base in order to assist in bridging any cultural differences. The traditional owners are extremely supportive of the sea farm, as they believe that the establishment of "big business" on their islands will provide a way forward for the younger generation.

The sea farm is currently making the transition from a pilot project to a commercial operation. Full scale weekly harvesting is due to commence with the 3 kg fish in May 2002, after a grow out period of 15 months. The systems for grow out continue to evolve, but Smith says that the "main focus of the operation is now on development of harvesting processes, and marketing of the product." A trial harvest was conducted in November 2001, and this process resulted in product being marketed in all Australian states. Feed back from the wholesalers was extremely positive, and "Marine Harvest Barramundi", with the identifiable taste of the sea, is already being sought after.

Staff moving feed on the pens

Day to day life for farm workers at Port Hurd is at the mercy of Mother Nature. For most of the year the workers go about their daily routine, sometimes oblivious to the majesty of the tropical environment around them. On a few days however, with 50-knot winds roaring through the cages, the farm is unapproachable and the fish don't get fed. Or do they, as that extensive eco-system in the turbid water is left to nature and the peculiar sound of "barra boofing" is lost somewhere between the howls of wind.

For further information on this story please contact Heather King at smithprops@bigpond.com

Induced spawning of *Pangasius sutchi* with pituitary extract

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The main species of Pangasid catfishes recently adopted for culture with Indian Major Carps are Yellowtail catfish (*Pangasius pangasius*) and Sutchi catfish (*Pangasius sutchi)*. These fishes were introduced into the farming system of Bengal from Thailand through Bangladesh in 1994-95. Though carnivorous at an early stage, the fish are compatible with Indian Major Carps from five days onwards and can grow to 3 kg/year on a balanced diet[1,2]. These fish have already established their importance as profitable species in aquafarming of Bengal. As a result of its remarkable growth rate (almost one kg in 90 days), now there is much enthusiasm among the fish-breeders and farmers of Bengal for its artificial spawning and culture. The demand for its seed is increasing by day.

In view of the increasing demand for *Pangasius sutchi* seed we tested techniques for induced spawning and larval rearing of this fish.

Technique for induced spawning

Brood fish were raised in farm ponds (area 2,500 m^3) from fry stage using a high protein balanced diet composed of cereal waste (25%), rice-bran (20%), mustard oil cake (15-20%) broken grain (25%) and animal meat (10-15%). The diet was provided 2-3 times per day at the rate of 5% of body weight. To check growth rate the percentage of animal meat was reduced as per requirement. The fish attain sexual maturity at four years when they normally reach a size of 7 kg. However, for the convenience of breeding the weight of brood fish we used was restricted to 1.5 to 2.0 kg with intensive stocking.

Males and females are easily distinguished particularly around April. Egg-bearing females are identified by their big, soft and distended belly with swollen and reddish pink vent (Fig. 1).

Males could easily be identified by their reddish genital opening and oozing of milt, when the abdomen is pressed[3].

Pangasius catfish. This specimen comes from a farm in Myanmar, close to Yangon.

As with clarid Catfish only carp pituitary extract (CPE) was used as the agent for inducing spawning. The results were promising. There are also reports regarding the successful use of human chorionic gonadotrophin, (HCG) and LRH-A in combination[3, 4].

A stimulatory first dose of 1.5-mg CPE/ kg body weight was injected into mature females (Fig 2). After 5-6 hours the second resolving dose of 6 mg CPE/kg body weight administered to females. Males were injected at the rate of 1 mg CPE/kg body weight at the same time as the second injection to female. In the case that female broodstock failed to reach the peak of maturity, the stimulatory dose would be increased to 2-2 mg CPE/kg body weight. The resolving dose in such situations would be 9-10 mg CPE/kg body weight.

Males were given a single resolving dose of 2 mg/kg body weight at the time of second injection to female. Variations in environmental temperature have a strong effect on the effectiveness of the dose. When temperature rises above 30^0C less CPE is required and more is needed when the temperature falls below 28^0C.

Breeding starts from April and continues until mid September. One brooder can be used at least two times during the same breeding season. After injection the fishes were returned to their respective cement tanks or hapa.

Spawning occurs after an interval of 5-6 hours. Both natural spawning and stripping is possible, but as the eggs are adhesive in nature stripping was considered best (Figs. 3 to 5).

Fig. 1. Mature female Pangasius sutchi *taken for injection (top).*

Fig. 2. The first injection to the female (bottom).

Fig. 3. Stripping the female

Fig. 4. Stripping the male.

Fig. 5. Eggs and milt are mixed with a feather; water is added.

Fig. 6. Fertilized eggs are mixed with milk solution to remove their adhesive covering.

Table 1. Positive fish response to trials after second injection.

Date	No. of females per trial	Average weight of females (kg)	Does of pituitary extract per kg body weight			Response to treatment (ovulation + fertilization) %	Hatching %
			Male	Female			
				1st	2nd		
5/4/2000	3	1.5	2.0	1.5	8.5	70-89	90-92
9/4/2000	3	2.0	2.0	1.5	8.5	75-90	90-92
15/4/2000	2	2.5	2.0	2.5	8.0	80-96	95
20/4/2000	3	1.8	2.0	1.5	8.5	80-89	95
25/4/2000	2	1.7	2.0	1.5	9.0	85-98	96
28/4/2000	3	2.5	2.0	2.5	8.0	85-92	90

We rinsed eggs in milk powder solution in aluminium hundi to remove the adhesive gelatinous covering of the fertilized eggs (Fig. 6). We prepared the milk solution by adding 200 ml of milk in 30 liters of water for 20 minutes. Afterwards the fertilized eggs were transferred to a Chinese hatchery.

Effectiveness of the technique

In all trials, the fish responded positively and ovulated within 5-6 hours after the second injection. The fertilization rate ranged from 95-100%. The fertilized egg doesn't swell as with carps and hatched within 24 hours at temperature ranges between 30-32^{0}C. Temperature was a prime factor for fertilization and hatching.

There are several other reports of the successful breeding of *P. sutchi* in Indonesia and Thailand[5]. According Saidin and Othman[4] the hatching period ranged between 24 to 26 hours at a water temperature of 28-32^{0}C with ovulation occurring in between 70-80% and with a survival of hatchings from 30-45%. Milt from one male is sufficient to fertilize the eggs of three to four females. The dry method of egg fertilization was followed. They also found that the hatchlings became cannibalistic if sufficient food is not available after 3 days of hatching.

We fed our hatchlings on lactogen for the first 48 hours. The hatchlings become carnivorous from about 72 hours and at this stage weigh 500 mg. We fed earthworm dust three times day continuing up to 5-8 days. After 10 days we fed soyabean dust as supplementary feed. Afterwards we transferred the hatchlings to a rearing pond with natural feed.

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Windmill software monitors environmental conditions for fish farming research

The Seafish Industries Research Station in Scotland is studying the farming of cod, hake and halibut in a recirculating system. The station pumps around 110 tons of seawater per hour into their tanks. Monitoring and maintaining this flow and other environmental conditions is essential to their success. To achieve this they have chosen a Windmill Software system.

The Windmill system continually monitors the temperature of the air and water, flow rate, dissolved oxygen concentration, salinity, pH, light and water levels and various alarm switches. Windmill provides mimic displays of the site showing pictures of the tanks and their current data values. Every 30 minutes the software logs the data to the computer's hard disk.

It is extremely important that alarms are raised when conditions fall below optimum. Windmill lets the researchers set thresholds which, when crossed, cause an audible alarm to sound on site, and an auto-dialler to telephone staff who may be off-site. The alarm thresholds can be set for individual measurements, with delays if necessary before alarms are triggered.

A computer running Windmill broadcasts its data values over the site network using the Windmill Repeat program. Each department can therefore log their own data sets incorporating data gathered both locally and around the site. The monitoring equipment communicates with the software over microlink units enabling the equipment to be up to 1 km away from the PC. Future versions are planned to enable remote monitoring over the Internet.

For more information visit http://www.windmill.co.uk/fish.html or email sales@windmill.co.uk, Fax +44 (161) 833 2190.

