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MALAYSIA *(JOHOR)*- Gold Coin Specialities Sdn Bhd/Gold Coin Biotechnologies Sdn Bhd, Tel: +607 237 0695 Fax: +607 236 1143 email: sp.koh@goldcoin-my.com
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INDIA JV *(CHENNAI)* - 1-B, Industrial Estate, Ambattur, Chennai 600098, India, Tel: +91 44 2625 8031 Fax: +91 44 2625 8034 email: viney.vatal@godrejagrovet.com

Contents

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Editor/Publisher
Zuridah Merican, PhD
Tel: +603 2096 2275 Fax: +603 2096 2276
Email: zuridah@aquaasiapac.com

Editorial Coordination
Corporate Media Services P L
Tel: +65 6327 8825/6327 8824
Fax: +65 6223 7314
Email: irene@corpmediapl.com
Web: www.corpmediapl.com

Design and Layout
Words Worth Media Management Pte Ltd
Email: sales@wordsworth.com.sg
Web: www.wworthmedia.com

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3 Pickering Street, #02-36 Nankin Row,
China Square Central, Singapore 048660
Web: www.aquaasiapac.com

Editorial and advertising enquiries
Request for reprints and articles
Email: zuridah@aquaasiapac.com
Tel: +603 2096 2275 Fax: +603 2096 2276

Subscriptions
Online: www.aquaasiapac.com
Email: subscribe@aquaasiapac.com
Tel: +65 9151 2420 Fax: +65 6223 7314

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WRITE TO THE EDITOR

We want to hear from you. Write your comments on the industry to the editor.

Send by fax to Zuridah Merican at +603 2096 2276 or email: zuridah@aquaasiapac.com

Letters may be edited prior to publication

From the editor

Review 2008- A year of extremes

In general, the last ten months have been a roller coaster ride for our industry. Status quo was thrown out the window. Early in the year, producers complained of high costs of production due to rising prices in feed, feed commodities and energy. International pricing within the US dollar brought lower profits at home with the weak US dollar. Farm gate prices remained stable but low.

Unprecedented expansion has brought attention to Vietnam's production of the Pangasius catfish. Despite adverse publicity on the conditions during the production process and impact on the environment, it did not lose market share in global trade. That is, until recently and for a different reason altogether. Low farm gate prices in the middle of the year were attributed to cyclic changes in demand and supply reported in our July issue. It was also due to high volumes of production, depreciation of the Vietnamese dong against the US dollar, high interest rates and lack of capital. It was a victim of its own success but before the industry could take stock of the situation, Vietnam was the first country to face the credit crunch in the middle of the year well before the credit crunch hit the USA. Today, prices are down again to VND 15,300 to VND 16,000/kg. Producers still lack operating capital due to tighter credit controls. The rise of the dollar is making the fish more expensive in Europe, Russia and Ukraine that are subsequently cutting back on purchases.

Optimism was in the air for shrimp producers and exporters early this year. There were hopes of reduced US antidumping tariffs or a total removal following World Trade Organisation (WTO) decisions for marine shrimp imports for Thailand. Tariffs were down for India with an average duty of 1.69% but alas, the industry in India was facing a triple whammy with higher costs, high mortalities from diseases and poor quality post larvae. Production of the black tiger shrimp has been shrinking and may be lower than 100,000 tonnes this year. Producers in India will now face a different set of challenges as they join the bandwagon to culture vannamei shrimp (see news section).

The margin between prices vs. production costs of black tiger and vannamei shrimp continues to bring woes for producers, especially for the former species. In Vietnam, the production cost of vannamei shrimp is VND30, 000/kg (USD1.79/kg) whilst farm gate prices are VND150,000/kg. For the black tiger shrimp, the cost has increased to VND80,000 (USD 4.8/kg) for 32 pcs/kg. September prices for black tiger shrimp in Bac Lieu province was reported at VND86,000/kg (USD5.25/kg), much lower than 2007 price of VND130, 000/kg (USD7.9/kg). In Indonesia, farm gate prices for vannamei shrimp (35/kg) was IDR 62,050/kg (USD 6.20/kg). We had expected some revival of the culture of black tiger shrimp but in the course of the year, this did not materialise despite supplies of disease free post larvae in Vietnam, Thailand and Malaysia, albeit at too high prices (USD 13-15/1000PL), namely 3 times higher than for vannamei PL.

Earlier in the year, the feed sector faced rising costs of feed ingredients coupled with high energy costs. Most feed companies raised prices at least once, although many said that they tried to delay this to help farmers. Now the situation has reversed as prices for petrol/diesel and feed commodities fell more than 50% from their peak in May. Soybean prices are at the lowest since August 2007 but not lowest historically. This situation should ease the pressure on profits and we should expect feed companies to reduce prices which will be a relief for many producers. However, this will not happen overnight as lower prices will take time to move through the supply chain.

The focus of food safety and how China is coping with the FDA ban on selected aquaculture products continued into 2008. During World Aquaculture 2008, in Busan Korea, the China Entry-Exit Inspection and Quarantine Authority explained the intensified measures to ensure the safety of export of aquaculture products. There were also initiatives with the FDA to set up inspection centres with Chinese authorities. Unfortunately, we now have news of the possibility of melamine entering the feed supply chain. On poor quality products, China is not alone as we still see frequent rejections of shrimp and freshwater prawn from India and Bangladesh according to the EU's Rapid Alert System for Food and Feed.

Despite these hurdles in food safety and uncertainties in demand and supply, Asian producers remain resilient and will continue to supply the world with affordable seafood. The once lucrative aquaculture industry in Europe is stagnating as its regulations have increased its cost of production. Although it has the perfect environment for fish farming, especially for marine fish, Europe imports 50% of its requirements.

Our Asian producers have to not only follow global trends but also be environmentally and economically sustainable to supply the global demands for seafood at affordable prices. As the world goes into a recession, many households are turning to supermarket house brands and value brands. We expect this to provide opportunities for the Asian aquaculture industry in 2009.

We wish all readers a Happy New Year!

Zuridah Merican

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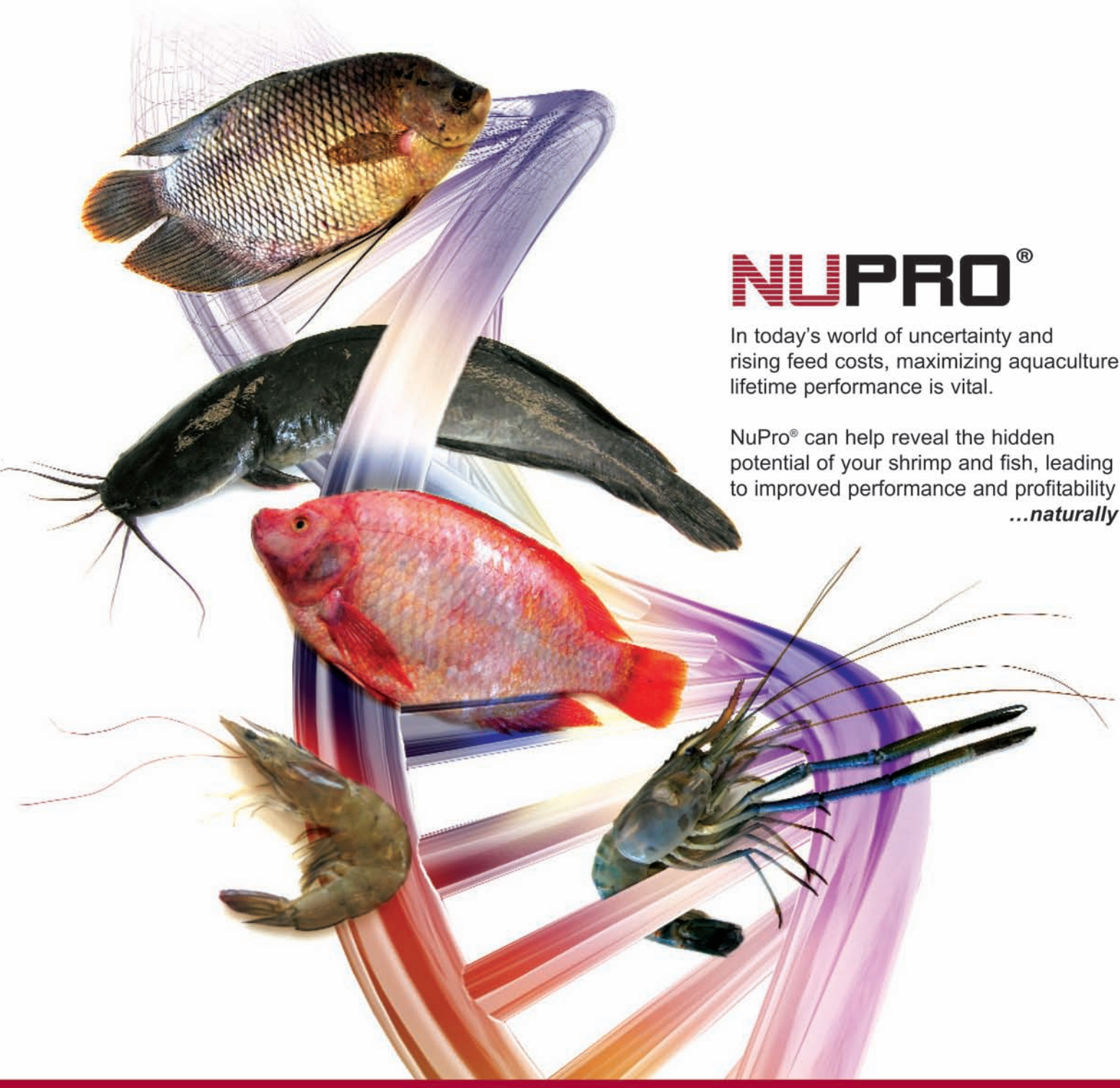

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India to farm vannamei

The long wait for shrimp farmers in India is now over. In early October, the government announced that Pacific white shrimp *Penaeus vannamei* will be farmed in India. The Newspaper Mint, quoted Vishnu Bhat, Director of Marine Products Export Development Authority (MPEDA), that the Rajiv Gandhi Centre for Aquaculture in Chennai will likely be the authority to import vannamei broodstock and keep it in quarantine before distributing to hatcheries and farmers.

In 2003, the Government had allowed two private companies to introduce the shrimp. This gave the companies the monopoly, said Fishing Chimes in its July 2008 editorial. It added that 'if the pilot trials to introduce the shrimp had been given to a Central Research Institute which would have tested the desirability or otherwise of introducing the shrimp, the decision would be accompanied by a set of guidelines and a clear plan of action'. Instead there has been confusing news since mid 2008 on whether the government is giving the go ahead or not. It also added that with the focus on this shrimp, the Indian white shrimp *P. indicus* has been neglected whilst there was some success in producing disease- free black tiger shrimp. The production of the black tiger shrimp has stagnated to around 100,000 tonnes annually since 2005. Production is expected to decrease further by end 2008.

S. Muthukaruppan, General Secretary, Society of Aquaculture Professionals (SAP) said that the news is a relief for many. He added that with the current economic situation, India needs to look at 'a lower end model' which the vannamei shrimp represents.

The Department of Animal Husbandry, Dairying and Fisheries has released guidelines for import of the species and for its culture. Permission for importing SPF vannamei broodstock will be granted by the Coastal Aquaculture Authority (CAA) keeping the annual requirements in mind. CAA, in consultation with the National Fisheries Development Board (NFDB), Central Institute of Brackishwater Aquaculture (CIBA) and MPEDA will shortlist the overseas suppliers based on the genetic base and disease status. Import of broodstock will be permitted only from such suppliers.

Chennai will be the designated port of entry for the imported broodstock. There will be an inspection of the consignment by the Animal Quarantine Officer before dispatch to the quarantine facility. The use of pond-reared broodstock is strictly prohibited and hatcheries involved in vannamei postlarvae production should not have any other species within the hatchery premises. Nauplii should not be sold to other hatcheries.

In the guidelines for culture, registered farms must submit an application to farm the species. These must have established bio-security measures as well as an Effluent Treatment System (ETS). Farms with zero water exchange systems will be encouraged to farm the shrimp. Approved farms cannot farm any other crustacean species. Stocking densities should not exceed 60 PL/m^2. Guidelines are available at http://dahd.nic.in/hatcheryguidelines.htm and http://dahd.nic.in/guidelineforSPF.htm, respectively

Crisis in shrimp sector and the way forward

In May, SAP organised a one day brainstorming session with Government representatives, farmers and other stakeholders of the shrimp industry on 'Crisis in shrimp sector and the way forward'. At this meeting, stakeholders from various associations spoke on issues faced by different segments of the industry. Falling prices, increased production risks in *P. monodon* due to WSSV, loose shell and slow growth, increase in production costs (by 25-30% as compared to those in other countries) were the major highlights of the meeting. The shrinking market share of black tiger shrimp especially for 30-40 count and antibiotic residues were some issues highlighted by exporters. The fall in post larvae production by 46% compared to 2007 and the increased WSSV prevalence in wild caught *P. monodon* broodstock were the issues raised by hatcheries.

It was during this meeting of SAP, that the unanimity among various stakeholders in allowing the vannamei shrimp into the country was confirmed. The two companies which were licensed to carry out trials with the shrimp had confirmed that farming vannamei was profitable for them. In the trials vannamei was stocked at densities of 7-25pcs/m^2 and grew to a maximum of 35 g in 170 days, the cost of production was under INR120/kg (USD 2.4/kg) and the culture was successful in all salinities.

SAP President, D Ramraj presented the industry's request for the introduction of the shrimp so that farmers can have a choice to diversify. To expand markets, the government also agreed to have road shows to increase domestic consumption of the shrimp.

SAP is conducting its 4th Annual event "Aqua India 2008" in Chennai, India on the 28-29 November 2008. The theme of the meet is "New Technologies and Initiatives". The two day event will focus on new technologies in shrimp culture. International and local speakers will discuss selective breeding, maturation, larval rearing and grow-out technologies with the thrust on markets. The selective breeding program of Moana Technologies in India will also be presented. On day two, technologies for seed production and grow-out of the tilapia and seabass will be covered (see page 35).

More whites from Vietnam

As prices are better for the white shrimp *P. vannamei* at VND150,000/kg (USD9/kg) farmers in Bac Lieu and Ca Mau in the Mekong Delta are expanding production areas. The average output is now 10-13 tonnes/ha and producers can earn USD 7,500 to USD 9,373/ha, according to Dinh Vu Hai, Technical Manager of Hai Nguyen Co in Fishsite.com. The advantage of culturing the white shrimp is the shorter days of culture (70-80 days) as compared to that for the black tiger shrimp. This allows for three cycles per year. In January, the Ministry of Agriculture and Rural Development (MARD) allowed coastal provinces in the south to farm the vannamei shrimp. The limitation was that it will control culture areas, but most farmers have expanded beyond the permissible level of 10ha.

The farms in Quang Ninh to Binh Thuan in the central region showed that white shrimp could develop well in sandy soil. White shrimp has become the rival to black tiger shrimp, according to www.vnbusinessnews.com. The production cost of white shrimp is VND30,000/kg (USD1.79/kg) whilst it costs VND65-75,000/kg (USD 3.87-4.46/kg) for the black tiger shrimp. Even though MARD wants the farmers to diversify shrimp species, it does not encourage the proliferation of hatcheries. These are limited to the central region. In the future, it wants the black tiger shrimp as the main shrimp in the Mekong River Delta.

Draft standards for responsible tilapia aquaculture

The World Wildlife Fund (WWF) has released the first set of measurable, performance-based tilapia aquaculture standards created through a transparent and multi-stakeholder process for public comment.