What's new in Aquaculture
News, products and announcements

Book reviews

NACA publications

For orders please contact the Publications Officer, NACA Secretariat, PO Box 1040, Kasetsart Post Office, Bangkok 10903, Thailand, Fax: 66-2-561-1728, publications@enaca.org. Please note that most recent NACA publications are available for FREE download from our website (given below).

Asia Diagnostic Guide to Aquatic Animal Diseases

Bondad-Reantaso, M.G., McGladdery, S.E., East, I., and Subasinghe, R.P. (eds.)

The Asia Diagnostic Guide to Aquatic Animal Diseases is a comprehensive, up-datable diagnostic guide for the pathogens and diseases listed in the NACA/FAO and OIE Quarterly Aquatic Animal Disease (QAAD) Reporting System including a number of other diseases which are significant in the Asia region.

This 240 page volume is divided into four sections, with Section 1 on Introduction, Background, Scope and Purpose, Guide for Users, Health and Aquatic Animals, Role of Diagnostics and Levels of Diagnostics; and Section 2 to 4 covers three different host groups, i.e. Finfish Diseases (Section 2), Molluscan Diseases (Section 3) and Crustacean Diseases (Section 4). Each host section commences with a chapter on "General techniques" which covers essential starting points that will enable prompt and effective response(s) to disease situations in aquatic animal production. These chapters are not disease specific and emphasizes the importance of gross observations (Level 1), and how and when they should be made, including information on environmental parameters worth recording, general procedures for sampling and fixation and the importance of record-keeping. The "General Techniques" section is followed by specific diseases for each host group with information on the following: causative agents, host range. geographic distribution, clinical aspects, screening methods, diagnostic methods, modes of transmission andcontrol measures.

The chapters for each host group also include three Annexes that provide information of the (a) list of OIE Reference Laboratories, (b) list of regional disease experts who can provide information and valuable health advise, and (c) useful guides/manuals. A glossary is also included. The manual is printed in water resistant material, contains more than 160 colour photos. Sections are colour coded for quick and easy reference and ring-bound so it can lays flat during use. Limited hard copies and a CD-version are available. An electronic (PDF) version is available for free download from the NACA website (http://www.enaca.org/aapqis/ - visit the publications link).

Technical Proceedings of the Conference on Aquaculture in the Third Millennium.

Subasinghe, R.P., Bueno, P.B., Phillips, M.J., Hough, C., McGladdery, S.E., and Arthur, J.R. (eds.)

The Technical Proceedings represent the most comprehensive and authoritative review assembled to date of the status of aquaculture development in the world. This volume addresses discussion of sustainable aquaculture development. Several papers in this Technical Proceedings may be useful for mariculture, including the following:

1. Technologies for Sustainable Aquaculture Development, Patrick Sorgeloos;
2. Current Status of Aquaculture in the Pacific Islands, Tim Adams, Johnn Bell and Pierre Labrosse;
3. Review of Status of Aquaculture Genetics, Rex Dunham et. al;
4. Aquaculture Development, Health and Wealth, Rohana P. Subasinghe, Melba -Reantaso & Sharon E. McGladdery; and
5. Nutrition and Feeding for Sustainable Aquaculture Development in the Third Millennium, M.R. Hasan.

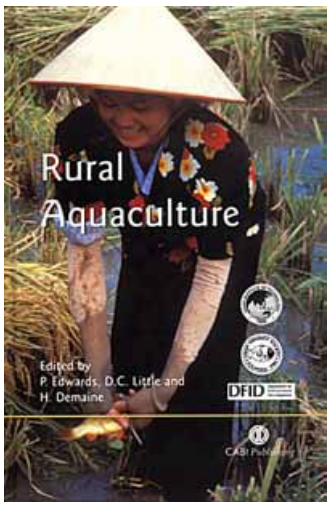
An electronic version of this Technical Proceedings can be viewed for free from the NACA website (http://203.101.155.227:9000/). Hard copies and a CD version are available from NACA Secretariat.

Rural Aquaculture

P. Edwards, D.C. Little & H. Demaine eds.

Aquaculture for both finfish and shellfish is expanding rapidly throughout the world. It is regarded as having the potential to provide a valuable source of high quality food in less developed countries and to be integrated into the farming systems and livelihoods of the rural poor.

This book addresses key issues in aquaculture and rural development, with case studies drawn from several countries in South and South-East Asia. Papers cover topics ranging from production and technical issues (such as pond culture and rice field fisheries) to social aspects and research and development methodology. The book



has been developed from a meeting of the Asian Fisheries Society. It is aimed at all concerned with aquaculture and rural development. The book is 328 pages and costs £49.95. *Contact Polly Douglas, Institute of Aquaculture, University of Stirling, Stirling FK9 4LA, Scotland, email afgrp@stir.ac.uk.*

Other Publications

Prawns & Prawn Fisheries of India
Dr S.V. Kurian and Dr V.O. Sebastian, Cochin University

The 5th edition of this popular book has been further enlarged with updated description of species based on their most recent international nomenclature. From 1976 this study has evolved from its marine origin to include freshwater culture. *Available from Hindustan Publishing Corporation, 4805/24 Bharat Ram Road, Darya Ganj, New Delhi-110002, India. Ph +91 (11) 325 4401, fax +91 (11) 6193511, email hpcpd@vsnl.com or visit www.hpc.cc.*

Proceedings of the First International Symposium on Cage Aquaculture in Asia, 2000
Editors – Chiu Lio and C. Kwei Lin

The proceedings comprise abstracts and full papers of diverse topics presented by speakers from Asia, Australia, Europe and North America. The papers review the status of cage culture in Asian countries, identify problems and opportunities, assess research needs and discuss sustainable culture technologies and their management.

Topics include discussion of the Norwegian regulatory system, Australia perspectives on cage culture and integrated aquaculture development in inland waters, offshore systems, automated feeding systems, solid waste modeling, diets, socio-economics, cage culture in ponds and much more.

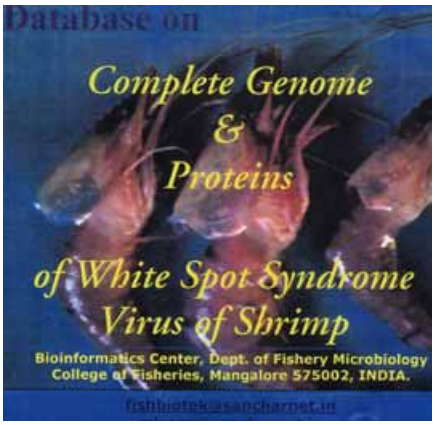
A collection of photographs showing the evolution of cage development is also included. This publication provides a wealth of information useful for fish culturists, scientists, traders and planners in private and public institutions.

Price: US$30 for WAS/AFS members and US$35 for non WAS/AFS members, plus US$5/volume shipping and handling (for parcel post/international surface mail delivery) or US$25/volume for international airmail delivery.

Contact: World Aquaculture Society, 143 J.M. Parker Coliseum Louisiana State University, Baton Rouge, LA 70803, USA, Fax: +1-224-388-3493, E-mail: WASMAS@aol.com

CD Database on Complete Genome and Proteins of White Spot Syndrome Virus of Shrimp
Bioinformatics Center, College of Fisheries, Mangalore

This CD contains a database on the complete genome and proteins of whitespot syndrome virus of shrimp has been released. Price: Rs 1,000 (Scientists in India), Rs 500 (Students in India) or



$US 200 for overseas institutions. *Available from The Coordinator, Bioinformatics Centre, Dept. of Fishery Microbiology, College of Fisheries, Mangalore 575 002, India. Email mircen@sancharnet.in.*

New from the Fauna Sinica series

The following publications are available from the Hauyu Nature Book Trade Co. Ltd., Jianneidajie Youju, P.O.Box 4088, Beijing 100001, China. Ph+86 10 68472697, fax +86-10-88510673, email hceis@263.net.cn or visit http://www.hceis.com/product/index/Fishes.htm.