The draft standards were developed by the Tilapia Aquaculture Dialogue, a group of tilapia producers, seafood buyers, nonprofit organizations, and other tilapia aquaculture stakeholders. The Steering Committee includes representatives from Regal Springs Trading Company, Sustainable Fisheries Partnership, New England Aquarium, Aquamar, Rain Forest Aquaculture and WWF.

"When finalized, these will be the world's most robust standards for the tilapia aquaculture industry," said Jose Villalon, director of the WWF-US Aquaculture Program. "They also will be the most credible standards, as they will be the outcome of three years of open discussions and consensus building among leaders in the tilapia farming industry."

The standards are designed to minimize the impacts, identified by dialogue participants, that cause 70-80% of the problems associated with tilapia farming. This includes chemicals (used to treat diseases, etc) released into the water, non-native tilapia escaping from farms and water being diverted for use on farms.

Comments on the draft standards will be accepted through February 2009. The purpose of the public comment period is to have inputs so that the standards are effective and attainable. The standards will be posted for two months, in accordance with the International Social and Environmental Accreditation and Labeling (ISEAL) Alliance's Code of Good Practice for Setting Social and Environmental Standards.

The dialogue participants will have one month to review the comments before posting an updated version of the standards that reflects the comments received. This three-month cycle will be repeated once. Final standards are expected in March 2009. When finalized, the standards will be given to a standards-holding entity that will use independent third-party certification bodies to audit farms. Third party involvement ensures fair and effective management of the standards. To read and comment on the tilapia standards, go to www.worldwildlife.org/tilapiadialogue

Shrimp Aquaculture Dialogue to meet in Asia

The Shrimp Aquaculture Dialogue initiated by the World Wildlife Fund (WWF) will hold its first meeting in Bangkok, Thailand from 17-18 November to develop standards for shrimp farming.

A first meeting in Asia, participants will work on creating the criteria to focus on in order to reduce each of the key environmental and social impacts related to shrimp farming. They then will create indicators, or points of measurement to determine the extent of each impact. They will build on draft criteria and indicators discussed at previous dialogue meetings, as well as the "International Principles for Responsible Shrimp Farming" adopted in 2006 by the Food and Agriculture Organization of the United Nations. (More information: The Shrimp Dialogue meeting will be from 9 a.m. to 5 p.m. at the Hotel Sofitel Centara Grand Bangkok. Email: Shrimp Dialogue coordinator Eric Bernard by October 29 at ebernard@wwf.fr or contact the WWF Thailand office at 104 Outreach Building, AIT, Paholyothin Road, Klong Nung, Klong Luang, Pathum Thani 12120, Fax 02 524 6134. Web: www.worldwildlife.org/shrimpdialogue

News in brief

CP Prima sales up 42%

Indonesia's PT Central Proteinaprima (CP Prima) has reported net sales of IDR 3.68 trillion (USD 367 million) for the first half of 2008, an increase of 42.18% from IDR 2.59 trillion (USD 268 million) in June 2007. CP Prima is the world's largest fully vertically integrated shrimp producer. It operates more 50,000 ha in several locations. Fajar Reksoprodjo, Corporate Communications said that CP Prima is optimistic that demand for its shrimp in the US and international markets will be high because of the farming technology and assurance on traceability and food safety. In Investor Daily, Shrimp Commission Indonesia, Shidiq Moesli said that the effect of the current financial crisis may begin to impact shrimp exports from Indonesia only in early 2009 after the 2008 contracts expire. In the US shrimp market, Indonesia is the fourth largest exporter after Thailand, China and Ecuador with 10% of the volume.

New generation fish in Mindanoa

The Philippines imported 500 tonnes of Pangasius catfish fillet from Vietnam for restaurants and fast food chains, according to Department of Trade and Industry (DTI) figures. The culture of Pangasius in the country, offers not only marketing opportunity for producers but also for exports as demand is high in US, Europe and Russia, said Rochelle A. Otoc, DTI in BusinessWorld. The farm gate price is PHP 50/kg (USD 1/kg). A freshwater pond can accommodate 100,000 fingerlings/ha, which could net at least 85,000kg at 85% survival rate. The DTI is optimistic that fish farmers will start production by converting some of their tilapia and African or native catfish ponds.

Hainan is second with tilapia

The rapid expansion in tilapia farming in Hainan Province, China with 1.14 million ha of ponds and 146,000 tonnes has made it second in production to Guangdong Province. Tilapia from Hainan now accounts for 70% of freshwater production and 15% of total output for China. According to the Hainan Provincial Marine and Fishery Department, the total exports of tilapia from Hainan totaled 19,800 tonnes, valued at USD 57.1 million from January to August 2008. The report in zhuzheli.com said that the increase in production was due to international market demand and its excellent quality. The latter was attributed to the importance placed on quality and safety of its products.

Booming fish farming in Cambodia

The government in Cambodia is encouraging freshwater fish fry production to meet demand. Ten million is required to stock small scale ponds. Fish farming is attracting foreign investment. The Fisheries Administration cited a Hungarian investing USD50 million in fish farms and a fish processing factory. In the report in Phnom Pen Post, Oceans King Company said that five million fry are used for a 20 ha fish farm in Kampong Speu province and 100 ha farm in Koh Kong province. The company plans to export 1,000 tonnes of fish fillet to America, Australia, Singapore and Hong Kong.

TUF acquires Avanti shares

Thai Union Frozen Products PCL.(TUF) of Thailand said that it will acquire shares of Avanti Feeds Limited (AFL) for THB 40 million. AFL is ranked as India's second largest shrimp feed manufacturer and is listed on the Bombay Stock Exchange. TUF is a major processor and exporter of canned and frozen seafood. This will increase its presence in India which has a strong potential in shrimp production, especially after the government's change in policy to allow *P. vannamei* shrimp culture, said Thiraphong Chansiri, TUF President. After the investment, TUF will own a 14.99% stake in AFL. TUF, through its subsidiary Thai Union Feedmill (TFM) is already working with AFL. TFM specializes in production and distribution of aqua feed products for shrimp and fish in Thailand. TFM has been supporting Avanti with its technical know-how on feed production for black-tiger shrimp over last few years.

Marketing tilapia from Tainan

Faced with competition from major producers of tilapia such as China, Egypt, the Philippines, Indonesia, Thailand and Brazil, Tainan County in Taiwan is helping its fish farmers to obtain international quality certification for their tilapia to enter markets in Japan and Europe. The aim is to establish a production and sales traceability system in order to create a niche market for quality Taiwan tilapia that would be a cut above the cheap tilapia sold by other countries. The program has 18 fish farmers and members of the county's two aquaculture associations with 72 ha of fish farms. Tainan produces 33,000 tonnes of the annual production of between 82,000 and 89,000 tonnes. The annual export volume is 40,000 tonnes. Taiwan's tilapia was barred from markets in European Union countries for many years due to contamination with unacceptable levels of chemical residues.

Cargill acquires feed mill in Medan

Cargill Animal Nutrition Indonesia has finalized a purchase agreement with PT Berlian Unggas Sakti to buy its animal feed mill in Tanjung Morawa, Medan, Indonesia. Cargill purchased all the physical assets of the feed mill. The acquisition will complement Cargill's existing animal feed business by extending Cargill's current supply network and coverage in Indonesia. Cargill has already committed to invest in a new extruder at the facility to cater to the floating fish feed market in Sumatera Island.

Shrimp farms in South Africa

Thailand's Board of Investment (BoI) is encouraging Thai firms to invest in emerging markets, according to the Bangkok Post. Charoen Pokphand (CP) will invest in shrimp farming projects in South Africa. It has set up a marketing unit for shrimp exports from India to South Africa. The company already has four shrimp farms in India.

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Selective breeding of Pacific white shrimp

By Shaun M. Moss, Dustin R. Moss, Steve M. Arce and Clete A. Otoshi

Researchers at Hawaii's Oceanic Institute have already developed a comprehensive shrimp breeding program for the Pacific white shrimp. Next is to select shrimp for resistance to IMNV and NHP and to optimize growth and survival of the shrimp under stable grow-out conditions.

Oceanic Institute (OI) in Hawaii, USA is a non-profit organization dedicated to applied aquaculture research, education, and training. In collaboration with scientists from the University of Arizona (UAZ), OI developed the first population of Specific Pathogen Free (SPF) Pacific white shrimp, *Penaeus vannamei*, in the early 1990s. In addition, it developed the first comprehensive shrimp breeding program to improve commercially important traits such as growth and disease resistance.

SPF breeding program

OI has been operating a family-based breeding program since 1994. Researchers obtained founder stocks of *P. vannamei* from different regions of its natural range, including Mexico, Ecuador, and Panama and this has resulted in OI having the world's most genetically diverse SPF population of selectively bred shrimp. New populations are added to the program periodically to increase genetic diversity of the breeding stocks. This is done to minimize inbreeding and to add potentially valuable and unique genes to OI's germplasm. The most recent population was introduced into the breeding program in early 2008.

Importantly, all OI shrimp are free of specifically listed pathogens including nine viruses, one prokaryote, and three protozoa. Viruses include White spot syndrome virus (WSSV), Taura syndrome virus (TSV), Yellow head virus (YHV) and Infectious hypodermal and hematopoietic necrosis virus (IHHNV), among others. In order to maintain the SPF status of the shrimp, all parent stocks are held in a high biosecurity Nucleus Breeding Center (NBC) where shrimp are kept indoors and where water is continuously recirculated and disinfected. In addition, OI participates in a rigorous disease surveillance program where all shrimp populations are routinely tested for pathogens. Disease testing is conducted by scientists at UAZ in conjunction with the State of Hawaii's Shrimp Surveillance and Certification Program.

Benefits of selective breeding

OI continues to play a significant role in establishing some of the fundamental principles of operating a family based breeding program for shrimp. OI researchers produce full-sib families from three shrimp lines per year and families are evaluated for growth and survival in ponds and tanks, as well as for resistance to multiple strains of TSV in laboratory challenge tests. Researchers use both between- and within-family selection strategies to improve shrimp performance (Fig. 1).

P. vannamei from OI's breeding program. Shrimp are injected with an elastomer tag (close-up in right photo) for family identification. Once tagged, shrimp can be cultured in a common environment and inferences can be made about family performance. During harvest, large shrimp from each family receive an eye tag for individual identification (left photo) and are later used for broodstock.

OI is also collaborating with scientists from UAZ and the University of Southern Mississippi, (Mississippi, USA) to explore the possibility of selecting shrimp for resistance to Infectious myonecrosis virus (IMNV) and Necrotizing Hepatopancreatitus (NHP). Both of these pathogens have caused significant disease problems throughout the major shrimp farming regions of the world.

Currently, OI has families of shrimp that exhibit 100% survival after exposure to TSV. In addition, there are families of shrimp that exhibit fast growth and high survival when cultured in raceways stocked at super-intensive densities (> 400 shrimp/m^2) and when reared in open, coastal ponds stocked at less intensive densities (Table 1). These results indicate that significant improvements in shrimp performance can be made through selective breeding.

Table 1. Recent performance of four shrimp families from OI's breeding program. Shrimp from these families were evaluated in open, coastal ponds during a research trial at a commercial farm in Asia and in a biosecure raceway at OI. In addition, shrimp from these families were evaluated for TSV resistance in a laboratory challenge test.

ADG = average daily weight gain.

Family	Asia ADG[a] (g)	Asia Survival[a] (%)	OI ADG[b] (g)	OI Survival[b] (%)	TSV Survival (%)
A	0.21	94.8	0.24	84.8	92.5
B	0.22	94.8	0.24	81.3	82.5
C	0.22	96.9	0.25	87.8	92.5
D	0.23	97.9	0.27	87.0	82.5

[a] *shrimp were stocked at 120/m^2*
[b] *shrimp were stocked at 400/m^2*

Current challenges

Although selective breeding offers a tremendous opportunity for increased production and profitability for the shrimp farmer, there are significant challenges associated with operating an effective breeding program. Commercial shrimp hatcheries throughout Asia typically use broodstock shrimp of unknown pedigree and this was an acceptable practice when broodstock were collected from the wild. However, most broodstock used by the industry now come from domesticated stocks of *P. vannamei* which likely originated from a narrow genetic base.

As a consequence, these stocks are highly susceptible to inbreeding which can cause a decline in shrimp reproductive performance, as well as reduced disease resistance. To minimize inbreeding, OI uses a pedigree database to quantify the degree of relatedness among all shrimp families so that the mating of closely related shrimp can be eliminated. In addition, the database links shrimp performance to pedigree data to maximize genetic gain. Currently, there are more than 180,000 individual shrimp records in the database.

Outside and inside view of the recirculating production system

'It is important for farmers using selectively bred shrimp to adopt cost-effective, biosecure strategies to mitigate the risk of pathogen introduction…"

The value of selectively bred shrimp cannot be fully realized if shrimp are grown in an environment where virulent pathogens exist or if there are widely fluctuating environmental conditions. It is important for farmers using selectively bred shrimp to adopt cost-effective, biosecure strategies to mitigate the risk of pathogen introduction into their growout ponds. They must also control and standardize growout conditions so that the genetic potential of their crop can be fully realized.

OI has developed a recirculating production system which prevents the introduction of pathogens and creates a stable environment within which selectively bred shrimp can flourish. During 2007, OI researchers conducted a trial in a 337m^2 recirculating system which was stocked with 828 shrimp/m^2. After 83 days, shrimp were harvested with a mean weight of 18.3 g. Survival was 67.9%, growth rate was 1.50 g/week, FCR was 1.5, and production was 10.3 kg/m^2 (6.4 kg/m^3).

Bottomline

As the economic benefits of selective breeding become more convincing, it is likely that the global shrimp farming industry will invest significant resources in SPF, selective breeding programs to produce genetically superior stocks reared under biosecure and stable growout conditions. Such programs will have the capacity to customize the genetics of the shrimp to match the unique conditions of the growout environment to increase production and profitability for the farmer.

From left, Clete Otoshi, Dustin Moss, Shaun Moss, and Steve Arce.

Shaun Moss is responsible for oversight of the Shrimp Department. He has a Ph.D. degree in Zoology from the University of Hawaii.
Dustin Moss is responsible for data analysis and shrimp breeding. He has a Masters degree in Fisheries Science from Auburn University.
Steve Arce is responsible for the maturation and hatchery phases of shrimp production and received his Bachelor's degree in Biology from the University of California at San Diego.
Clete Otoshi is responsible for the nursery and grow-out phases of shrimp production and received his Masters degree in Marine Biology from the University of Oregon.
Email: Shaun M. Moss (smoss@oceanicinstitute.org).

Sea bass seed production in Vietnam: Bridging the gap

By Zuridah Merican

The self financing hatchery at Nha Trang University has developed the protocol for hatchery production of sea bass, trained farmers and now regularly supply seed stock for commercial culture.

The culture of sea bass *Lates calcarifer* was introduced into Vietnam in the late 1990s using wild fingerlings and hatchery seed stock imported from Thailand and Malaysia. Seed stock also came from China via well boats buying fish from Vietnam for markets in China and Hong Kong. Due to the long distance travelled and a limited quarantine system, the imported fingerlings showed survival rates as low as 2%. The fingerling supply bottleneck, if continued would never develop the industry in Vietnam. A local hatchery production of sea bass fingerling was essential.

In 1997, Dr. Nguyen Huu Dung and his team at University of Fisheries (which was renamed in 2006 as the current Nha Trang University) started his initial studies in marine finfish hatchery production, i.e. biomass cultivation of microalgae and rotifer with the collaboration of scientists from the Norwegian University of Science and Technology (Trondheim, Norway) and the University of Algarve (Portugal) with financial support from the Norwegian Council for Higher Education (NUFU).

In 2001, the research group continued with studies on sea bass broodstock management and spawning as well as feeding regimes, aimed to develop a protocol for hatchery production of sea bass which was completed in 2003.

In 2006, after the completion of the Norwegian funding program, Nha Trang University established the Centre for Aquatic Animal Health and Breeding Studies (CAAHBS) based on the facilities, skill and experience developed through the collaboration program. The centre is now a self-financing unit and is set to play a bridging role between the academic institution and aquaculture business sectors, particularly the small-scale farmers. University students use its facilities to conduct their research and practise nursery management during afternoon practical sessions.

Broodstock collected from various provincial water bodies are tagged for identification to prevent in-breeding. A recirculation water system is used for both broodstock and hatchery tanks to precisely manage water parameters as well as diseases. Keeping broodstock in sea cages is not an option as Dung believes that it is impossible to protect the broodstock from various transmissible pathogens present in the water.

Seabass broodstock at the hatchery

Dung (right) and Kevin Chang, NTPL among outdoor cultures of green algae. The hatchery also provides microalgae and rotifer stocks to farmers. The initial rotifer stock was obtained from shrimp ponds

Feeding

According to Dung, it is important to harmonize the live feed biomass production and the spawning rhythm of the broodstock. Rotifers should be available to feed the one day post-hatch fish larvae. Starvation at first feeding stage would result in poor quality fingerlings with low survival and slow growth during grow-out. At day 1-10, feeding is with rotifers, followed by artemia and day 18-20 is the weaning period which is completed by day 25.

"We use Great Salt Lake artemia cysts, crumble and pelleted feeds, as well as enrichment diets from Inve extensively at CAAHBS during nursery stages. The hatchery is also trying pelleted feeds for its broodstock to compare the spawning performance and fingerling quality of groups of broodstock fed with various pellet feeds to those of broodstock fed with fresh trash fish with vitamin and mineral supplementation", said Dung.

Supply to farmers

CAAHBS is currently providing sea bass fingerlings to local farms. Today, the centre sells fingerlings at 2-3cm at US 6 cents each and 4-6cm fingerlings at US10 cents each. Production in 2008 increased 20% over that in 2007 to meet the demand from farmers. The current target is 10 million per year although it can be increased to 15 million if demand increases. The Centre also provide fish health management consultancy services and short training courses in fish health

At the hatchery, a simple feeding system developed at a marginal cost.

Live feed culture tanks

management, shrimp and finfish farming techniques and sea bass seed production to local farmers.

Subsequent to their training at the hatchery, local farmers have set up 10 small hatcheries, each with a capacity of 5 million fingerlings/year. The average survival is 40% from hatching to 3cm size.

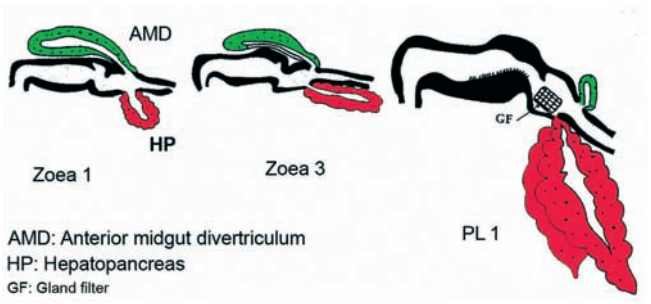
"My role is to help them start the core pilot system. We have a close relationship with hatchery operators and encourage them to supply only quality fingerlings to farmers to ensure a successful grow-out cycle. We also supply microalgae and rotifer stocks for these hatcheries. By checking on their feed usage through the regional feed supplier, we can indirectly judge the quality of the fingerlings", said Dung.

As the hatchery is successful in seabass, it will now diversify to another species. Dung has chosen the pompano.

Highly-digestible artificial feeds for shrimp larvae and postlarvae

By Roeland Wouters

The continuous decline in shrimp prices over the last years has driven shrimp farmers to implement cost cutting measures and improving production efficiency. At the hatchery level, more efforts are made to replace live food with nutritionally-balanced artificial feeds, thus simplifying larviculture systems and optimizing growth and survival of shrimp larvae. Although live Artemia nauplii are still the best food, the use of artificial diets can help to reduce and stabilize costs, to provide a more consistent nutrition and predictable output. These diets are now successfully used to partially replace live Artemia in commercial shrimp hatcheries. However, a total Artemia replacement is yet to be reached.



Changes in larval gut morphology (Zoea1, Zoea 3 and PL1). The hepatopancreas will become fully developed in late PL stages. Adapted from Jones et al. 1997.

Live food replacement with commercial feeds

In the eighties, the groups of David Jones (UK) and Akio Kanazawa (Japan) succeeded in the total replacement of live food for penaeid shrimp in zoea and mysis stages. This was provided a single dose of live algae was given at the first-feeding zoea 1 stage. In those days, the focus was mainly on algal substitution, but in late mysis stages, Artemia was also replaced successfully. The work of Jones and co-workers resulted in the development of commercial cross-linked protein microcapsules called Frippak®.

In the past decade, major projects were initiated by research institutes in the USA, Australia, Denmark and other countries aiming at Artemia replacement in shrimp (and fish) larviculture. Likewise, the aquafeed industry has invested in improving the performance of artificial hatchery feeds. As a result, the Artemia replacement levels applied by commercial hatcheries are steadily increasing year after year, albeit slowly. This is in part due to the fluctuating cost of Artemia cysts and to progress in feed formulation and feed processing technology.

Table 1 summarizes recent findings on the performance of experimental and commercial hatchery feeds. In general, the use of microbound feeds decreases survival as well as growth when fed at levels of 40-50% or higher. However, because of their lower cost compared to Artemia, a partial replacement can result in considerable savings during mysis and early postlarval stages.

Commercial-scale trials performed by Inve Technologies nv/sa and feed-back from customers indicate that the economical benefit of using Artemia replacement levels above 65% is not justifying the increased risk of culture failure (although this largely depends on the experience of the local hatchery staff). Not surprisingly, researchers

Preparing the transport of postlarvae to the grow-out farm.

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Table 1. The effect of Artemia replacement. The use of microbound feeds decreases survival or growth when fed at levels of 40-50% or higher. In controlled laboratory conditions, however, the results are generally better than in commercial hatcheries.

Species	Diet	Artemia replacement (%)	Larval stages	Result compared to Artemia control	References
Penaeus monodon	Crumbled experimental microbound diet	100	Z-PL	Similar survival but lower growth	Kanazawa 1982
P. monodon	Crumbled experimental microbound diet	100	Z-PL	Similar survival and growth	Kanazawa 1985
P. monodon	Microencapsulated diet Frippak®	100	Z-PL	Similar survival and growth	Jones et al. 1989
Litopenaeus vannamei	Microencapsulated diet	70-100	Z-PL	80% survival compared to 90% survival in live food control (commercial scale)	Jones et al. 1997
L. vannamei	Crumbled microbound diets Microfeast	25, 50, 75, 100	M-PL	Decreased growth rates at 50, 75 and 100% and decreased survival at 100%	Samocha et al. 1999
Litopenaeus setiferus	Crumbled experimental microbound diets	40, 60, 100	Z-M	Decreased survival, growth, development and stress resistance (but similar survival at 40 and 60% in the presence of algae)	Gallardo et al. 2002
P. monodon	Microencapsulated diet Frippak® Fresh	100	Z-PL	Increased survival, growth and development (one single dose of live algae in Zoea1)	Wouters et al. 2003
P. monodon	Crumbled microbound diet Frippak® Flake	40, 100	PL	Lower survival, similar (100%) or improved (40%) growth	Wouters et al. 2003
L. vannamei	Crumbled microbound diet Frippak® RW+	100	PL	Similar survival and growth in trial 1, lower survival and higher growth in trial 2 (98% survival in Artemia Shellfree control)	Wouters et al. 2003
Farfantepenaeus aztecus	Liquid feeds Epifeed™ and Liqualife™	50, 100	M-PL	Decreased survival (except Liqualife™ at 50%), growth and stress resistance	Robinson et al. 2005
F. aztecus	Microbound diets Zeigler™ E-Z Larvae, Zeigler™ Z-Plus and E-Z Artemia	50, 100	M-PL	Decreased survival, growth and stress resistance	Robinson et al. 2005

(*) References used in this table can be found in Jones et al. (1993) and Wouters & Van Horenbeeck (2003) or in the references below.

have also tried to replace Artemia with other live food, such as nematodes, or tried to give added value to Artemia cysts and nauplii.

This suggests that there is still much to be done in the field of larval nutrition before diets can consistently guarantee high survival and optimal post larval quality. In late postlarval stages, however, total Artemia replacement is possible and is common practice for several years.

Feed digestibility

The nutrition of shrimp involves an understanding of the behavioural, mechanical and physiological processes of feeding in the target larval or post larval stage. One of the key considerations is the development of the gut structure and function. Larvae of crustaceans have a simple gut structure that gradually becomes more complex. The physiology of the gut and gut enzymes also changes and since transit times may be quite short, designing a nutritious, easily-digestible diet is still a challenge. This is particularly important in early postlarval stages, when the increased consumption of Artemia is becoming a high cost in the hatchery operation.

It has been demonstrated with different penaeid species that enzyme secretion is particularly limited in postlarvae, which often are unable to digest sufficient amounts of full-length proteins and longer peptides present in the feed. Moreover, artificial diets generally contain 90% or more dry matter, compared to only 10% in Artemia nauplii, which renders dry particles harder to digest than live food.

Dietary enzymes

One area of investigation that has received little attention especially when compared to the agrifeed industry is the supplementation of artificial feeds with exogenous enzymes. Some studies with digestive enzymes have failed to demonstrate beneficial effects or have resulted in poor growth rates. The difficulty is to select or engineer enzymes that are active at relatively low temperatures, with an optimal functioning at the pH levels typical for the gut environment.

Following this, low-temperature feed processing technology is required to prevent denaturation of the applied thermolabile enzymes. Some examples of cold processing are microencapsulation for the

Early postlarval stages secrete low enzymes levels and therefore need highly digestible diets.

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Shrimp postlarvae.

production of Frippak® larval feeds as well as Refractance Window Drying (RWD™) for Frippak® flakes. Finally, feeds supplemented with enzymes need extra protection from nutrient leaching, as partial pre-digestion of raw materials will increase the proportion of water-soluble short peptides and amino acids.

Similarly, an increased inclusion of fish hydrolysates and amino acids in the feed formula needs to be countered with adequate feed technology to prevent losses of solubles through leaching. For larval shrimp stages, microencapsulation is the best way to prevent leaching, provided that easily digestible proteins and polymers are selected for cross-binding. The same applies for the selection of binders used in microbound particles for postlarvae.

A recent publication in the field of enzyme technology (Sirvas-Cornejo et al. 2007) refers to the use of microcapsules based on commercial diets (Frippak #2 CD) that have been supplemented with microbial digestive enzymes. The authors demonstrated the ability of the enzyme mixture to assist in the digestion of the protein available in the diet as well as in the walls of the capsules.

Another approach is to select only highly-digestible ingredients for feed formulation, such as using fresh marine ingredients in Frippak® Fresh larval diets: the ingredients are not dried nor milled into a meal, but are included as fresh or fresh-frozen material directly into the processing line. Some researchers (Ezquerra et al. 1997; Lemos & Nunes, 2008) have established in-vitro methods and in-vivo tests with enzymes and correlated protein digestibility of feed ingredients and/or commercial feeds with protein hydrolysis and shrimp growth in *Litopenaeus vannamei*. These examples indicate that enzyme technology combined with advanced feed technology may offer potential benefits for the development of highly-digestible shrimp feeds, needed by the shrimp farmers to cope with increasing economic pressures.

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Shrimp hatchery feeds in a shop in Vung Tau Vietnam.

Roeland Wouters, has a PhD in bio-engineering and is researcher with INVE Technologies based in Belgium since 2000. He has 15 years of experience in crustacean nutrition in Asia and Latin-America. E-mail: r.wouters@inve.be

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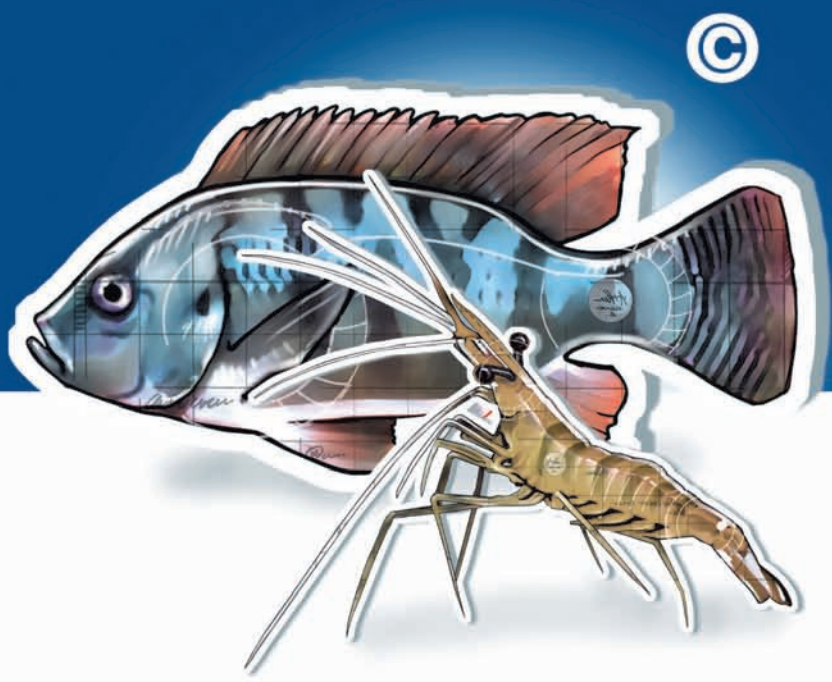

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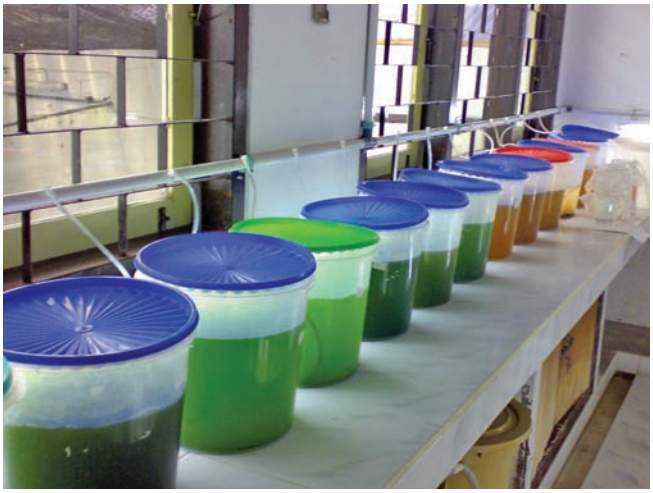
Review: Carotenoids in shrimp maturation and larval quality

By Regunathan

This is a two part article to increase awareness among shrimp hatchery operators on the importance of carotenoids in broodstock nutrition. Part 1 in Volume 4 (5) provided available information on the various types of carotenoids and discussed their functional role in shrimp reproduction.



Microalgae are one of the best sources of carotenoids

Part 2: Carotenoids in maturation diets

Carotenoid sources for broodstock diets

During penaeid shrimp maturation, nutrient reserves, mainly from the hepatopancreas, are mobilised to support ovarian and testicular maturation, gametogenesis and vitellogenesis (Harrison, 1997). Tissue reserves in the hepatopancreas can be depleted rapidly, especially under forced maturation by eyestalk ablation. Thus, the diet is the most important contributor of nutrients to the developing egg.