Fauna Sinica Ostichthyes: Myctophiformes, Cetomimiformes, Osteoglossiformes
Chen Suzhi

This book describes the 116 species in these groups found in China up to 1996. The book has two parts. The first is a general account of each species including history, systematic and evolutionary review, distribution, morphological character and biology. The second part is systematic lists. This book provides valuable scientific and systematic taxa summaries for these species. The book is written in Chinese with an English key to species. ISBN: 7-03-009020-9/Q.1027, 349 pages, hardcover. Price:US$45+$7 by sea mail.

Fauna Sinica Invertebrata Vol.29 Phylum Mollusca, Class Gastropoda: Order Archaeogastropoda: Superfamily Trochacea
Dong Zhengzhi

In Chinese language with English key to species. This book describes the living trochacean (trochus) gastropods collected from the Chinese waters. A total of 105 species are described, belonging to 45 genera in 8 families. Of these, 5 species are new to science. Part one describes the historical review, morphology, systematics, chorology, biology and importance of trochacean gastropods. Part two is a detailed account of the morphological features, biological characteristics, geographical distribution and economic uses of species. The scientific names for a few species are discussed and revised, and the keys to all taxonomic categories are given. The main research of trochacean gastropods published in China is summarized and the book also includes new biological data on economically important species. ISBN: 7-03-009509X/Q.1065, hardcover, 210 pages With 119 inserted figures, 57 distributed maps and 2 color plates. Price: US$38+$6 by sea mail.

The Fishes of Fujian Province
Editorial Sub Committee

Two volumes in Chinese language, first published in 1984 and 1985. These two volumes describe 815 species belonging to 38 orders, 180 families, 360 genera. 528 pages (Vol 1) + 700 pages (Vol 2) with 813 figures, hardback. Price US$80+$12 by seamail.

The Fishes of Shanghai Area
East China Sea Fisheries Research Institute

In Chinese language. First Published in 1990 this book describes 250 species belonging to 88 familes. The book covers the geographical and climatic features of the region, hydrology, and a description of the fish fauna including diet, fishery biology, and resource assessments of commercially important species. The book also discusses the

What's new in Aquaculture
News, products and announcements

New Australian species of brine shrimp may be farmed

An Australian company, Para Tech (WA) Pty. Ltd., has developed technology to farm species of brine shrimp *Paratemia* that are found only in Australia.

The eggs (cysts) of the brine shrimp *Artemia* underpin a large part of global aquaculture production as they are an important feed source for the larvae and juvenile stages of many cultured species.

The world supply of *Artemia* cysts comes mainly from wild capture fisheries in salt lakes. The annual harvest is highly variable from year to year as it is affected by climate and other factors. During years when the wild harvest is poor, shortages of Artemia can cause the price of cysts to rise substantially.

Commercial farming of *Artemia* has never been carried out on a large scale, leaving the aquaculture industry without certainty of supply and creating a major opportunity for farmed product.

Para Tech has established that an Australian brine shrimp, *Parartemia*, has outstanding potential for intensive cultivation under laboratory conditions and on a large scale. This has not been achieved before.

Exploratory research into the fifteen species of *Parartemia* (found exclusively in Australia) has shown that their biology differs from *Artemia* in ways that indicate that their cysts and biomass (adult animals) may be commercially cultivated and harvested in quantities. The company has established the base nutritional requirements, aquaculture techniques and equipment designs to achieve this. *Parartemia* is rich in protein and provides opportunities for use as a feed supplement in many industries including for human nutrition.

Para Tech is now evaluating finance options to continue its research to the stage of a pilot plant on which would be based a full commercial operation, set to take a share of an industry presently estimated to be worth many hundreds of millions of dollars per annum globally. Preliminary projections indicate that significant revenues and profits could be generated from a core business of cyst production based on the technology that has been developed, with further opportunities in the application of the product for commercial purposes.

The company will continue its research at a dedicated laboratory and has secured a site and permits suitable for research and ultimate commercial production, in Jurien Bay Western Australia. A Memorandum of

Parartemia spp. adult male

Parartemia cysts

Understanding with the University of Western Australia is expected to provide the basis for an ongoing research relationship and certification of research and productivity outcomes.

A full scale operation will bring regional benefits in the form of nutrition supply and employment. Nationally it will provide Australia with a guaranteed feed supply to underpin its aquaculture growth and a significant source of export earnings.

For further information contact Mr Gavin Wright, Para Tech (WA) Pty. Ltd., Level 3 Gledden Building, 731 Hay Street, Perth WA 6000, Australia. Ph +61 (8) 93241695, fax +61 (8) 93224558, email parartemia@lycos.com.

Training

Shrimp Health Management Training Workshop, 17 – 22 June 2002, Bangkok, Thailand

Co-organized by the Aquatic Animal Health Research Institute, and NACA.

The training course will last for six days and will include lectures, practical, case studies, visits to farms and adequate time for discussion. The course will emphasize the benefits of maintaining healthy stock and preventing disease through management of the pond. The use of chemical treatments will be covered but only as part of an integrated management system.

Course outline

Topics covered in the course include:

1. Update on shrimp culture systems - the rapidly changing nature of shrimp farming with reference to both intensive and less intensive systems.
2. Pond Environment - the theory behind the pond environment, which is essential to understanding pond preparation and water management.
3. Pond preparation - the preparation of the pond from site selection to stocking.
4. Water management - the management including monitoring and manipulation for a variety of systems from high water exchange to closed re-circulation.
5. Farm records - real farm data will be presented to emphasis the need for accurate records and the use of such records to identify and prevent problems.
6. Disease - the theory of disease and a description of the major diseases of farmed shrimp. The emphasis will be on improved production through disease control.
7. Larval assessments - a method for evaluating the heath of post larvae.
8. Chemical treatments - the use of chemical treatments as part of an integrated management strategy.
9. Current situation in Thailand - the current disease problems faced by the industry and the very latest techniques employed to overcome these problems.
10. Field trip - this is an opportunity for participants to visit a hatchery and

grow-out sites. The farms to visit are extremely co-operative and will provide a great deal of practical information.

11. Case studies - problems based on real farm data. Participants are asked to attempt to solve these problems as a working group and present their findings for further discussion.

Lectures will be presented by internationally-recognized experts in the field. These include Dr. Pornlerd Chanratchakool from the Aquatic Animal Health Research Institute; Dr. Chalor Limsuwan from the Faculty of Fisheries at Kasetsart University; Dr. Jimmy Turnbull from the Institute of Aquaculture, University of Stirling; and Dr. Dan Fegan from the Shrimp Biotechnology Programme at the

National Center for Genetic Engineering and Biotechnology.

The registration fee is US$ 750: The registration fee covers the cost of tuition, a copy of "Health Management in Shrimp Ponds" and the workshop dinner. Participants will be responsible for the cost of hotel accommodation and subsistence during the workshop.

For further information, download the course brochure from the training section of www.enaca.org or contact the Training Officer, NACA, PO Box 1040, Kasetsart Post Office, Bangkok 10903, Thailand, ph +66-2 561 1728, fax +66-2 561 1727, training@enaca.org.

Top to bottom (column 2):

- *Dr. Pornlerd Chanratchakool is shown at one of his lectures at a recently held shrimp health management course;*
- *Participants visiting a Thai shrimp farm;*
- *The NACA Secretariat office at the Kasetsart University Campus where the course is held; and*
- *A visit to a Thai shrimp farm.*

Aquaculture Calendar

Management of diseases in aquaculture, 12-16 May 2002, Hotel Istana – Kuala Lumpur

The workshop will be held in conjunction with the Asia-Pacific Conference on marine science and technology . The theme of the workshop is Marine Science in the New Millennium: New Perspectives and Challenges.

The workshop is jointly organized by the Institute of Biological Sciences, University of Malaya and Kinabalu Biotechnology Sdn. Bhd.

For information, contact Prof Phang Siew Moi, Secretariat, Asia-Pacific Conference on Marine Science & Technology, Institute of Postgraduate Studies, University of Malaya, 50603 Kuala Lumpur, ph: 603-7967 4610; fax: 603-7956 8940, 603-7967 4606; email: h l p h a n g s @ u m c s d . u m . e d u . m y ; loy008@imu.edu.my

Coastal Zone Asia-Pacific Conference "Improving the State of the Coastal Areas", 12-16 May 2002, Bangkok, Thailand.

The overall aim of the conference is to bring together researchers, practitioners, educators, communities, industries, government and non-government groups and funding agencies to develop national and regional strategies, research and education programs and information sharing network for integrated coastal management that will improve the state of our coastal areas.

Themes include: Coastal fisheries, aquaculture and tourism; coastal ecosystem management; community and resource interactions; coastal resource economics; sustainable integrated catchment management; coastal area planning; and integrated sciences and coastal policy. The conference is expected to develop a regional plan of actions on collaborative research, cooperative education program, information sharing system, and regional coastal policies and web-based COASTALPROJECT Database.

Visit www.vims.edu/czap for more information or contact Dr Ratana Chuenpagdee, Virginia Institute of Marine Science, PO Box 1346 Gloucester Point, Virginia 23062, USA, ph +1 (804) 684 7335, fax +1 (904) 684 7843, email ratana@vims.edu.

Livestock & Aquaculture Fair 2002 and Agriculture 2002, 13-16 June 2002, Bandar Sunway, Malaysia

The fourth International Exhibition on livestock, poultry, aquaculture, fisheries & food technology, supplies & services exhibition, and fourth International Agriculture & Agrotechnology, Machinery & Equipment, Supplies & Services Exhibition. These exhibitions are the only forum in Malaysia to provide a neutral platform for sellers and buyers of equipment, materials and services for the livestock industry. Over 30,000 industry participants are expected to attend. C*ontact Inter-Reliance Management Services, PO Box 8448, 46790 Petaling Jaya, Selangor Darul Ehsan, Malaysia, ph +60 (3) 5621 1030, fax +60 (3) 5631 1602, email imshl@tm.net.my.*

Seventh Pacific Islands Conference on Nature Conservation and Protected Areas, 8–12 July 2002, Rarotonga, Cook Islands

The theme of the conference is mainstreaming nature conservation. The objectives of the meeting are to review progress in the implementation of the region's Action Strategy for Nature Conservation and to define priorities and the region's nature conservation agenda for the next four years. The Seventh Pacific Islands Conference has widened its traditional appeal to attract trade specialists, economists, development planners, tourism operators and others in the more mainstreamed sectors of economic development. The agenda includes keynote presentations on different perspectives and synergies on mainstreaming nature conservation.

Working groups will explore the following areas from a mainstreaming nature conservation perspective: Biodiversity conservation, protected areas, species conservation; New funding mechanisms; and Planning and legal processes. The conference is jointly organized by the South Pacific Regional Environment Programme (SPREP) and the Cook Islands Environment Service and Ministry of Culture. *For more information visit www.pacificbiodiv.org/conference or contact Kate Brown, at SPREP in Samoa on 685 21929 fax 685 20231 or email kateb@sprep.org.ws.*

Fourth International Conference on Recirculating Aquaculture and Trade Show, 18-21 July 2002, Roanoke, Virginia

The world's premiere forum on Recirculating Aquaculture. The last conference was attended by more than 500 people from more than 60 countries, over 40 exhibitors, and more than 75 papers were presented. Paper submission and Exhibitor Enrollment are currently underway. For more information, contact Ms. *Terry Rakestraw at 540-231-6805, or e-mail at aqua@vt.edu, or visit www.conted.vt.edu/recirc/aqua.htm*

International Symposium on the Management of Large Rivers for Fisheries: Sustaining Livelihoods and Biodiversity in the New Millennium, 11-14 February 2003, Phnom Penh, Cambodia

The symposium will review and synthesize the current status, management and development of large rivers systems including their ecology, fisheries, environmental impact assessments, multiple uses of resources and associated socio-economic considerations. The symposium will also raise the political, public and scientific awareness of the importance of river systems, the living aquatic resources and the people that depend upon them and contribute to better management, conservation and restoration of the living aquatic resources of large rivers. Organized by the Mekong River Commission, the Cambodian Department of Fisheries and the FAO. *Visit http:// www.lars2.org for more information.*

Australian Prawn Farmers Association and the Australian Barramundi Farmers Association Joint Annual Conference, 19-20 July, Sydney

Over 400 delegates are expected to attend from around Australia and overseas. The Conference will include 30 Trade Exhibitors. *For more information contact*

Martin Breen on ph +61 (417) 006639 or +61 (7) 3255 1070, or visit www.apfa.com.au.

The 4th Japan International Seafood and Technology Expo, 24-26 July 2002, Tokyo, Japan

For more information phone +81-3-5775-2855, fax +81-3-5775-2856, email. info@exhibitiontech.com, or visit http://www.exhibitiontech.com/seafood

The World Congress on Aquatic Protected Areas 2002, Cairns, Australia, 14-17 August 2002

This event is hosted by the Australian Society for Fish Biology in conjunction with their 31st annual conference. The themes of the conference are 1) Who and what are the beneficiaries of aquatic protected areas; 2) How to design and select aquatic protected areas; 3) success factors in the implementation and management of aquatic protected areas; 4) how good are aquatic protected areas – measuring their performance; and 5) the role of aquatic protected areas in the aquatic ecosystem. *For details contact OzAccom Conference Services, ph +61(0)7 3854 1611, fax +61(0)7 3854 1507, email apa2002@ozaccom.com.au. Further details are also available from the website http://www.ozaccom.com.au/apa2002.*

The 5th International Acid Sulfate Soils Conference, 25-30 August 2002, Tweed Heads, Australia

The theme of the meeting is the "sustainable management of acid sulfate soils." Researchers, land managers and legislators have become very aware of the potential environment degradation for the unsustainable use acid sulfate soils.

The conference has four broad themes: (1) characteristics of acid sulfate soil hazards; (2) management of acid sulfate soils; (3) planning, legislation and regulation; (4) acid sulfate soil education and communication.

For more information visit http://www.out.at/acidsoil.

Fish Eye View Exhibition 2002, 6-8 September 2002, Kuala Lumpur, Malaysia

An international exhibition on tropical fish, fishing and aquaculture accessories, products and technology. The exhibition will be grouped under three main themes: Aquaculture and Fish Farming; Recreational Fishery and Ornamental fish.

For more information contact Jungle Motion Sdn. Bhd., ph+603 5638 2019, fax +603 56382069, email enquries@fisheyeview.net or visit www.fisheyeview.net

Aquaculture Europe 2002, Trieste, Italy 16-19 October

The theme of the meeting is Seafarming – Today and Tomorrow and will address key issues related to the future of the farming of the seas. In addition to the main conference, three workshops will be held to encourage interactive discussion on future perspectives with industry.

The workshops will address 1) applied solutions to health management in Mediterranean aquaculture – a practical approach for farmers; 2) new technologies for Mediterranean aquaculture; and 3) certification in aquaculture – HACCP, ISO Standards, Eco-labeling and organics.

More detailed information is available from the European Aquaculture Society website www.easonline.org or email ae2002@aquaculture.cc

5th Triennial Symposium on Diseases in Asian Aquaculture (DAA5), 25–28 November 2002 at the Gold Coast International Hotel, Australia

The Fish Health Section of the Asian Fisheries Society will host the 5th Triennial Symposium on Diseases in Asian Aquaculture (DAA5) from 25 – 28 November 2002 at the Gold Coast International Hotel, Australia. Two satellite workshops will follow the Symposium: Epidemiology and Risk Assessment 29-30 November 2002, and the Asia-Pacific Regional Molluscan Health Management Training Program Phase II 2-6 December 2002.

For more information, contact OzAccom Conference Services, ph +61 7 3854 1611, email daa5@ozaccom.com.au. For more information about the workshops, contact Dr Chris Baldock - ph +61 7 3255 1712 (Epidemiology and Risk Assessment), email chris@ausvet.com.au and Dr Rob Allard - ph +61 7 3840 7723 (Molluscan Health).

Asian Fisheries – Asian Aquaculture, February 2003, Bangkok, Thailand

A new annual event following on from the highly successful presentation of the ASEAN-SEAFDEC Millennium Fisheries Exhibition. In 2003 the event will be aimed equally at both the rapidly modernising fish capture sector and the fast growing aquaculture industry. The conference theme will be "Improving the Economic Sustainability of the Seafood Industry".