Moreover, unlike their wild counterparts, captive broodstock have less reserves of carotenoids in their body parts (Iamsamang et al. 1996, Linan-Cabello et al. 2003, Regunathan, 2008). This is because the natural diet of penaeids includes gastropods, bivalves, crustaceans and microalgae which contain a range of carotenoids including astaxanthin in various amounts.

However, even with wild broodstock, carotenoid supplementation is recommended. The repetitive spawning or extended stay under usual hatchery feed regime results in the depletion of body carotenoid reserves (around 3 to 4 weeks post ablation). This leads to reduction in the carotenoid content of ovary, eggs and nauplii (Regunathan, 2004). It is noteworthy that even growth and moulting results in loss of pigments (Latscha, 1991).

Astaxanthin has been proven to be a more effective source of pigmentation and antioxidant as it is twice as effective as β-carotene in quenching singlet oxygen. Antiperoxidative activity is 50% more than β-carotene and zeaxanthin. A better bioconversion to retinoids has been reported with β-carotene. It is also noted that eyestalk ablation, affects most of the transformation pathways of carotenoids, including its transformation to bioactive retinoids. Both astaxanthin and β-carotene are recommended in the diets of ablated spawners.

Based on their biological use, some authors have suggested including diverse carotenoids rather than a single cartoenoid in diets. However, retinoids are absent in the eggs, nauplii stages and protozoea (Dall et al. 1995), leading to the suggestion that they are not essential in early development of crustaceans and carotenoids may take their place.

Commercial maturation diets

These include one or more of the carotenoid sources such as seaweeds, crabmeal, Spirulina, astaxanthin etc. Most of the diets do not indicate the astaxanthin or total carotenoid levels in their diet. A specified concentration of astaxanthin in one of commercial diet is 250 mg/kg. Some producers also claim 100% replacement of fresh feeds with their diet but at present, these diets are used only to partially replace fresh feeds. Notwithstanding the feeding protocol, dietary carotenoids are crucial for successful reproductive performance and the customer should know the amount. Sustained feeding of fresh feeds alone has been shown to result in reduced pigmentation in ovary as well as in eggs and nauplii (Wyban et al. 1997).

The options available to hatchery owners for ensuring adequate supply of carotenoids in maturation diets are, either to rely on commercial diets with guaranteed carotenoid content, or supplement them with fresh feeds or with proven commercial carotenoid products or formulate semi moist diet with utmost care to control the loss of unstable carotenoids.

In earlier experiments by Wyban et al. (1997) and Regunathan & Wesley (2006), the carotenoid sources (Paprika and Spirulina, respectively) were mixed with fresh feed diet, marinated overnight in a refrigerator. Pelleted diets could be spray coated with powdered product and fish oil mix and then air dried under dark conditions before feeding. However, it is vital to confirm that the product is very stable in oil.

Table 1. Plant based carotenoid sources used in shrimp pigmentation experiments

Source	Major carotenoids
Red yeast *Phaffia rhodozyma* (=*Xanthophyllomyces dendrorhous*)	astaxanthin
Spirulina	ß-carotene, lutein
Microalgae *Dunaliella salina*	ß-carotene, zeaxanthin
Paprika *Capsicum annuum*	capsanthin, zeaxanthin, ßcarotene, capsorubin, ß-cryptoxanthin
Microalgae *Haematococcus pluvialis*	astaxanthin, ß-carotene and canthaxanthin
Marigold *Tagetes erectapetal* meal	lutein and zeaxanthin
Forage Alfalfa leaf meal (20% protein) dehydrated	lutein, zeaxanthin, beta carotene
Leguminous *Leucaena leucocephala* leaf meal	lutein, zeaxanthin

Until recently, most of the commercially produced pigments (astaxanthin, β-carotene and canthaxanthin) are artificially synthesized. However, present industry interest is in the use of natural sources. The reasons are that chemical synthesis produces mixtures of stereoisomers, some of which may not be found in nature and may not be as active as the naturally occurring carotenoid isomer. Furthermore, these may not be desired by the consuming public because of side effects and are not organic.

Numerous commercial products have been introduced as feed additive, with carotenoids extracted from natural sources like microalgae (*Dunaliella* spp. and *Haematococcus pluvialis*), yeast (*Xanthophyllomyces dendrorhous*), fungus (*Blakeslea trispora*), bacteria (*Paracoccus carotinifaciens*, *Zeaxanthinibacter enoshimensis*), marigold (*Tagetus erecta*) and leguminous plants (alfalfa *Medicago sativa*). They are available as powdered meal or beadlets or emulsion or oil suspension.

Table 2. Some of the common animal based carotenoid sources used in commercial diets

Source	Astaxanthin (mg/kg)
Krill (*Euphausia spp.*), meal	82
Frozen shrimp waste	157
Crawfish (*Procambarus clarkii*) meal	137
Red crab (*Pleuroncodes planipes*), waste	76
Norwegian shrimp meal	25
Shrimp offal, cooked (boiled)	66
Shrimp (*Pandalus borealis*), silaged	74
Shrimp (*P. borealis*), vacuum dried	100
Shrimp (*P. borealis*), carotenoprotein	1160
Lobster shells, cooked (boiled)	35
Shrimp (*P. borealis*), oil	1095
Krill (*Euphausia pacifica*), oil	727
Copepod (*Calanus finmarchicus*), oil	520
Red fish (Capelin) oil	71
Crab, red (*P. planipes*), oil extract	1550
Crawfish (*P. clarkii*), oil extract	750

Carotenoid sources

The various carotenoid sources which have been evaluated (Table 1) for pigmentation, survival, disease as well as stress resistance of cultured shrimp postlarvae, juveniles and adults could be used in a maturation diet, provided they are biologically converted to astaxanthin and retinoids. Astaxanthin concentrations in natural sources range from 1,500 ppm in the oils to 15,000-20,000 ppm in NatuRose™ (microalgae based commercial product) (Table 1 and 2).

When the maturation diet is formulated locally, it was noticed that common animal based carotenoid sources have some disadvantages when they are used for preparing diets. Crab meal suffers the disadvantage of introducing undesirable calcium into the formula. Krill is an excellent attractant and a rich source of highly unsaturated fatty acids, but is generally quite expensive. All crustacean meals have a relatively low content of astaxanthin and high levels of moisture and ash (generally in excess of 20%). Chitin poses the risk of disease transmission. A higher quantity of crustacean meal in the feeds for efficient pigmentation adds unwanted bulk and ash to the final feed.

Moreover, products such as krill meal raise doubts about contamination with PCBs, dioxins and heavy metals. The recommended inclusion level in shrimp grow-out diets is 5-10 % for shrimp head or shell meal, 23% for crab meal, 2 to 5% for krill meal. Antioxidants (natural or synthetic) have to be included to enhance carotenoid stability

Spirulina is a proven source of carotenoids

in the diet. The stability of the carotenoid when frozen or refrigerated needs further attention during the selection of a carotenoid source.

Inclusion rates for shrimp maturation

The recommended inclusion level in the shrimp grow-out diets (Chamberlain and Hunter, 2001), for carotenoid sources (astaxanthin 1550 ppm, β-carotene 50-100 ppm; canthaxanthin 50-100, Marigold extract 90 ppm, paprika 90-120 ppm, Spirulina 0.5 to 3%, xanthophylls 90-120 ppm) would be low for maturation feeds. For astaxanthin, a supplementation level of 150 ppm in maturation diet has been recommended (Todd Lorenz, www.cyanotech.com). Usually, the optimum inclusion level for a hatchery for a particular carotenoid source should be a matter of trial and error. This is because bioavailability of a particular carotenoid is influenced by numerous factors and would differ with different sources.

As mentioned above, only astaxanthin, paprika and Spirulina have been evaluated as carotenoid sources in shrimp maturation diets. The positive results have shown that they can be used as carotenoid sources in broodstock diets. However, both non astaxanthin sources (capsanthin and other carotenoids in paprika, β-carotene, zeaxanthin and other carotenoids in Spirulina) need a lag time (3 to 4 weeks) for their bioconversion to astaxanthin. Any carotenoid source supplied will be converted to astaxanthin through a metabolic pathway and its proximity to astaxanthin in the pathway makes it more efficient. When non astaxanthin sources are used, for successful results, the broodstock (especially captive ones) needs to be fed enriched diet weeks in advance before the production process is executed, allowing enough time for bioconversion.

Other carotenoid sources suggested include carotenoid-rich flowers (*Adonis annua*, *A.aestivalis*), microalgae meal (*Chlorella vulgaris*), seaweeds (*Fucus serratus*), marine protests thraustochytrids (genus *Thraustochytrium* and *Schizochytrium*), aerial microalga *Coelastrella striolata* var. *multistriata*, astaxanthin extracted from shells of prawns and crabs.

Future prospects and research needs

It is vital to know that oxidation of carotenoids may occur by autoxidation, by free radical chain reaction with oxygen or by photo oxidation which is produced by oxygen in the presence of light. Different techniques are presently followed to improve the carotenoid stability. Prevention of degradation by providing them with a protective layer of biopolymers (encapsulants such as gum arabic) is now widely practiced. Even the feed production process like pelleting and extrusion could lead to some carotenoid losses and even during storage. So, the carotenoid product or prepared feeds need to be taken care to avoid carotenoid loss.

As multiple factors that affect their absorption, breakdown, transport, and storage, different commercial products needs to be critically assessed as carotenoid source for shrimp broodstock. Bioavailability of carotenoids in fishes has been noted to be influenced by animal size, ration level, dietary lipid, composition of carotenoid sources etc.

A future trend would be to have more natural carotenoid in the feed additive market. Unfortunately, at present, natural sources of astaxanthin are not cheap and face severe price competition with synthetic astaxanthin (<USD 2,000/kg).

The recent decision by Hawaii based Cyanotech Corporation to discontinue its production of Naturose™ (algae meal from astaxanthin rich *Haematococcus pluvialis*) was due to price competition from synthetic astaxanthin (http://www.cyanotech.com/news/news_032608.html). The price of other natural carotenoid sources range from nearly USD 620 to 2,000/kg of active principle. Cost reduction with pigment production may be achieved through isolated or combined strategies, such as optimization of production technology, improved carotenoid content in sources through selection or mutagenesis, better processing methods to improve bioavailability and reduce losses, developing low- cost based fermentation media for microbial production of carotenoids etc. This would make the products or the feeds incorporating them affordable to hatchery owners.

A better understanding of the functions of carotenoids is lacking at the molecular level. In addition, the pathways, possible mechanisms of carotenoid breakdown and factors affecting the bioavailability of carotenoids (carotenoid type, interaction with other carotenoids, antioxidants and other food components, stereo and geometric isomers, nutritional status and infection), and bioconversion to retinoids, all needs further study.

Recently, contrary to general belief, the in vitro experiment results of Liu and Osawa (2007) showed that cis-astaxanthin especially 9-cis-astaxanthin exhibited a higher antioxidant effect than the all-trans isomer. Studies with fish have shown that carotenoids have synergistic effects with other antioxidants such as Vitamins C and E. In shrimp, the crucial role played by Vitamin C and E in maturation process has been proven (Alava et al. 1993, Cahu et al. 1995, Wouters et al. 2001).

It is believed that in future public interest and government regulations would favour the use of natural carotenoids. Technical advances in production processes would certainly bring down the cost of products.

Regunathan, PhD. is currently Project Manager at Al Oula Marine Consulting in Kuwait and is responsible for finfish and shellfish aquaculture. He has a M.Sc. Mariculture from Cochin Univ. of Science & Technology and a PhD from M.S. University, India. Email: drregu@gmail.com

Intestinal absorption and incorporation of protein in a carp and catfish

By Partha Bandyopadhyay

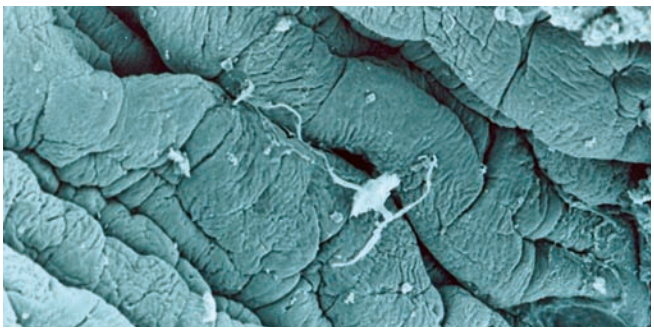
Investigations to provide a better understanding of the absorption of amino acids and protein in two species of carps and catfish that will help to develop the right formulation and feeding strategy.

Dietary protein is considered to be of primary importance in fish feeds. Its requirements in fish are higher than those of terrestrial animals. Protein is the basic building nutrient of any growing animal and muscle constituents and it is the major component of the fish body (68-85% dry wt). The degradation products of protein are absorbed from the intestinal content as amino acids or peptides.

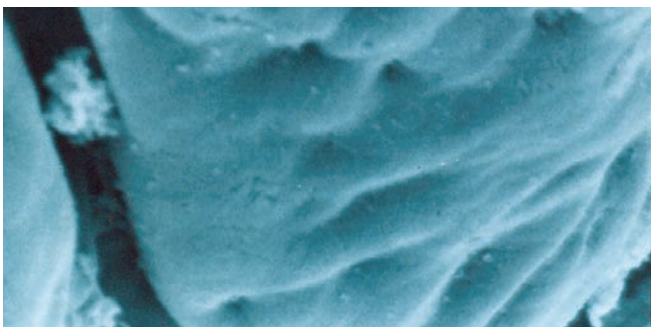
Individual amino acids are readily absorbed against concentration gradients and active transport is driven by co-transport with H+ or Na+. These inorganic ions transport according to their electrochemical potential.

To some extent, protein and peptides in the intestinal content are probably also taken up, without previous degradation, by pinocytosis or related processes. A satisfactory level and balance of amino acids in a diet does not guarantee that ingestion of the diet will satisfy the amino acid requirements of the fish. This could be made only by proper digestion and most important is the absorption from the intestinal content.

The use of cheaper but nutritionally balanced artificial diets is becoming common in intensive and semi-intensive culture systems. The following investigation on the intestinal absorption and incorporation of protein may help to explain to fish nutritionists the difference in protein utilisation between ingredients and pave the way for the use different protein sources.



SEM showing the serosal layer of the anterior part of the intestine (20 cm apart from the oesophagus) of the carp L. rohita



SEM showing the serosal layer of the intestine of the carp L. rohita

Selection of fish

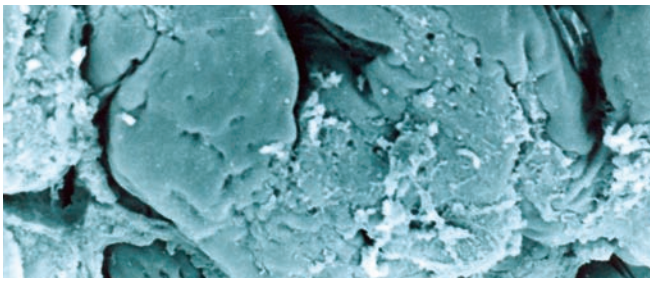
Two fish species were selected for the present investigation. The Indian major carp *Labeo rohita* is herbivorous and does not have a stomach. The other fish was the air-breathing and carnivorous catfish *Clarias* batrachus with a stomach. In India, both are important culture species, although the latter has only emerged recently.

Fry and fingerlings were obtained from a local fish farm. After acclimatization, these were transferred to a large aquarium, sectioned into four compartments with perforated plastic. There were four groups each consisting of 10 fish. The fish were maintained with Halver's synthetic diet or sometimes with live food i.e.zooplankton.

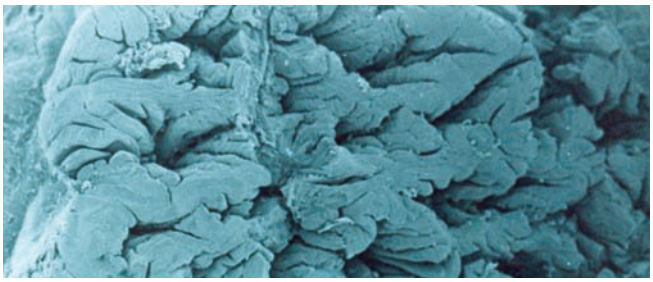
Absorption of protein

This was analysed by the everted and non everted sac technique. Fish were starved for 24 hours to empty intestinal (agastric fish) residues. Thread ligatures were placed at the esophageal (upper and lower), stomach, duodenal, anterior intestinal and posterior intestinal junctions in anaesthetized fish. Thorough and clean washing is essential for a correct estimation of absorption, because the presence of any food particle may give an erroneous result. Two small incisions were made at the opposite ends of each ligatured section in selected parts of the intestine such a (oesophagus, stomach, duodenum and ileum etc). These were then thoroughly washed with Krebs-Ringer bicarbonate solution at 30°C.

One ml Kreb-Ringer bicarbonate solution in 100mg of fish saline/per µg of protein at 30ºC was injected into each of the above segment. The vicera and the ligatured segments were kept moist with Krebs-Ringer



SEM showing the serosal layer of the catfish C. batrachus



SEM showing the intestinal serosal layer with absorption sites of catfish C. batrachus (last part of the intestine).

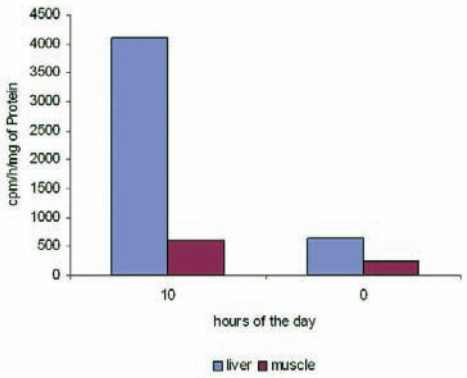


Figure 5: Rate of amino acid assimilation in the carp Labeo rohita

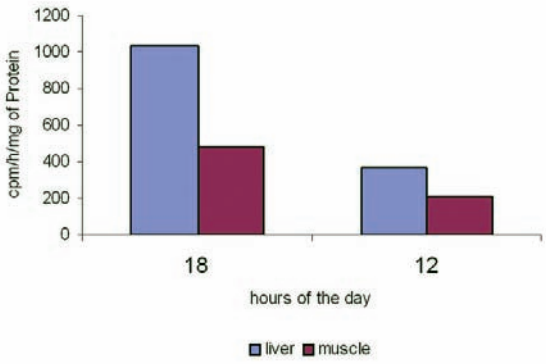


Figure 6: Rate of amino acid assimilation of the catfish Clarias betrachus

bicarbonate/fish saline solution at 30ºC in an incubator. Absorption was allowed for 30, 60 and 90 minutes, following which the segments were removed from the rest of the gut.

The post absorption fluid from the different segments were collected in vials and wet weight recorded. An aliquot of the fluid was taken for spectrophotometric determination of protein and amino acid and was expressed as g protein/ amino acid absorbed hour^{-1}cm^{-1}. This experiment was repeated six times.

The site of absorption of protein in the intestine was observed using Scanning Electron Microscopy (SEM) techniques. Tissues were fixed in primary fixative gluteraldehyde for 15 minutes, kept for 24 hours and then washed by cacodylate buffer with three changes at 15 minutes intervals. The tissues were fixed in 1% Osmeum tetroxide for 2 hours. The tissue was then dehydrated with graded ethanol.

Tissues were kept in acetone to a critical point of drying (CPD). These were then coated with gold - palladium malloy (160 Å thickness) for 5 to 15 minutes in three consecutive series on a sputter coater (Polaron Equipment Ltd., SEM coating unit E 5000) for uniform coating to enhance material density and electrical conductivity. This was necessary for emission of secondary electrons for fine and perfect image. Samples were then observed under a Scanning Electron Microscope Philips SEM 515 at varying magnifications. Selected areas were photographed.

Absorption of amino acid

The results showed that the absorption of amino acid was always higher in the posterior intestine of both the carp and catfish. There are no specific differences in the rate of absorption of non polar, polar, basic or other amino acids in the intestinal serosal layer of both fish. The SEM of different intestinal segments (serosa) of the carp (Figures 1& 2) and catfish (Figure 3 & 4) revealed that the amino acid could be absorbed in all the intestinal segments starting just below the stomach to the rectum of the catfish (Figure 6). However, amino acid cannot be absorbed in the last part of the posterior intestine to rectum in the case of the carp.

Satiation time

In both fish, satiation time was about 60 minutes after feeding and this may stretch to about 90 minutes for the catfish. However, both fish may continue feeding up to 2 hours, depending upon the physico-chemical parameters of water and climatic condition such as temperature.

The feed intake was maximum at 10 am to 12 noon and minimum at midnight for the carp. It was maximum at 6 pm and minimum at 12 noon for the catfish.

Amino acid assimilation

Figure 5 & 6 showed that the maximum amino acid assimilation took place at 10 hours for the carp and 18 hours for the catfish. Maximum incorporation takes place at 2 hours in the liver and 4 hours in muscle, in the case of both fish. However, there are no differences in assimilation rate either in the liver or in the muscle with formulated diets and synthetic diets in both fish.

Conclusion

Differences in protein utilisation between diets may be due to the different in rates of digestion and absorption of the constituent amino acids. Optimal protein synthesis requires that all amino acids are present simultaneously and in adequate quantities within the tissues. It is generally accepted that amino acids in excess of requirement, are used for energy purposes or metabolized into fat or glycogen. However, excretion of amino acids cannot be excluded.

The middle intestinal segment had the ability to absorb macromolecules of protein by pinocytosis. A similar situation appeared to exist in both fish, which showed strong alkaline phosphatase activity in the anterior intestine. It was also observed that almost all essential amino acids were absorbed rapidly in the anterior 40 –50% portion of the intestine of carps and catfishes. Macromolecules of protein such as ferritin was absorbed in the middle segment of the intestine by pinocytosis, i.e. engulfing of macromolecules of protein by the enterocytes.

References are available on request.

Dr. Partha Bandyopadhyay is Technical Executive in Aqua Division of Biostadt India Limited, Mumbai, India.
Email:partha.bandyopadhyay@biostadt.com

Marine fish in Vietnam

by Nguyen Huu Dung

Some challenges and opportunities in marine fish culture in Vietnam

Vietnam's marine fish culture industry started to expand from the early 1990s. Currently the major species are the malabar grouper, *Epinephelus malabaricus*, humpback grouper, *Cromileptis altivelis*, estuarine grouper *E. coioides*, sea bass *Lates calcarifer* and cobia *Rachycendron canadum*. The main culture areas are from Quang Ninh to Nghe An Provinces in the North, Phu Yen and Khanh Hoa Provinces in the central regions, to Ba Ria - Vung Tau Provinces in the South.

With the exception of large offshore farms involved mainly in cobia farming, most marine fish farming enterprises are small scale and traditional coastal cages. In 2005, the Ministry of Fisheries reported 3,250 tonnes of production. Industry has estimated the annual production of marine fish in Vietnam at 20,000 tonnes, excluding the direct export of fish.

However, the development of marine fish farming lags behind that of other countries mainly because of the lack of knowledge on culture and hatchery technology. For marketing, it is totally dependent on buyers of live fish from Hong Kong and China. There is still a dependence on imported seed stock and with a primitive quarantine system in place, the suspicion is that poor quality fry and fingerlings are being sold to producers in Vietnam. The industry is also dependent on trash fish as feed for all types of marine fish which has resulted in a negative impact on the environment.

Nursery cages at NTPL (see page 25)

Foreign direct investments into the sector are increasing. The industry has attracted investors from Taiwan, Norway, Russia, China and Australia, all of which have strong background and technical know-how in marine fish production. There is however, no data on production from these enterprises. It is also unfortunate that many of these large companies also use trash fish as the main feed item. The consumption can be estimated at 5-10 tonnes of trash fish/tonne of fish produced at an FCR of 5-6. Diseases such as viral nervous necrosis (VNN), vibrio and parasites are common.

In Vung Tau, cobia culture in traditional cages at the 20 cage-farm of Ms Trinh My Hong. Here 6kg fish are sold fresh at VND 65,000-70,000/kg (USD 4/kg in September). Fingerling of 10-12cm costs USD 0.80 each. Seasonal prices for trash fish are VND 4,500 to 6,000/kg to 8,000 to 12,000/kg. This farm uses trash fish only whereas some Taiwanese farmers in the area prepare a mixture of mash and trash fish to feed the cobia.

Tiger grouper. The farm also cultures the tiger grouper, sold live at USD 16/kg to brokers. Fingerlings are imported from Indonesian producers who have a satellite facility in Vietnam. The mortality rate of the tiger grouper is high (50-70%) at 8cm size. The lower cost fingerlings (USD 0.40 for 4-5cm) are not weaned onto pellets and thus trash fish are used as feeds during grow out.

Marine fish in traditional cages in Vung Tau

In Vietnam, the culture of cobia began in 1999, mainly in coastal floating cages situated from Vung Tau in the south to Nghe An to the north. Fry and fingerlings are locally produced or imported from Taiwan and China. Cobia eggs are also imported from Taiwan and nursed to fingerlings on site. The total production of cobia was reported as 1,200 tonnes in 2004 (Vietfish, 2007).-AAP

Opportunities to use shrimp ponds came about as farmers abandoned ponds after facing production declines. Losses due to disease problems resulting from environmental pollution of organic matter were compounded by low market prices. The most important challenge was to seek ways of removing organic matter from shrimp ponds. Several trials were then conducted in cooperation with local farmers in various coastal provinces.

In the trials, tilapia (*Oreochromis mossambica*) were stocked into shrimp ponds after a harvest. Tilapia feed on the accumulated organic matter and spawn naturally in shrimp ponds. Subsequently, sea bass fingerling of 2-3 cm in total length are stocked into the ponds. Seabass fingerlings feed mainly on the tilapia offspring in the first 2-3 months. For the rest of 6-8 month growth period, fish are fed with trash fish or supplemented with pelleted feeds. After harvesting the sea bass, the ponds are ready for the next season of shrimp farming.

In these trials it was demonstrated that sea bass culture could be rotated with shrimp culture to increase productivity. In the shrimp-tilapia-sea bass rotation system, farmers could have two crops per year thanks to the introduction of the domesticated white shrimp *Penaeus vannamei*. In other cases, farmers learnt that sea bass monoculture can be more profitable than the shrimp-finfish rotation farming system.

A positive result is a high demand of sea bass fingerling. In 2006, 30% of the abandoned shrimp farming area in Cam Ranh District of Khanh Hoa province was converted into tilapia-sea bass ponds. In December 2006, most of the sea bass stocked ponds were harvested with an estimated production of 2,000 tonnes.

The opportunities to develop feed for this industry is also tremendous as the national target production is 200,000 tonnes of fish by 2010. If we calculate the volume of trash fish, this will be a million tonnes. The use of extruded pellets will be an opportunity for feed companies.

Dr Nguyen Huu Dung is with the Centre for Aquatic Animal Health and Breeding Studies, Nha Trang University. He made this presentation at the opening ceremony for a new representative office of Akva group, Pharmaq and Ewos in Ho Chi Minh City, 12 September 2008). See page 40 for related article.

Cobia in idyllic Central Vietnam

Better returns for NTPL after a change in strategy to diversify to other species whilst keeping cobia as the main focus.

View of cages in Bai Lach

The idyllic waters off Central Vietnam's Nha Trang City provide ideal conditions for offshore cage culture. Nha Trang Pearls Limited (NTPL) became a pioneer in cobia *Rachycendron canadum* culture in 2003 and has the rights to 800 ha of sea area in five locations as well as three operational land bases, Currently, it is one of three large foreign owned companies involved in the culture of various marine fish with cobia as the main species in large offshore cages.

NTPL's farm site at Bai Lach which covers 165ha is well protected from strong winds and typhoons. The farm has a total of 115 cages. There are 24 flexible cages of 50m circumference (16 metres diameter) and eleven 50m diameter cages used for grow out of the cobia. Installation of the latest addition of eight square 30 x 30m floating cages is underway. The large circular cages follow the Norwegian Polarcirkel type cages but were constructed on site using HDPE pipes imported from Taiwan. The large square cages follow Japanese technology and are designed to withstand high waves. The latter type is essential as currently, round cages are towed to protected areas to avoid high waves at certain times of the year. All nets are Japanese in origin and assembled on site.

In addition, there are 80 square cages used as nursery cages for all fish and for grow out of fish other than the cobia. These cages also hold broodstock of tiger grouper *Epinephelus fuscoguttatus*, humpback grouper *Cromileptes altivelis*, coral trout *Plectropomus leopardus*, red drum *Sciaenops ocellatus*, pompano *Trachinotus blochii* and sea bass *Lates calcarifer*. Circular cages are designed to hold 20 kg/m^3 but NTPL only stocks 10 kg/m^3. Each 30m square cage can hold 90 tonnes of fish. The target annual production is 4,000 tonnes/year comprising mainly cobia.

Idealism in cobia farming

Similar to the situation in Taiwan and China, the interest in farming cobia in Vietnam was fuelled by its fast growth at nearly 6kg within a year. Kevin Chang, General Manager of NTPL was thrilled with aquaculture after reading the article in the Economist magazine on the 'Blue Revolution' and chose the cobia as the species for his first venture into aquaculture.

"I chose cobia culture which unfortunately, today only one or two farms in Taiwan, has shown this to be a profitable business. I am only beginning to see better profits this year as I change my business strategy and culture other species in addition to the cobia. This year is my turnaround year. Despite the ups and downs with feed prices and low ex-farm prices, I am lucky that I have the support of my family and can continue this business", said Kevin.

"In cobia farming, the key factor is costs of feeding the fish as the cobia is a voracious feeder. Extruded feeds are imported from Taiwan, Japan and Canada. If the feeding rate is 1.5%/day, more than 100kg of feed is used daily during the early stages. The cost of production ranges from USD 3.0 to 3.5/kg depending on size whereas the ex farm price of fish is only USD 4-4.5/kg".

Cobia fingerlings in square cages. These are transferred to the large cages on reaching 500g each by towing the larger circular cage close to the group of square cages holding smaller fish.

Circular cages.

Several extruded feeds have been tested at the farm. Feeds from Taiwan cost USD 1.3/kg with an average feed conversion ratio (FCR) of 2.5. Other imported feeds costs USD 1.5 to 1.6/kg. FCR is variable ranging from 1.5 to 2.3. The farm has tried using trash fish to produce moist feed on farm which showed a FCR of 5-7 but there were problems with parasites.

Marketing cobia

There was also the challenge of marketing the fish. When he first started, cobia was a relatively unknown among consumers in Asia. Kevin participated in several seafood shows to introduce the cobia, particularly as sashimi grade fish for Asian markets. His efforts have worked as today, he markets fresh cobia to Taiwan and Japan, frozen and chilled fish and fillet to the Middle East, Eastern Europe, EU and USA. Fish is sold in various forms, fresh frozen, skinned and skinless fillet and slices. Processing is by a HACCP certified processing plant. He has also developed several size ranges for cobia staring from 172g to 1200g. A kilogram of fish yields 390 to 410g of fillet.