The event will incorporate a very useful and user-friendly conference. *For further information, please contact Ms Jodie Ramage, Baird Publications, ph +61 3 9645 0411, fax +61 3 9645 0475, email: marinfo@baird.com.au.*

Fourth International Conference on Environmental Problems in Coastal Regions, 16-18 September 2002, Rhodes, Greece

The conference will address the subjects of monitoring, analysis, and modeling of coastal regions including, air and ground phenomena, focussing on topics which need to be recognized in order to prevent, alleviate or minimize environmental problems, allowing a balanced use of the coastal regions as a common resource around the world. As population growth and industrial and tourist activity development continues in coastal zones, the environmental stress on near-shore water, air and ground increases. Due to the ecological, social, economic and cultural interests within the coastal zone, almost all activities or actions within this area generate conflicts amongst different interested parties such as users, landowners, engineers, ecologists, economists and politicians. *For more information visit http://keywater.vub.ac.be/External.asp?http://www.wessex.ac.uk/*

Global Shrimp Outlook 2002, September, Bali, Indonesia

Charoen Pokphand Indonesia will provide in-country support for the next edition of this annual conference organized by the Global Aquaculture Alliance (GAA). At Global Shrimp Outlook: 2002, major international shrimp buyers, sellers, producers and processors will help forecast the shrimp market during focused, half-day sessions. The program will answer tough questions like what will happen when China's fast-growing shrimp production exceeds its internal consumption; when Ecuador's faltering industry would recover; and others. *For more information on Global Shrimp Outlook: 2002, contact the GAAHome Office - e-mail gaa@mo.net, tel +1-314-293-5500, fax +1-314-293-5525.*

Chloramphenicol concerns in shrimp culture

Amornchai Somjetlerdcharoen
Aquatic Medicine, Aquatic Animal Health Research Institute, Department of Fisheries, Thailand
E-mail : amornchs@fisheries.go.th

Due to the detection of chloramphenicol residue in black tiger shrimp (*P. monodon*) exports to European Union (EU) in September 2001, an ad hoc committee was established by the Department of Fisheries (DOF) for the investigation and monitoring of the use of chloramphenicol and to find solutions to any problems.

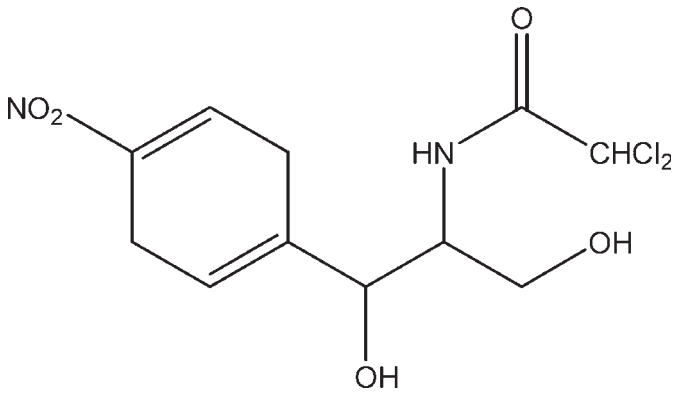
In EU and the USA, the use of chloramphenicol is banned in aquatic animals cultured for human food. Similarly, DOF has had a strict policy to prohibit this drug in all aquaculture, particularly in treatment of *P. monodon* disease. However, in some cases, farmers may not be aware that chloramphenicol is present as a component in treatments for shrimp disease that are commonly sold under other names.

Following a strong recommendation of the Food and Drug Committee, the Ministry of Public Health issued an order banning the use of chloramphenicol and its derivatives in all animals for human consumption, effective since 1 September 1988.

Therefore, the author would like to provide a general background of this drug:

Chloramphenicol

This substance is an antibiotic synthesized from Streptomyces venezuelae bacteria, which was discovered in soil sample from Venezuela. It is effective for both gram positive and gram negative bacteria.



Chemical structure

The structure of chloramphenicol is not complex and it can be chemically synthesized. It is colorless and non-soluble.

Pharmaceutical mechanism

Chloramphenicol can invade bacterial cells and attach to the 50S ribosome, blocking the linkage between the 50S ribosme and tRNA. The reaction between the peptidyl transferase enzyme and amino acids is therefore interrupted causing a breakdown of protein synthesis. Chloramphenicol is categorized as 'bacterial growth inhibiting drug'.

Chloramphenicol also affects protein synthesis in the mitochondria of vertebrate cells because these have similar physical characteristics to bacterial ribosomes. The tissues for producing red blood corpuscles in vertebrates are therefore extremely sensitive to this drug.

Chloramphenicol has a wide range of effect on various kinds of bacteria. Bacterial growth will cease at a dose of 8 microgram/ml or lower. In general, chloramphenicol effectively suppresses the growth of anaerobic bacteria and most gram-negative bacteria. However, other bacteria may also be sensitive to it.

Absorbtion, distribution and secretion

Tablets for oral administration contain chloramphenicol in free form or as "chloramphenicol palmetate" ester, which can react with water and lipase enzyme to form free chloramphenicol before absorption through the intestine. As non-soluble drug, chloramphenicol administered by injection must be in the form of soluble succinate ester

Chloramphenicol can distribute widely into various body tissues including the cerebrospinal fluid in nerve system, gall bladder and milk. It can be transferred from mother to child during pregnancy. Chloramphenicol is able to react with 50% of blood protein.

Chloramphenicol also stops the function of "cytochrome P450" enzyme in liver which usually eliminates this drug. The drug residue can therefore exist for a long period. Liver cells will convert chloramphenicol to soluble form by glucuronide formation. Therefore the concentration of chloramphenicol residue in blood depends on the ability of liver function in secretion of the drug through the urine.

Toxic effect

Bone marrow is a target for the side effects of chloramphenicol. It can affect the production of blood corpuscles by reduction of blood cells pancytopenia or body response idiosyncrasy caused by composition change in blood. The mechanism for the toxic effect on bone marrow is not clear. Patients who have survived from the toxic effect on bone marrow may have high risk for leukemia. From case studies, the risk of pancytopenia is related to the amount of drug taken while idiosyncrasy mainly relates to the period of drug application.

Chloramphenicol also causes poor development of red blood cells which is determined by low level of red blood cells in

blood circulation. The effect of chloramphenicol on red blood cells varies depending on the amount of drug used. Choramphenicol generally stops protein synthesis in mitochondria and reduces reticulocyte which causes a decrease in haemoglobin and an increase in the iron level in the blood.

These changes in the composition of the blood will happen if the level of drug in blood circulation is greater than 25 microgram/ml. This situation is usually found in patients who have continuously taken a high dose of the drug over a long period. It may be fatal. Patients that survive may be recovered if there is no application of this drug again.

Drug administration

Though chloramphenicol is very efficient in wider bacterial treatment, it is suitable only for some diseases due to its adverse effects. It is mainly used for specific virulent cases and unavoidable situations. The potential toxic effects of chloramphenicol must be carefully weighed against the advantage in bacterial treatment in consideration of applying this drug. Chloramphenicol is recommended for treatments of typhoid caused by *Salmonella typhi* and meningitis caused by *Hemophilus influenzae*. However, penicillin is generally used for treatment of meningitis caused by *Neisseria meningitidis* or *Streptococcus pneumoniae*. If patients are allergic to penicillin, chloramphenicol may be applied instead. Chloramphenicol can be used for treatment of diseases caused by anaeraobic bacteria and infections of the central nervous system.

Drug resistance

Drug resistance to chloramphenicol is caused by genetic transfer through bacterial plasmids leading to the synthesis of acetyltransferase enzyme, which prevents the attachment of the drug to the 50S ribosome, thus reduces the effect of chloramphenicol. Drug resistance may also be caused by genetic changes in bacteria such as adaptation of cell wall to prevent drug absorption or adaptation of 50S ribosome structure to prevent attachment of drug.

Conclusion

Solving the problem of application of chloramphenicol in shrimp farming is an initial task to realize the importance of using drug in aquaculture. The DOF is studying and seeking solutions including the standardization and registration of aquaculture drugs, strict application of drugs following scientific instruction, prevention and control of the potential impact of drugs on the environment and human hygiene, and identification of suitable drugs.

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Thai Section

Advice on Aquatic Animal Health Care

ปัญหาคลอแรมฟินิคอลกับการเลี้ยงกุ้งกุลาดำ

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สถาบันวิจัยสุขภาพสัตว์น้ำ กรมประมง

สืบเนื่องจากมีการตรวจพบยาคลอแรมฟินคอลตกค้างในกุ้งกุลาดำที่ส่งไปยังตลาดยุโรปในเดือนกันยายน 2544 กรมประมงจึงได้ตั้ง คณะกรรมการเฉพาะกิจขึ้นมาเพื่อตรวจสอบ ติดตามและแก้ปัญหา การใช้ยาคลอแรมฟินิคอล ทั้งนี้เพราะในยุโรปและอเมริกา ยาคลอแรมฟินิคอลเป็นยาที่ไม่อนุญาตให้ใช้กับสัตว์น้ำที่ใช้บริโภคเป็นอาหาร กรมประมงมีเป้าหมายที่จะกวดขันและกำจัดยาชนิดนี้ออกจากการเพาะเลี้ยงสัตว์น้ำ โดยเฉพาะอย่างยิ่งการใช้ในการรักษาโรคในกุ้งกุลาดำ การตรวจพบยาคลอแรมฟินิคอลในกุ้งกุลาดำ แสดงว่ามีการใช้ยาชนิดนี้ในการเพาะเลี้ยงสัตว์น้ำ ซึ่งจากการตรวจสอบพบว่า เกษตรกรผู้เลี้ยงกุ้งมีการใช้ยาชนิดนี้จริง หรือใช้ยาชนิดอื่นที่มีส่วนผสมของยาคลอแรมฟินิคอลโดยที่เกษตรกรไม่ทราบตัวยาที่แท้จริง ที่เป็นส่วนประกอบของยาที่ใช้เพื่อรักษาโรคกุ้ง

สำหรับยาดังกล่าวนี้ กระทรวงสาธารณสุขมีคำสั่งที่ 578/2531 เรื่องเพิกถอนทะเบียนตำรับยา ตามมติการประชุมของคณะกรรมการยาครั้งที่ 8/2531 เมื่อวันที่ 1 กันยายน 2531 ให้เพิกถอนใบสำคัญการขึ้นทะเบียนตำรับยาซึ่งมีคลอแรมฟินิคอลและอนุพันธ์ผสมอยู่ซึ่งนำมาใช้ในสัตว์ที่ใช้บริโภคทุกรูปแบบ ดังนั้นผู้เขียนขอนำเสนอข้อมูลพื้นฐานของยาชนิดนี้เพื่อเป็นประโยชน์ทางวิชาการดังมีรายละเอียดต่อไปนี้

คลอแรมฟินิคอล

เป็นยาปฏิชีวนะที่ได้จากการผลิตของ Streptomyces venezuelae ค้นพบในปี 1947 จากตัวอย่างของดินที่ได้จากประเทศเวเนซูเอล่า ออกฤทธิ์อย่างกว้างขวางต่อแบคทีเรีย ทั้งพวกแกรมบวกและแกรมลบ

คุณสมบัติทางเคมี

คลอแรมฟินิคอลมีสูตรโครงสร้างทางเคมีที่ไม่ซับซ้อนมากนักและสามารถสังเคราะห์ขึ้นมาได้ด้วยกระบวนการสังเคราะห์ทางเคมี เป็นสารที่ไม่มีสี และไม่ค่อยละลายในน้ำ

กลไกในการออกฤทธิ์

คลอแรมฟินิคอลจะแพร่กระจายเข้าสู่เซลล์ของแบคทีเรีย และ จะเข้าไปจับกับไรโบโซม 50S ของแบคทีเรีย ทำให้ไปขัดขวาง การจับกันระหว่างไรโบโซม 50S และ tRNA ปฏิกิริยาระหว่างเอ็นไซม์ peptidyl transferase กับกรดอะมิโนจาก tRNA จึงไม่เกิดขึ้น เป็นผลทำให้ไม่มีการสังเคราะห์โปรตีน คลอแรมฟินิคอลจึงจัด อยู่ในกลุ่มของยาที่ยับยั้งการเจริญเติบโตของแบคทีเรีย

คลอแรมฟินิคอลยังสามารถยับยั้งการสังเคราะห์โปรตีนในไมโตคอนเดรียของเซลล์สัตว์ชั้นสูง เนื่องจากว่าไรโบโซม ในไมโตคอนเดรียของสัตว์ชั้นสูงมีลักษณะทางกายภาพใกล้เคียงกับไรโบโซมของแบคทีเรีย เซลล์ที่สร้างเม็ดเลือดแดงในสัตว์ชั้นสูงจะมีความไวต่อยาคลอแรมฟินิคอลมากเป็นพิเศษ

การทำงานของคลอแรมฟินิคอล

คลอแรมฟินิคอลเป็นยาที่ออกฤทธิ์อย่างกว้างขวางต่อจุลชีพชนิดต่าง ๆ จุลชีพที่มีความไวต่อยาชนิดนี้จะถูกยับยั้งการเจริญที่ระดับความเข้มข้น 8 :g/ml หรือต่ำกว่านี้ โดยปกติแล้ว คลอแรมฟินิคอลเป็นยาที่ยับยั้งการเจริญเติบโตของจุลชีพ (เช่น แบคทีเรียที่ไม่ต้องการออกซิเจนในการเจริญเติบโตและแบคทีเรียแกรมลบส่วนใหญ่) แต่พบว่าคลอแรมฟินิคอลสามารถฆ่าจุลชีพบางชนิดได้

การดูดซึมการแพร่กระจายของยา การเปลี่ยนแปลงของยาในร่างกายและการขับถ่ายยาคลอแรมฟินิคอล ในรูปของยากินมีทั้งที่เป็นคลอแรมฟินิคอลอิสระหรือในรูปของ ester คลอแรม - ฟินิคอลพาลมิเตต (chloramphenicol palmetate) ซึ่งยาในรูปของ ester จะทำปฏิกิริยากับน้ำและเอ็นไซม์ lipase ได้เป็นตัวยาคลอแรมฟินิคอลอิสระ และจะถูกดูดซึมในลำไส้ คลอแรมฟินิคอลเป็นยาที่ไม่ค่อยละลายน้ำ ดังนั้นยาชนิดนี้ในรูปของยาฉีดจึงต้องมีการเปลี่ยนให้อยู่ในรูปของ succinate ester ที่ละลายน้ำได้ คลอแรมฟินิคอลแพร่กระจายได้ดีตามเนื้อเยื่อต่าง ๆ ของร่างกาย และยังสามารถแพร่กระจายเข้าไปในของเหลว ในระบบประสาท (cerebrospinal fluid)

นอกจากนี้ยังพบในน้ำดี น้ำนมของแม่ และสามารถแพร่ผ่านเข้าสู่ลูกได้ในหญิงมีครรภ์ คลอแรมฟินิคอลสามารถจับกับโปรตีนในเลือดได้ประมาณ 50 %

นอกจากนี้คลอแรมฟินิคอลจะไปยับยั้งระบบการทำงานของเอ็นไซม์ cytochrome P450 ที่อยู่ในตับ ทำให้คลอแรมฟินิคอลคงอยู่ ได้นานในร่างกาย ตับจะทำหน้าที่เปลี่ยนคลอแรมฟินิคอล ให้อยู่ในรูปที่ละลายน้ำได้โดยขบวนการ glucuronide formation ดังนั้นความเข้มข้นของยาคลอแรมฟินิคอล ในเลือดจึงขึ้น อยู่กับภาวะในการทำหน้าที่ของตับ ร่างกายจะขับถ่ายคลอแรมฟินิคอล ออกทางปัสสาวะ