"The cobia is a very tasty fish and different parts of the fish have different combinations of fat and moisture, thus offering a range of tastes. Cobia has now carved itself a niche in the Japanese and Taiwanese sashimi market. Raw cobia meat is fatty and juicy and is comparable to the tasty Toro (fatty tuna)", said Kevin.

"I want to get more consumers interested in cobia but I am very concerned with prices. It is good at present moment. In Taiwan, prices vary from USD 9/kg for more than 8kg fish to USD8/kg for smaller 6-7kg fish".

Production challenges

The early challenge of insufficient seedstock for the cobia has been overcome at NTPL. Now it has two land based hatcheries. One hatchery produces cobia fingerlings of 9-12 cm of 45 days old for stocking directly into the sea cages. These are held in square cages until fish reach 500g and they are transferred to 10m diameter cages.

In another hatchery, technicians produce fingerlings of several marine fish such as the humpback grouper, tiger grouper and coral trout. These will be kept in nursery tanks for two months and at 5 inch (12.7cm), fish will be transferred to sea cages. In the nursery, feeding is with oyster eggs, followed by rotifer, artemia and artificial diets. NTPL has also trained some technicians in Japan on hatchery techniques to improve production and fry quality.

As cobia shows fast growth, NTPL similar to other producers, harvest the fish at 6-8kg. Fish can reach one kg within 6 months and 5-6 kg within a year. The Taiwanese market also prefers fish with high oil content (at least 10% lipid) and this is only possible when fish reach at least 6kg.

"However, I am seeing that the volume of feeds increase at a rate of 75% per month. It is acceptable to have an FCR of 1.5 for a 2kg fish. However, when I continue feeding with dry feeds, the FCR of fish larger than 3 kg increases to 3.2 and this continues to increase as the fish grows. In contrast, I see reports of FCR only of 1.5 of cobia fed moist pellets of 48% protein and 18% fat. With dry feeds, my production costs are extremely high if the fish is to be harvested at 6kg each. Our formulated feeds are priced at USD 1.4 to I.5/kg and we feed at the recommended rate of 2.5% body weight per day. To match costs of production to selling prices, my alternative is to harvest the fish at a smaller size", said Kevin.

Facing global competition

Cobia farming is gaining momentum globally which means that NTPL has to be competitive. Potential competitors for the US market include farms in Panama and Brazil. In Asia Pacific, interest in its farming is appearing in Indonesia, Thailand and Australia.

"The small farmers in Vietnam are not competitors but are collaborators who we should be working with", said Kevin.

With regard to quality of products, producers in Taiwan can easily market the cobia as sashimi grade fish to Japan. Kevin said that meeting market requirements is important as some cobia from Vietnam do not meet Japanese standards for its sashimi market.

Kevin Chang, General Manager of NTPL

Leading the charge in Malaysia

Blue Archipelago Bhd reported a successful first harvest in September 2008 at its black tiger shrimp farm in Ayer Hitam, Kedah in the northern part of Peninsula Malaysia. The 400ha farm constructed in 1993, was taken over by Blue Archipelago in January 2008, after several changes in ownership. With this harvest, the company is confident of an annual production of 1,500 tonnes valued at USD 12 million.

Ponds at the Ayer Hitam farm complex.

Blue Archipelago was established in 2007 by Khazanah Nasional, the strategic investment arm of the Government of Malaysia, to help catalyse the growth of the shrimp aquaculture sector in the country on the foundations of economic and ecological sustainability.

Blue Archipelago is bullish about the shrimp aquaculture sector and is rapidly expanding its operations and plans for a processing plant with a capacity of 1,500 tonnes per year. With plans for a feed mill and a hatchery in Kedah, the company aims to turn the farm into a fully integrated shrimp aquaculture complex by the end of 2009.

"The future of seafood lies in the culture of high quality products, ensuring the highest level of food safety combined with a deep respect for the environment", said Dr Shahridan Faiez, CEO of Blue Archipelago in a recent interview. "These values are embedded in the DNA of our company and shapes the way we approach our business and partnerships".

These investments to transform the Ayer Hitam farm into a fully integrated operation is the first of Blue Archipelago's three-pronged strategy. The second track is the development of the world's first integrated shrimp aquaculture park -iSHARP. This is based on an innovative public-private partnership to catalyse the creation of an export oriented shrimp industrial cluster.

"Shrimp aquaculture is a knowledge intensive activity and the iSHARP will bring together the critical elements of technology, human capital and sustainable design within an environment that ensures the production of high quality, safe and wholesome seafood products for the global market", added Shahridan Faiez.

The company recently received approval from the east-coast state of Terengganu for a 1,000ha land to develop iSHARP. This will produce an estimated 5,000 tonnes of black tiger shrimp with annual revenues of more than USD 35 million. It is expected to spin off more than 30 modern small-to-medium shrimp enterprises that will create more than 1,400 jobs in the state.

Finally, Blue Archipelago intends to invest in a research and development program to promote technological innovation in the sector.

"We are currently looking for partners to help us shape and implement what will be a highly exciting shrimp R&D program. In searching for sustainable solutions in food production, we will truly embark on an amazing journey", said Shahridan Faiez.

Shahridan Faiez "In the long run, our competitive advantage will lie in our ability to innovate better and safer ways of producing seafood and creating newer products for our increasingly sophisticated global consumer".

Positions vacant

BlueArchipelago

Quality I Safety I Ecology

Take up the Challenge to Transform the Aquaculture Industry!

BE A PART OF THE AQUACULTURE ORGANIZATION OF CHOICE

Blue Archipelago Berhad is Malaysia's leading aquaculture organization, incorporating the latest technologies to enhance and increase shrimp production capability through the highest levels of quality standards, food safety and ecological sustainability. Blue Archipelago is a knowledge driven organization and we are seeking dedicated and dynamic individuals to work in a fast-paced, dynamic, team-oriented environment.

Program Leader, Research & Development

She/He will be responsible for Blue Archipelago's R&D strategy and lead the establishment of a shrimp aquaculture Center of Excellence in Malaysia. Priority areas of research include domestication and a breeding program for marine shrimp, initially with *Penaeus monodon*, shrimp nutrition, health, disease, pond and environmental management. The incumbent will develop effective relationships with different expert communities and with state, national and international networks to maximize the impact of Blue Archipelago's operations and work with partners and collaborators in strategic areas of aquaculture research, management and education of new as well as ongoing programs.

A Masters or Ph.D. in aquaculture, fisheries, livestock/ natural resource management, organizational development, economics, engineering or relevant field with significant project management experience and strong leadership qualities to realize the company's goal of becoming a knowledge-driven organization, and have;

- demonstrated ability to lead a knowledge-driven organization and evidence of top-level managerial skills
- professional experience in managing a public or private research facility is an advantage.
- demonstrated ability to form alliances in support of research; ability to bring groups together and establish effective and meaningful partnerships.
- A team player

Senior Aquaculturist/Aquaculturist (two positions)

She/He will provide strategic support to the overall business strategies of the organization and act as the subject expert in all the aspects of an integrated shrimp farming operation and development activities of the company.

Applicants are required to have technical experience in the overall management and operations of shrimp farms (semi-intensive to intensive, earthen and plastic-lined ponds) to post harvest handling, for both *P. monodon* and *P.vannamei* shrimp. Experience in processing of IQF and block frozen shrimp processing and exposure to GAP programs in the farm, HACCP in processing and factory set-up and familiarity in shrimp hatchery operations is essential.

Graduates in aquaculture related discipline, ideally with formal training in aquatic ecology or environmental management and a distinguished career with considerable experience in the field of aquaculture, preferably in the shrimp industry are preferable. Additional experience in environmental and aquatic resource management will be an added advantage.

Interested and qualified candidates are invited to post or email their full resume with personal details, qualifications, experiences and salary expectations to:

Blue Archipelago Berhad
T3.9, KPMG Tower, 8 First Avenue,
Pesiaran Bandar Utama
47800 Petaling Jaya, Selangor Darul Ehsan,
Malaysia.
Fax: +603 7725 2050
Email: **jobs@bluearchipelago.com**

Sustainable krill harvest in the Antarctic

By Maja Baevre-Jensen and Simon Wadsworth

The technology key to secure sustainable harvesting as well as superior treatment of the bioactive components in the Antarctic krill is described.

Antarctic Krill (Euphausia superba)

Aker ECO-harvesting™ is the technological concept developed and patented by Norwegian company Aker BioMarine, and has proven to minimize fisheries by-catch and environmental impact. Bringing the Antarctic krill live onboard the ship, means an ultimate starting point for a high value production where bioactive components are preserved when being processed onboard modern factory trawlers. The ECO-harvesting™ technique allows production of Qrill™ (the registered brand of krill derived products for animals) without degrading the bioactive compounds present. When compared to commercial diets containing high levels of fish meal & fish oil, Qrill™ has shown to significantly improve performance (feed intake, growth and feed conversion ratio).

Antarctic krill

Antarctic krill *Euphausia superba* are small, shrimp-like crustaceans that filter feed on marine algae. They are one of the world's most abundant crustaceans with estimates of total biomass varying between 150,000,000 tonnes to 500,000,000 tonnes. Krill can survive and prosper in the unique low temperature environment of the Antarctic by utilising a range of bioactive compounds including phospholipids, fatty acids, astaxanthin, amino acids, cholesterol and chitin. There is a high level of demand for these unique marine nutrients.

The Antarctic ecosystem is largely dependent upon krill as a primary food source. Any large scale disruption will have a dramatic impact on a range of marine mammals, birds, as well as fish species. Consequently, there are very stringent controls on the krill fishery to avoid any adverse impact on this system. All fishing operations in the Antarctica are managed under the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR). This is an international organisation representing over 25 countries. CCAMLR scientists have set a precautionary limit of 4,000,000 tonnes of krill available for harvest, but it is highly unlikely that this level will be reached in the foreseeable future.

On board processing of the krill

A krill fishery has been operating in the Antarctic since the 1970s and is currently removing a modest 150,000 tonnes/year (Figure 1). If the current level of harvesting does increase there are management plans in place to restrict fishing effort to specific areas. A harvesting level of 600,000 tonnes would trigger the implementation of these management plans. These additional controls will prevent significant tonnages of krill being removed from sensitive locations, adjacent to predator colonies. Such groups could be vulnerable to a reduction in their local sources of krill.

CCAMLR operates a long term ecosystem monitoring programme (CEMP) to conduct annual assessments of the predator populations. Over the past 20 years there has been no adverse effect observed on these dependant populations from the harvesting of krill.

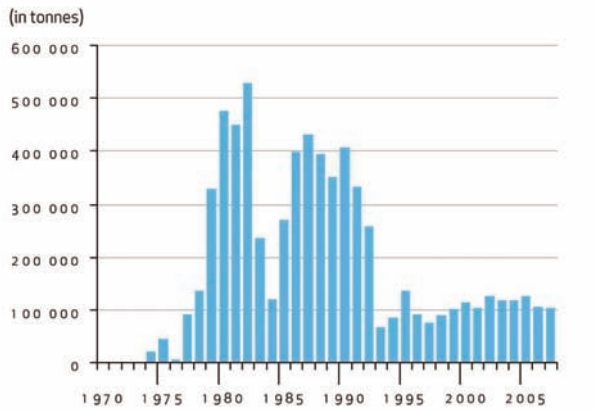


Figure 1-Total annual harvest of Antarctic krill

Sustainable operations

Aker BioMarine ASA, an integrated biotechnology company, has adopted a range of controls, in addition to the CCAMLR regulations. On-board satellite monitoring equipment records the position and duration of the vessel in the fishery at all times. There are independent observers on all Aker BioMarine fishing vessels. The observers collect a variety of data including tonnages of krill harvested, as well as any by-catch. Unique ECO-harvesting™ equipment prevents accidental by-catch of larger predators such as whales, seals and penguins. There has been low level by-catch of marine larvae and this is currently being independently assessed by scientific groups, including the British Antarctic Survey.

The Norwegian based company has recently successfully passed a pre-assessment for Marine Stewardship Council (MSC) certification of its sustainable operations. The company will now proceed for full MSC assessment. With partnership with WWF-Norway, it will ensure a sustainable management of marine resources in the Southern Ocean. A series of detailed discussions are also planned over the next few months with a range of stakeholders to address main issues related to the sustainability of the krill fishing operations.

By Maja Baevre-Jensen is Product Manager and and Dr Simon Wadsworth, Sustainability Manager, Aker BioMarine ASA. Email: maja.baevre-jenson @akerbiomarine.com

Innovation in a global market

Skretting Australasian Aquaculture 2008, held from 4-6 August, 2008 in Brisbane, truly focused on innovative aquaculture for the future. The conference and trade show attracted 1,146 participants from 35 countries. An extensive trade show with 461 participants including exhibitors and 100 booths featured companies from Asia Pacific to the Americas. Particularly significant was the number of exhibitors involved in aeration technology, marine fish culture and water treatment technology, the forte of industry in Australia to meet domestic and regional demand.

Plenary sessions, carried out daily throughout the three day conference matched the theme of innovation. In innovation in global marketing, John Connelly, President of the National Fisheries Institute, USA looked at global issues in marketing and industry response to them. He discussed the importance of economic integrity in seafood marketing versus negative practices such as species substitution, illegal short weighing and illegal transhipment. All these affect corporate reputation in marketing seafood. Asia is highest with notifications on seafood quality. As one in five of Americans are concerned on food safety, this issue can be a future threat. The message was that aquaculture must improve its performance. Antibiotics usage is what drives consumers away. Speed in marketing and sacrificing safety is the biggest risk to long term growth.

Skretting Australia, the major sponsor launched its Active Nutrition range of feeds, as well as sustainability brochure and recipe cards. It offered a spread of nigiri sushi at lunch time and sponsored several speakers and guests from Asia. In the plenary session on innovation in sustainability, Viggo Halseth, Managing Director Skretting Trout & Marine and of Skretting ARC, spoke on the latest global trends in aquaculture sustainability.

Increasing production to meet health targets

Australian aquaculture is the fastest developing among food industries with a farm gate value of AUD793 million in 2006-07. The top species in terms of production volumes are Atlantic salmon, Southern Blue Fin Tuna (SBT), edible oyster and marine prawns. It produced 3,563 tonnes of prawns and 1,567 tonnes of barramundi *Lates calcarifer*. The industry is dominated by small producers. Exports accounted for 60% of the value of Australian aquaculture and some species such as the SBT and kuruma prawns are specifically produced for export.

Australia already produces 280,000 tonnes of seafood and if each Australian is to follow the Australian Heart Foundation recommendation of two seafood meals a week, 700,000 tonnes of seafood a year will be required. The options are to increase production or increase imports.

The first option is helped by the fact that production volumes of finfish have been increasing. It has doubled from 29,300 tonnes in ten years to 57,800 tonnes in 2006-07. A reasonable target, according to Patrick Hone, FRDC executive director is for 100,000 tonnes of finfish by 2015. Three species will drive production; SBT, Atlantic salmon and barramundi. This will require Atlantic salmon to double production to 50,000 tonnes and barramundi to increase 150% to 15,000 tonnes. SBT will remain at 100,000 tonnes as it is quota managed. (FRDC News, June 2008).

Conference highlights

There were over 200 oral presentations with 70 poster presentations. The theme on innovations continued with those on innovations in marine fish culture, feed processing and nutrition and recirculation water technology. Presentations also covered topics of current interest such as climate change and aquaculture. Attention also focused on the work on the domestication of the tiger shrimp which the team led by Dr Nigel Preston is conducting. The program was started in 1998 and currently improvements in female weight with age have been recorded. Yields have increased to 12.8 tonnes/ha in 2006 in one farm. The program has also shifted to four farms to extend the geographical spread. By 2013, the target is to improve health and product quality with elite genotypes.