ความเป็นพิษของยาคลอแรมฟินิคอล

อวัยวะเป้าหมายที่มีความเสี่ยงต่อการใช้ยาคลอแรมฟินิคอล คือ ไขกระดูก คลอแรมฟินิคอลมีผลต่อระบบการผลิตเม็ดเลือด 2 ประการ คือ ทำให้จำนวนเซลล์หรือองค์ประกอบในเลือดลดลง (pancytopenia) และการตอบสนองของร่างกาย (idiosyncrasy) อันเนื่องมาจากการเปลี่ยนแปลงของเซลล์ที่เป็นส่วนประกอบสำคัญในเลือด กลไกความเป็นพิษของคลอแรมฟินิคอลต่อไขกระดูกยังไม่เป็นที่ชัดเจน ในรายของผู้ป่วยที่รอดชีวิตจากผลกระทบของคลอแรมฟินิคอล ต่อการเปลี่ยนแปลงในไขกระดูกนั้นจะมีอัตราเสี่ยงสูงต่อการเป็นมะเร็งเม็ดเลือดขาว (leukemia) จากผลการศึกษาพบว่าการลดลงของจำนวนเซลล์ที่ผลิตเม็ดเลือดในไขกระดูกขึ้นอยู่กับปริมาณของยาคลอแรมฟินิคอลที่ใช้ ในขณะที่การตอบสนองของร่างกายอันเนื่องมาจากการลดลงของจำนวนเซลล์ที่เป็นส่วนประกอบสำคัญในเลือด ไม่ได้ขึ้นอยู่กับปริมาณยาคลอแรมฟินิคอลที่ใช้ แต่มีแนวโน้มว่าจะขึ้นอยู่กับระยะเวลาที่มีการใช้ยาคลอแรมฟินิคอลติดต่อกันเป็นเวลานาน

นอกจากนี้คลอแรมฟินิคอลยังมีผลต่อเม็ดเลือดแดง ทำให้เม็ดเลือดแดงมีการพัฒนาอย่างไม่สมบูรณ์ เป็นผลให้เม็ดเลือดแดงในกระแสเลือดต่ำกว่าปกติ ผลกระทบของคลอแรมฟินิคอลต่อเม็ดเลือดแดงจะแปรผันตามปริมาณของคลอแรมฟินิคอลที่ใช้ คลอแรมฟินิคอล จะไปยับยั้งการสังเคราะห์โปรตีนของไมโตคอนเดรีย ทำให้จำนวนของ reticulocyte ลดลง ตามด้วยการลดลงของปริมาณ hemoglobin

การเพิ่มขึ้นของปริมาณธาตุเหล็กในเลือด ภาวะการเปลี่ยนแปลง ดังกล่าวขององค์ประกอบต่าง ๆ ในเลือดจะเกิดขึ้นเมื่อมียาคลอแรมฟินิคอลอยู่ในกระแสเลือดในปริมาณตั้งแต่ 25 :g/ml เป็นต้นไป มักจะพบในผู้ป่วยที่มีการใช้ยาคลอแรมฟินิคอลในปริมาณสูงและต่อเนื่องกันเป็นเวลานาน ความเป็นพิษของยาคลอแรมฟินคอล ในกรณีนี้อาจจะทำให้ถึงแก่ชีวิตได้ สำหรับผู้ป่วยที่รอดชีวิตจะสามารถกลับไปสู่ภาวะปกติได้ถ้าหยุดการใช้ยา

การใช้ยาคลอแรมฟินิคอล

คลอแรมฟินิคอลเป็นยาต้านจุลชีพที่มีประสิทธิภาพในการรักษาโรคติดเชื้อแบคทีเรียหลายชนิด แต่มีการนำไปใช้รักษาเพียงบางโรคเท่านั้น ทั้งนี้เนื่องจากผลข้างเคียงของยา ส่วนใหญ่จะใช้รักษาการติดเชื้อที่มีความรุนแรงเฉพาะและไม่มีทางเลือกที่ดีกว่า เช่น การดื้อยา หรือการแพ้ยาที่จำเป็นต้องใช้ในการรักษา ดังนั้นในการใช้ยาคลอแรมฟินิคอลมักจะมีการชั่งน้ำหนักระหว่างผลดีในการรักษา กับความเสี่ยงจากความเป็นพิษของคลอแรมฟินิคอลดังที่ได้กล่าวมาข้างต้น

คลอแรมฟินิคอลยังใช้รักษาโรคไข้ไทฟอยด์ ซึ่งมีสาเหตุมาจากเชื้อ Salmonella typhi โรคเยื่อหุ้มสมองอักเสบที่มีสาเหตุมาจากเชื้อ Hemophilus influenzae สำหรับโรคเยื่อหุ้มสมองอักเสบที่มีสาเหตุมาจากเชื้อ Neisseria meningitidis หรือ Streptococcus pneumoniae ปกติแล้วจะทำการรักษาด้วยยาเพนนิซิลิน แต่ถ้าพบว่าผู้ป่วยมีการแพ้ยาในกลุ่มนี้ก็จะมีการใช้ยาคลอแรมฟินิคอลแทน

คลอแรมฟินิคอลยังสามารถใช้รักษาโรคที่เกิดจากการติดเชื้อจากจุลชีพ ที่ไม่ต้องการออกซิเจน และยังใช้ในการรักษาโรคที่เกิดจากการติดเชื้อในระบบประสาทส่วนกลาง

การดื้อยา

สาเหตุในการดื้อยาคลอแรมฟินิคอลเกิดจากการถ่ายทอดคุณสมบัติของการดื้อยาผ่านทาง plasmid มีการสร้างเอ็นไซม์ acetyltransferase ภายในเซลล์ของจุลชีพ ซึ่งจะไปยับยั้งการทำงานของยาคลอแรมฟินิคอล ทำให้คลอแรมฟินิคอลไม่สามารถ ที่จะจับกับไรโบโซม 50S ของแบคทีเรีย นอกจากนี้การดื้อยาคลอแรม-ฟินิคอลยังพบว่ายังสามารถเกิดขึ้นได้โดยขบวนการเปลี่ยนแปลงทางพันธุกรรมของแบคทีเรีย โดยการเปลี่ยนแปลงโครงสร้างของเยื่อหุ้มเซลล์เพื่อลดการดูดซึมของยาคลอแรมฟินิคอล เข้าสู่เซลล์ และยังมีการเปลี่ยนแปลงโครงสร้างของไรโบโซม 50S เพื่อไม่ให้คลอแรมฟินิคอลมาจับ

บทส่งท้าย

การแก้ปัญหาเรื่องเกี่ยวกับยาคลอแรมฟินิคอลในกุ้งกุลาดำเป็นเพียงบทเริ่มต้นที่ทำให้มีการตระหนักถึงความสำคัญของการใช้ยาในสัตว์น้ำ การมีมาตรฐานของยาสัตว์น้ำ การจดทะเบียนยา เพื่อรับรองให้ใช้ในสัตว์น้ำ การใช้ยาอย่างถูกต้องตามหลักวิชาการ การควบคุมและป้องกันปัญหาในเรื่องผลกระทบของการใช้ยาทั้งต่อสิ่งแวดล้อม และต่อสุขอนามัยของผู้บริโภคสัตว์น้ำรวมถึงการกำหนดชนิดของยาที่อนุญาตให้ใช้กับสัตว์น้ำประเด็นต่าง ๆ เหล่านี้ได้เป็นเรื่องที่ทางกรมประมงกำลังเร่งดำเนินการเพื่อหาข้อสรุปและกำหนดแนวทางในการปฏิบัติต่อไป

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Current Status and Trends of Finfish Market in Hong Kong

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香港位于中國東南沿海， 人口約760萬。二〇〇〇年之漁產品總消耗量達242, 000公噸，即每人36公斤（其中169, 400公噸爲魚類）。 香港水產養殖業及捕撈漁業的總漁產量爲162, 000公噸（產量分別爲 4, 660 及 150, 000公噸）， 據估計約有一半的漁獲在香港以外地區卸下。

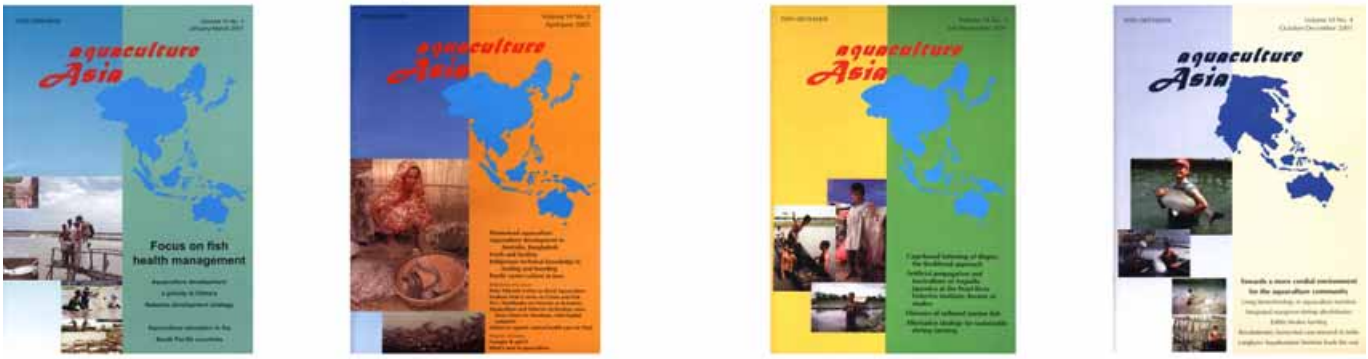
香港每年從亞太地區入口大量魚類，包括活魚、鮮或冷凍及急凍魚，以供應本地市場的需求。 二〇〇〇年全年的總入口量爲114, 500公噸。

淡水魚的消耗量達46, 000公噸， 市場需求以活魚爲主， 大部分從中國內地入口， 本地養殖生產約占6%，常見品種包括鯉魚 (*Ctenopharyngodon idellus*)、 大頭 (*Aristichtys nibilis*)、烏頭 (*Mugil sp.*) 及福壽 (*Tilapia sp.*) 等。 有些品種主要從內地入口，包括桂花魚 (*Siniperca chuatsi*) 及加州鱸 (*Micropterus salmoides*)， 多數來自中國廣東。

二〇〇〇年海魚的需求約119, 000公噸，約五成由本地捕撈漁業供應，主要爲鮮或冷凍魚， 包括南中國海常見的品種， 例如紅衫 (*Nemipterus virgatus*)、 鯧魚 (*Stromateoides argenteus*) 及木棉 (*Priancanthus tayenus*)等。海魚養殖業則供應約1, 800公噸活魚，常見品種包括青斑 (*Epinephelus coioides*)、 紅鮸 (*Lutjanus argentimaculatus*) 及鯛魚 (例如黃腳鯛 *Acanthopagrussarba*)。

海魚入口方面，二〇〇〇年的數字爲約70, 680公噸，價值約美金292百萬，其中約八成(即55, 600公噸，美金152百萬) 爲由各地入口鮮或冷凍魚，包括亞洲、歐洲及北美洲等，主要品種有鱒魚 (例如 *Oncorhynchus spp.*)、鰈魚 (例如 *Hippolossus spp.*)、鮪魚 (例如 *Thunnuspp.*) 及鱈魚 (例如 *Gadus spp.*) 等。 活海魚的入口量約15, 100公噸， 價值約美金142百萬，其平切價較鮮或急凍魚爲高，大部分由中國內地、泰國及其他亞太區地方供應，常見品種包括紅鮸(*Lutjanus argentimaculatus*)、青斑 (*Epinephelus coioides*) 及其它斑類。

Aquaculture Asia



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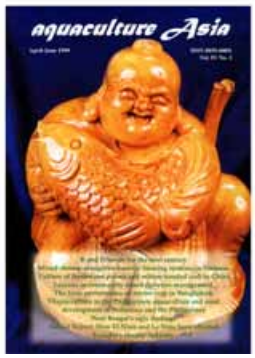

What's new on the Web

Translation of websites – Babelfish: http://babelfish.altavista.com/

The diversity of languages spoken in the Asia-Pacific region is extremely high. However, the linguistic diversity of the internet is quite low. It is dominated by English. This makes it difficult for many people to access a lot of information that might be useful to them.

Similarly – and as Dr Graham Mair pointed out in his regular column, a lot of Asian information is also not accessible to English-speakers (or to speakers of other Asian languages).

Fortunately there are now some free services available on the internet that anyone can use to translate websites from English into a variety of other languages. While most of these sites are oriented towards European languages, there is one, Babelfish, which supports several Asian languages. The list is still quite limited, but I expect that language support will grow with time.

To use Babelfish all you have to do is to enter the website address of the page you want translated and click go. Babelfish (and some others) also allow you to enter words or phrases that you would like translated. The results aren't perfect – particularly in terms of grammar – but they are good enough to allow me to understand many non-English websites and gather information from them. If English is not your first language – or if you are trying to read a colleague's paper in a language unfamiliar to you - then you might like to try out the Babelfish site to see if you find it useful.

	Translation	
Asian language support	English to Chinese English to Japanese English to Korean	Chinese to English Japanese to English Korean to English
Non-Asian language support	English to French English to German English to Italian English to Portuguese English to Spanish	French to English French to German German to French Portuguese to English Spanish to English Russian to English

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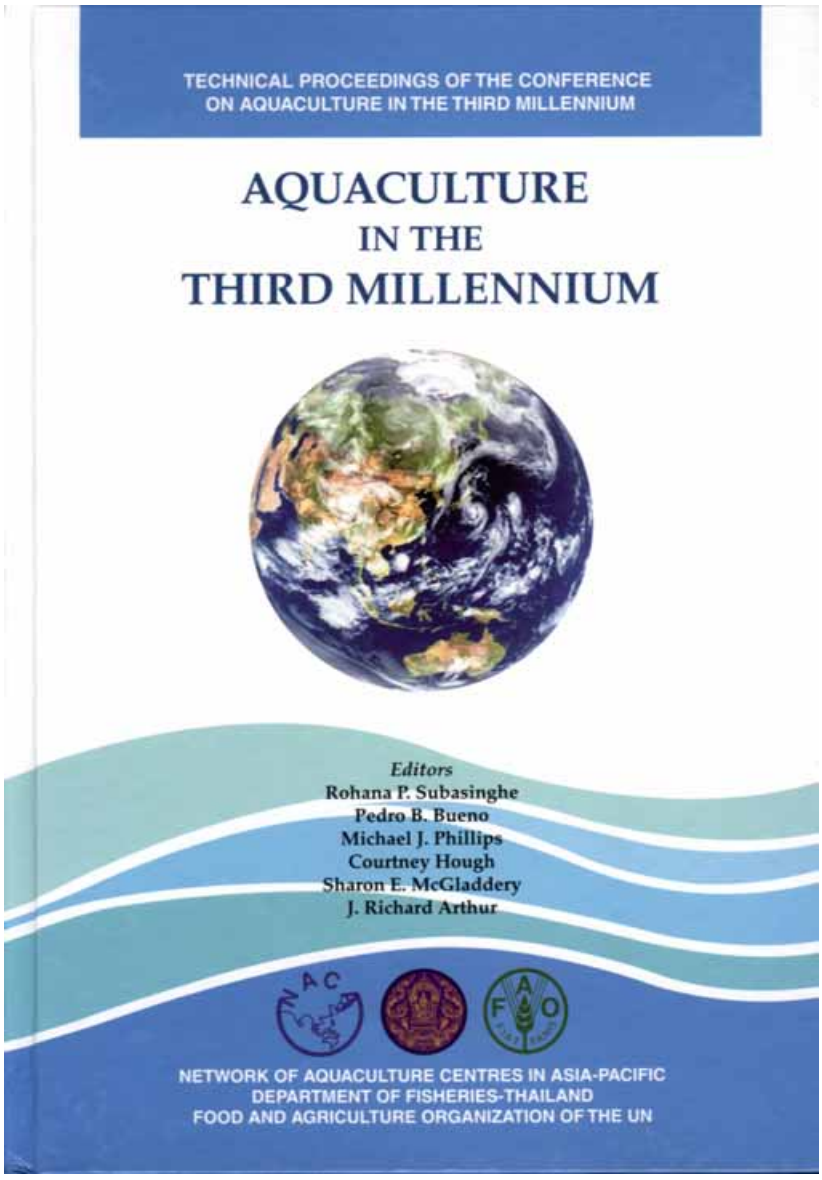

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