Climate change & aquaculture

The world has warmed by 0.6 deg. Celsius during the past century and the trend is expected to continue. In aquaculture, possible consequences include changing and more varied weather patterns and water temperatures affecting production (FDRC, 2008). The 20 year view of the Fisheries Research and Development Corporation takes this into consideration in its R&D support to industry.

The potential effects of climate change in aquaculture was summarised by **Elvira S Poloczanska** of the Climate Adaptation Flagship, CSIRO Marine and Atmospheric. She said that, "Climate change is projected to bring warming temperatures, increased storm intensity, and alteration of wind and rainfall patterns. The aquaculture species that are farmed in Australia are sensitive to changes in temperature: a change of only a few degrees might mean the difference between a successful aquaculture venture and an unsuccessful one".

However, warming temperatures may also bring the opportunity of new aquaculture species to cooler regions. In Australia, freshwater aquaculture industries may be the most vulnerable given the projected impacts of climate change on freshwater supplies. Still unknown are the effects of ocean acidification, which will negatively impact calcification rates in molluscs and other species. A decrease in calcification rates in farmed molluscs could result in substantial economic loss.

Laura M. Parker, University of Western Sydney said that elevations in atmospheric carbon dioxide (CO^2) are expected to have enormous impacts on organisms in oceanic environments. She presented preliminary data indicating that genetic variability in the Sydney rock oyster, *Saccostrea glomerata* response to climate change and that selective breeding may be capable of ameliorating some of the impacts that could occur.

Marine fish and larval rearing innovations

G. Koumoundouros, University of Patras, Greece said that skeletal deformities in marine fish downgrade both the image of the product and the biological performance of reared fish, with direct negative effects on both the market value and the production cost. Today, industry copes with the problem of skeletal deformities mainly by manual sorting of deformed fish.

These are the effects of environmental disruptions and are not limited to reared fish. It is a frequent problem in intensive hatcheries. The mean recorded frequency was 7-20% on an annual basis and 45-100% in some solitary (but not rare) cases. Deformities are not species specific. Some examples of deformities were discussed.

Ton Hovers, Vice President Trouw Nutrition Asia Pacific (right) with Octo Rachnalim, Indonesia (left) and Ng Hiang-Chek, Marketing Manager Asia Pacific.

In his presentation, **H. Fushimi**, Fukuyama University, said that deformities such as malpigmentation and vertebral malformation in hatchery-raised juveniles continue to occur in variable degrees in Japan. Usually these problems have been reported in the early stages of larviculture in Japan. The causative factors for skeletal deformity of finfish larvae include temperature, salinity, malformation of swim bladders, genetics and nutrition. Dietary components that influence skeletal development in finfish larvae are vitamin C, vitamin A, vitamin D3, vitamin K, tryptophan, peptides, essential fatty acid, highly unsaturated fatty acids (HUFAs), and phospholipids. In their work they are looking at the nutritional composition of live feed. Prerequisite work will be on stocking density of yolk sac larvae. Testing of different enrichment diets with concentrations of vitamin A was followed by those for EPA, DHA and their ratios.

Feed for growth

Robert J van Barneveld, Queensland said that security of aquafeed supply could be compromised with issues such as the availability of fishmeal and fish oils, concerns over inter-species recycling, access to alternative protein sources and declines in supply and access to alternative protein sources that need to be either GM free or mammalian-protein free to meet the needs of specific markets. Peripheral impacts of biofuel production have placed increased pressure on feed ingredients such as phosphates, synthetic amino acids and on some vitamins and minerals. The aquafeed industry also faces potential increases in the cost of some alternative grains and protein sources due to the rapidly growing biofuel industry. A renewed approach to securing diversity in cost-effective protein and energy supply is a priority for the Australasian aquafeed sector if the industry is to remain profitable and sustainable.

The two typical methods of producing shrimp or prawn feeds commercially today for use in aquaculture systems are pelleting and extrusion cooking. Both systems have been improved over the years as the required feed characteristics of water stable sinking feeds developed. The major difference is that feeding shrimp in some locations are with feeding trays. The required density of the feed used in this application needs to be heavier to overcome the surface tension of the water. In the US, **Joseph P Kearns**, Wenger Manufacturing is carrying out trials in conjunction with Dr. Addison Lawrence of Texas A&M with five processing version of the same shrimp feed formula. The formula is low cost and pelleting to get the desired physical specifications for a shrimp feed may not be possible. In his trials, he prepared feeds in five ways; extruder plus PDU which is cooking and forming, the above with the addition of glycerine (thus reduced drying), conditioning and forming with no cooking barrels and extrusion with vented head and lastly, normal extrusion.

Results showed that the density was around 630-700g/l. All feeds were stable for 24 hours with the exception of the one without cooking which was 8 hours. Growth trials were also convincing in that survival was more than 90% and a linear growth rate was obtained at 1.7g/week. These showed that the methods used can achieve the heavier densities easily with extrusion cooking. Additional benefits include the wide variety of possible ingredients allowing for least cost formulations.

More information: Pogram book and CD on abstracts, http://www.australian-aquaculturereportal.com/austaqua/aa08.html

Innovation in marketing

The range of international and domestic issues relevant to the Australian aquaculture seafood sector as well as to importers was discussed in this session led by Jayne Gallagher and Roy Palmer.

"Australia is a small player and thus it will need the whole industry to work together, be creative and build capacity. With the fuel crisis worsening, the dollar strengthening, and other important issues having impacts it is clear that change is inevitable. Seafood businesses have to be flexible, have to look outside the square to keep their marketing edge so they do not miss the valuable insights from experiences and knowledge of international experts", said Roy Palmer, Executive Officer of Seafood Experience Australia Ltd (SEA).

Fish names

The Fish Names Brand Scheme will allow industry to have 'fish names' compliance. This national scheme managed by Seafood Services Australia addressed an issue which concerned 80% of consumers. At the launch in June in Sydney, industry said that it was the 'best thing for customers and our industry'. This is to control the supply chain from producer/importer to purchaser with a standardized naming and country of origin. It will look at industry's interest and give the purchaser confidence by using the same fish names everywhere. The most important factor is that consumers are getting the species of fish they are paying for. This means that the Australian Fish Names Standard has become an Australian Standard® – AS SSA 5300-2007. (www.seafood.net.au)

Good points of seafood

Roy said that generally the news reports on seafood are not good news and as such, it is essential that the industry work on media to put out the good news on seafood such as its health benefits.

"We should be ready draw upon the health benefits when we are faced with adverse reports on seafood. We should also learn to demystify seafood"

Misinformation is a big problem because many consumers do not know much about fish and how it is produced or harvested. A national level information program is necessary. Media needs to know the positive aspects of seafood.

Health benefits of seafood

Fish and other seafood should be a major source of protein in the Australian diet but seafood consumption surveys indicate there is plenty of scope for improvement. The omega-3 centre has recommended 430mg/day of omega-3 EPA and DHA from fish sources for women and for men, 610 mg/day to optimise diets for lowering chronic disease risk (www.omega-3centre.com). However, the latest guidelines on healthy eating from the Australian Government's National Health & Medical Research Council (NHMRC) have recommendations such as portions of 200 to 250 grams rather than the standard portion of 150 grams of a variety of fish and other seafood at least twice a week. It said ideally, four times a week or more of fish and seafood should be eaten.

"A long-running international study of 25,000 women and their babies has concluded that higher seafood consumption during pregnancy led to better development at six months and 18 months of age", said Roy Palmer quoting information from the Seafood Services Australia's 'Global Seafood for Health' program. The benefits from this study were

Chefs on SEA stand at Rest08 Sydney

generated by 400 to 450g a week of European fish species such as cod, plaice, salmon, herring and mackerel. He added that a major research project and published in the British Medical Journal suggested adherence to a Mediterranean diet reduced the risk of Type-2 diabetes by more than 80%. Seafood Services Australia is a not for profit company supported by the Australian seafood industry and the Australian Government through funding from the Fisheries Research and Development Corporation.

Although there is already considerable information on the health benefits of eating adequate amounts of fish and other seafood on the heart and on general health, there are substantial gaps in species-specific information on the composition of fish and other seafood, especially in critical nutrients such as zinc, selenium, iodine and copper, said Dr Shawn Somerset, Griffin University. (www.seafood.net.au/news/news.item.php?pid=238).

Seafood CRC

Roy Palmer

Australia's seafood industry has formed the Australian Seafood Cooperative Research Centre. Members comprise 80% of the industry's gross value (aquaculture, wild catch harvest, processing and post harvest), science/research and academic sectors. The Australian government supports the group with an AUD 35.5 million grant over seven years. Industry, research providers and others have added AUD100 million to this. The total investment is AUD140 million.

This will look at weaknesses at various points along the value chain. The national collaborative approach will be to fix the critical gaps and make significant improvements. It will look at production innovation to achieve substantial increase in production and profitability. In product and market development, it will increase demand and premium market access for Australia's products. An innovative training program will improve capabilities in the labour force for the industry as well as offer the opportunity to 40 PhDs over the 7 years.

The key points in marketing Australian seafood (www.australianseafood.com.au)

- Live better- Health benefits
- Sea friendly- Sustainability
- Great tasting- Recipes and attributes
- It is easy- Demystify seafood
- Australian Made- Heritage and Provenance

The Australian seafood market

More than 90% of Australians eat seafood with a consumption of 15.3kg per capita, according to a survey conducted in Sydney in 1999. However, this could be lower in areas outside Sydney. Consumption outside the home has been increasing and this has been a boom for producers. Conversely this has also resulted in declining profits as per kilo prices fall with competition between large supermarkets and specialized seafood markets. Changes such as regulatory limits on quotas, cheaper imported seafood and increased operating costs and consumer resistance to rising prices is pushing for innovative marketing strategies (FDRC, 2008).

In 2005-06 Australia imported AUD 1.03 billion of edible fisheries products. Thailand and New Zealand continue to dominate as the major source of imported seafood with 42% of the total. Imports from Vietnam valued at AUD133 million, were mainly frozen shrimp (predominantly vannamei shrimp) and frozen fish fillets (predominantly catfish). Imports from China valued at AUD 101 million were mainly frozen vannamei shrimp (Australia Fisheries Statistics, ABARE, 2007).

Case studies on aquaculture health in Australia

by Olivier Decamp, Liz Evans, David Moriarty and M.J. van Schoonhoven

In a presentation during a session on marine fish and larval rearing innovation, at the Australasian Aquaculture 2008, Brisbane we discussed that Bacillus probiotics are proving very beneficial for fish larval rearing in European and Asian hatcheries, The strains of Bacillus were checked for safety and selected for their ability to inhibit directly bacteria pathogenic to fish, produce exoenzymes to improve digestion and degrade waste products and to grow under a wide range of conditions, e.g. pH, temperature, salinity.

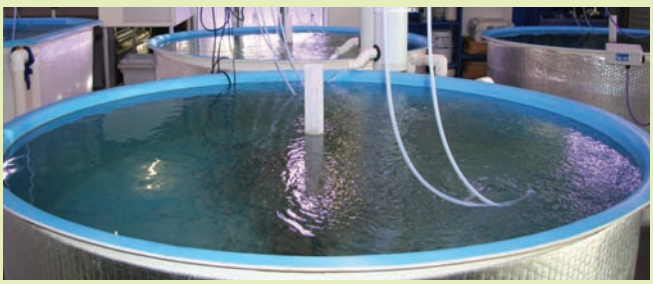
Specific mixtures of these strains of Bacillus are used in commercial products for shrimp and fish larviculture and ongrowing. Using examples from Australian barramundi (seabass, *Lates calcarifer*) hatcheries, we reported the benefit associated with three products:

A water quality enhancer and green water substitute for larval fish rearing. It can replace up to 100% of live algae for green water technology, and improves water microbiological characteristics inducing a favourable microbial flora (Sanolife ALG)

A microbial water conditioner for fish hatcheries. It may be applied directly in the water of the larval rearing tank or administered via the live food (bioencapsulation) - (Sanolife MIC-F)

A microbial water conditioner and pond bottom conditioner for grow out. It is applied during the pond preparation and during the production cycle in order to maintain algal blooms and improve waste degradation (Sanolife PRO-W)

Case study 1: Australian Barramundi (*Lates calcarifer*) in Paradise Aquafarm, Gordonvale, North Queensland



Paradise Aquafarm with larval rearing tanks with 25 day old Barramundi

This barramundi hatchery with 4 tanks of 2,000 litres each is located inland. It relies on trucked sea water for the first 20 days of rearing. Freshwater from an underground borehole is used for the rest of the cycle. Probiotic strains that are metabolically active under a wide range of salinity conditions (Decamp et al., 2006, Moriarty et al., 2005), are an added advantage in the rearing of catadromous species such as barramundi.

Protocol

Each tank of full strength seawater (1,000 litres) was stocked with 80 larvae/litre. The tanks were topped up daily with new seawater until day 15 with a maximum volume of 2,000 litres. Sanolife ALG was added daily at a rate of 4g/tonne water, in 2 doses per day, until Artemia feeding started at day 8. Rotifer feeding was stopped at day 10. Sanolife MIC-F was applied at a rate of 5 g/tonne of water, once per day from day 9 until day 24. On day 18, weaning began using Proton 2/4 (200-400µm),a micro-particulated extruded diet formulated with highly specific raw materials, On day 24, grading commenced with 2mm grader. On day 24, 200,000 weaned fingerlings at 20mm were moved to the nursery, with an overall survival rate of more that 60%.

Results

Overall there was a uniformity of size, with 99% at first grade. Labour was saved compared to previous runs where two to three grades were required before fingerlings reached 2mm. The hatchery owners, Dave and Lynelle McIlvernie, observed that the faeces of the weaned fish were much softer and appeared as such as the feed has been well digested. The bottom of the larval tanks was cleaner than previous runs where live algae had been used.

Barramundi

Case study 2:
Australian bass (*Macquaria novemaculeata*) in Clarence River, New South Wales

This fish hatchery is situated on the Clarence River, and uses brackish water for tank and earthen pond culture of Australian native fish for restocking. The wild Australian bass brood stock are captured and held in tanks to acclimatize, where they are fed 8mm Lansy Breed Maturation soft pellets until spawning is induced.

Protocol

Before stocking, Sanolife MIC-F was applied at a concentration of 2 g/tonne of water. On day 1 after hatching, 100,000 larvae were stocked in 2 tanks (3,000 litres) filled with green water (fresh algae). Sanolife MIC-F was applied daily at 1 g/tonne water from day 1 to day 28, when fingerlings are transferred to 250m^2 lined earthen pond. The first 28 days were characterized by static culture conditions: salinity 20 ppt and temperatures ranging between 18 and 20ºC.

The feeding regime included an initial period with rotifers and copepods cultured on Culture Selco High Density, then Artemia nauplii and finally adult copepods and Artemia. On day 28, 100,000 larvae and 60,000 larvae were transferred from the two tanks into two 250 m^2 and 1 m deep lined fertilized plankton pond. Both ponds were fed a combination of zooplankton and Artemia. Sanolife PRO-W was applied weekly at a rate of 200g/ha per 1 m depth until the ponds were harvested 10 weeks post hatch.

Results

After 10 weeks, the first pond was harvested and 100,000 25mm bass fingerlings were captured and sold for restocking. This was 100% survival. The previous best results had been 18,000 fingerlings from the same size pond. The hatchery operator, Glen Searle, observed that, at day 28, the tank bottom was extremely clean compared to previous runs. There was no black sediment at the bottom of tank and any sediment was grey.

Summary

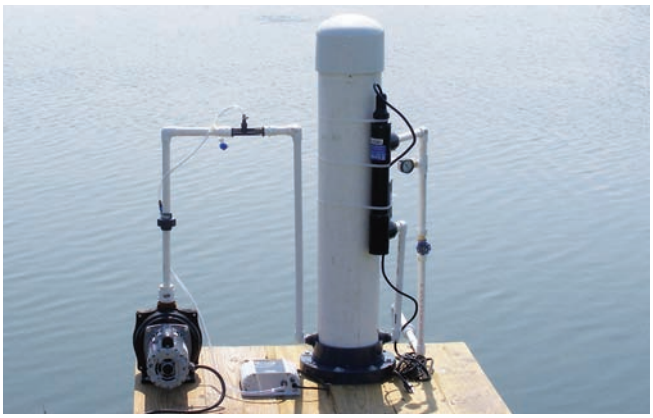
These results from Australia show that the addition of selected strains of Bacillus improves fish production by improving water and sediment quality, thus increasing survival and growth rate. Similarly, the benefits associated with the use of Bacillus strains in Europe (seabream, seabass, turbot) and Asia (Japanese flounder, red tilapia, grouper, rockfish, bream) have been reported elsewhere. The selected strains were from Bacillus species that occur naturally in fish, and other aquatic animals, and thus by improving the health of the animals and improving water and bottom quality, are true probiotics for fish.

Olivier Decamp is Product Manager and David Moriarty is Consultant with INVE Aquaculture Health, Thailand. David is also with the Centre for Marine Studies, The University of Queensland, Australia. Liz Evans is with Primo Aquaculture, Australia and M.J. van Schoonhoven is Sales Manager with INVE, Thailand. Email: Olivier Decamp (olivier@inveasia.co.th)

Efficient oxygenation for sustainable aquaculture

By Dennis L. Mast

The core focus of this technology is to add oxygen to water in the form of tiny bubbles in order to raise the oxygen level in a given fish pond to the desired level.



The device for efficient oxygenation is known as the "Add-o-mizer". It is specifically designed for efficiently dissolving gas into liquid. This device comprises a pressure vessel or column for receiving a gas-entrained liquid via an inlet and for injecting the gas-entrained liquid via a riser into a headspace of the vessel.

A flow director is positioned in an upper portion of the vessel to form a swirling flow path extending into a liquid pool in a lower portion of the vessel. An outlet directs the liquid away from the vessel into a non-pressurized body of water.

The processed effluent is sufficiently supersaturated with oxygen. By controlling the level of super saturation, the size of these "microbubbles" can be controlled to less than 5 microns in diameter ie 0.005 millimeters. The slow rise rates of 0.28 cm/sec combined with a surface-to-volume ratio more than 1,000 times higher than that for fine bubble diffusers. The rise rates for bubbles generated is extremely slow giving extended time for the oxygen in the bubbles to come in contact with the water and higher standard oxygen transfer efficiencies. This makes microbubbles a very efficient mechanism of oxygenation with minimal operating and maintenance costs.

The system under pressure can achieve dissolved oxygen (DO) levels far greater than possible with a mechanical aerator in an open basin. The Add-o-mizer aerates by dissolving the feed gas into the water under pressure. This often makes aerating with air rather than oxygen very cost-effective.

Other types of aeration systems operate at relatively low efficiencies. As a result, air must be supplied in great excess in order to ensure adequate dissolution of oxygen. With an oxygen transfer efficiency of 15%, a blower system must pump 10.472 cubic meters of air into water to dissolve 0.45 kilograms of oxygen. In order to dissolve the same 0.45 kilograms of oxygen into water, the technology only needs to inject 0.308 cubic meters of air.

In addition, it allows for the use of either ambient air or enhanced gases such as pure oxygen to affect a greater transfer rate of oxygen and to minimize the electrical and mechanical costs. It does not require porous membranes that tear, plug, or foul.

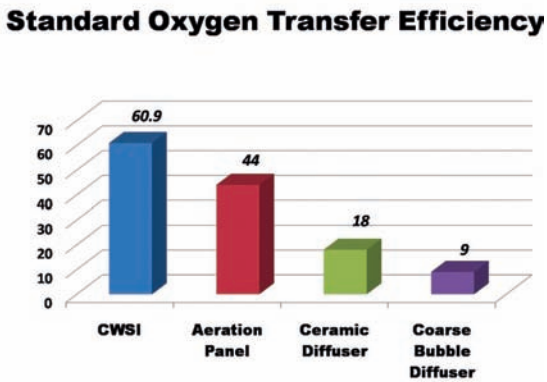
Benefits to aquaculture

The benefits include efficient oxygenation, less feed requirements, shorter maturation cycles and healthier aquaculture by using ambient air instead of requiring the use of liquid oxygen. The mixing abilities prevent stratification in the pond eliminating varying layers of oxygen levels in a pond.

The supply of dissolved oxygen often becomes limiting in fish ponds because the combined respiration of fish, phytoplankton, and mud-dwelling organisms exerts a tremendous demand for oxygen. At high phytoplankton biomass levels (which is the typical condition in fish ponds during summer), oxygen production by algae is insufficient to meet the respiratory demand of the pond community and a daily oxygen deficit develops. If this deficit is not offset by artificial aeration, dissolved oxygen levels will drop very low and fish will die.

The key to successful management is early identification of those ponds that may require supplemental mechanical aeration to keep fish alive. Aeration is initiated when dissolved oxygen concentrations fall to a level considered critical (usually around 3 to 4 mg/L). Under current production practices, nearly every fish pond has dissolved oxygen concentrations less than 2 mg/L at dawn during mid-summer. The duration of low dissolved oxygen concentrations at night usually ranges from 3 to 6 hours/day during mid-summer. Aeration is continued until past dawn when measurements indicate that dissolved oxygen concentrations are increasing as a result of photosynthetic activity If necessary, the tank/pond water can be sanitized following each cycle/harvest without the need to replace all of the water by using ozone as the gas being entrained into the liquid. Ozone, a powerful oxidizing agent, disinfects and oxidizes organic pollutants while increasing the water's dissolved oxygen level. The end result is exceptional water quality, which is a fundamental requirement for intensive fish farming. Ultra Violet light systems economically disinfect top-up water in both fresh and saltwater farms.

Both ozone and UV systems are easy to adapt to large scale ponds and raceways as well as small holding tanks and nurseries. Improved water quality leads to reduced mortality rates and an increased yield of a healthier product.



The CWSI system which is the addition of micro bubbles has the highest efficiency of oxygen transfer compared to other aeration (eg paddlewheels), ceramic diffusion (eg airstones) and coarse bubble diffusers.

Dennis L. Mast, PhD has 25years experience in the water industry. Clean Water Scientific, Inc. (CWSI) is a producer of patented waster aeration systems. Email:dmast@cleanwaterscientific.com

TenCate

Dealing with impacts in marine fish culture

In any cage farming system, there are many aspects that can impact operations, predators that can destroy nets allowing fish to escape, strong currents which can reduce the cage volume causing stress on the fish, biofouling which reduces oxygen flow and flushing action, longevity and strength of the net material, as well as market negative issues of using chemicals such as antifoulants and excess nutrients from food and faeces which can in some areas disturb the flora and fauna on the ocean bottom.

Don Bishop, Technical Advisor - Market Manager for TenCate Aquagrid® Containment Systems said, "Traditionally, cages use netting which originated in the fishing industry. These have two primary issues strength and biofouling. These were developed to be in the water for short periods of time (i.e. fishing) and are never intended to be exposed to the water for the amount of time required to grow fish".

"After seven years of R&D, TenCate Geosynthetics North America working with Bishop Aquatic Technologies of Canada developed Aquagrid®, semi rigid netting designed not only to contain fish, but to address the concerns of the aquaculture industry and the environment. It offers longer life which can be twice the 4-6 years of traditional netting used in aquaculture, improved strength, lower maintenance and biofouling control".

It was also created to "fight predators such as marine mammals and predator fish found in the marine environment". For example, in Chile, salmon culture is a success but a major struggle for fish farming operations has been with sea wolves destroying nets and fish escapes. Farm operations that are using Aquagrid® containment systems have reduced escapes caused by predation from an average 12 % to less than 1%.

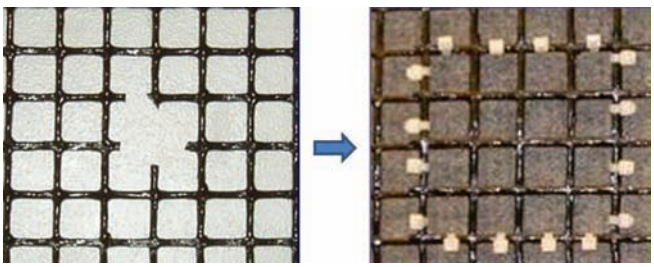
Tested in accordance with the ASTM 6637 parameters, the net is shown to be up to twice as strong than the traditional nylon netting. The semi rigidity of the net also means that a larger mesh size can be used as the net keeps its shape and does not stretch or elongate diagonally with fast currents.

"Aquagrid nets can biofoul as easily as any other net but the difference is that the smooth surface does not allow bio fouling organisms to have a firm attachment. This allows for easy in water cleaning using rotary cleaners operated from the surface. There have been cases where biofouling was removed from the net by wave action during a storm. This leads to the elimination of antifoulants. Chemical discharge to the environment is then avoided", said Don.

Mortality retrieval system

A common husbandry problem is the removal of dead fish and pulling of the net up for harvesting. TenCate has an optional mortality retrieval system. This is placed inside the cage to collect dead or moribund fish. This system also collects uneaten feed and fish faeces. The frequency for removal of mortalities and excess waste differs based on each operation. Most farms have found that removing this waste every 12 hours is optimal. This allows farms to control nutrient loading and protect the surrounding water column. Operations employing the mortality/waste management system have seen up to a 95% reduction in solids, more than 90% removal of phosphorous and more than 70% removal of nitrogen.

Harvesting is also now done completely different with the Harvest Bottom System. This is much easier as the cage no longer needs to be shallowed and two people can harvest a cage or herd the fish for treatment without assistance.



Repairs are done very easily in the water or out of the water using an Aquagrid patch attached with cable ties wraps since Aquagrid is a woven product each fiber bundle is independent so damaged areas cannot get larger and a permanent repair is easy to do as in the pictures.

Cost effective waste removal

The company has also introduced the Geotube®, a dewatering technology for both freshwater and marine water systems which reduces nutrient loading in a filtrate. This has been approved as a Best Management Practice for aquaculture in Carolina State, USA.

How this works is that sludge is pumped into the container in which environmentally safe polymers are added to the sludge. Solids will bind together and water will separate out. Clear water drains out as 99% of solids are captured. The water can be reused into the recirculation system. After water reduction, the solids can be used as a valuable nutrient. For more information or to request an information CD www.aquagrid.com or Email: don@aquagrid.com

Aqua VIV Asia 2009

This is the second time that VIV Asia will focus on aquaculture at the Aqua Pavilion. Below some company representatives tell us what they will bring to the Aqua Pavilion from March 11-13, 2009.

Wenger Manufacturing, Inc. will be prepared to discuss the interrelationships with extrusion equipment and use of lower cost formulas now being considered based on the tremendous fluctuations in ingredient prices. Equipment designs and operational parameters are paramount in being successful in overcoming these differences in formulations with pellet durability also an issue.

"Our history as the premier supplier of extrusion equipment results in understanding the relationships of the equipment and formulation changes and how to deal with these issues. Come see us at our **booth AQ20**, Aqua Pavilion", said **Joseph Kearns**.

Tel: +1 785 284 2133 Contact: Rock Chen, Director of Wenger Asia
Email: rockchen@wenger.com
Web: www.wenger.com

Tekni-Plex has developed an innovative new concept for aeration in aquaculture ponds, raceways and hatchery tanks which greatly reduces energy demand when compared to traditional aeration technologies. "We are currently expanding our distribution network throughout the Americas and Asia and we view Aqua VIV Asia as a great place to meet potential distribution candidates as well as end users for our technology from throughout the region. We expect the show to deliver an excellent mix of large farmers and suppliers of aquaculture products and it is the perfect place for us to target both." -**Ben Williams**, Business Development Manager, Tekni-Plex

Tekni-Plex Asia Pacific, Tel: +86 512 65933222 Contact: Tiger Ge
Email: info@coloriteaerationtubing.com
Web: www.aero-tube.com

"**Aquativ** is expert in the design, manufacturing and sales of attractants and palatability enhancers (PE) that improve fish and shrimp feed palatability and performance. We provide aquafeed manufacturers with complete solutions dedicated to palatability. At VIV Asia, we will have the team from Thailand, China and Vietnam to meet our existing customers as well as explain to farmers and feed producers how our product works. We may also plan a conference but details will be available later. Do not hesitate to visit us at **Booth AQ09** Aqua Pavilion." -**Stephanie Fortin**, Communications Manager.

Aquativ offers:

- Numerous powerful PE available locally
- Nutritional support to achieve cost effective formulations
- Customized test methodologies to scientifically substantiate PE benefits
- Technical recommendations to optimize industrial use of PE

Email: contact@aquativ-diana.com
Web: www.aquativ-diana.com

Green Era Bio-Tech Corp., is the First bio-tech company to manufacture fermented soyameal here in the Philippines. The vision of the company is to provide the aquaculture feedmills and farms with a very good source of vegetable protein with probiotics, an ideal alternative to traditional animal protein based diets.

"We want to encourage them to produce prawn and fish meat without antibiotics, more organic in nature and to provide safer food to all. Since this is our first time to join the VIV exhibit, we hope to see lots of farmers, feedmill owners and managers and nutritionists. We hope Aqua VIV Asia 2009 will be a very successful exhibition"- **Johnson Lu**, Export Department, Green Era Bio-Tech Corp.

"Novus has focus on expanding aqua business to serve the market all over the globe. Thailand and Asia Pacific is the homeland of the world's leading aquaculture production and we look forward to meeting industry prospects and expanding our market and distribution network at Aqua VIV Asia 2009, the best integrated exhibition of terrestrial and aquatic animals. At the show, we expect to share knowledge and showcase aquaculture's best innovations from industry players" - **Dr. Farshad Shishehchian**, Global Aqua Manager, Novus International Inc.

Booth AQ 01 Aqua Pavilion
Email: aquanovus@novusint.com
Web: www.novusint.com

AKVA group is the global leader in aquaculture technology, providing services spanning from single components and consulting services to fully equipped, turn-key farm facilities for land or sea based aquaculture in a number of species.

"We consider VIV Asia 2009 to be an increasingly important platform for us in our continuous effort to put focus on developing a strong market position in Asia". - **Jan Erik Svensson**, Regional Director in South East Asia, AKVA Group.

Aqua VIV Asia 2009

March 11-13, 2009
BITEC, Bangkok

VIV Asia 2009 presents Aqua VIV Asia, the 1st dedicated event for Asia-Pacific's aqua business

Aquaculture is the fastest growing food production sector in the world. Asia-Pacific is the home of aquaculture. Innovative Feed-to-Meat exhibition VIV Asia 2009 is the logical platform to present Aqua VIV Asia as the meeting place for suppliers and professional buyers in Asia-Pacific. Aqua VIV Asia succeeds the successful Aqua Walk and Forum at VIV Asia 2007, which was attended by 5,648 aquaculture buyers (26% of the total VIV Asia 2007 visitor number of 21,726).

At Aqua VIV Asia, you will find suppliers offering their solutions and consultancy on technology and equipment, improving production efficiency and output, animal health and feed.

Exhibitors Aqua VIV Asia

- AKVA Group SEA Co., Ltd – Thailand/Norway
- AQUATIV – France
- Bayer Health Care – Thailand
- Beijing Sunpu Biochem. Tech. Co. Ltd., P.R. China
- DSM – Thailand
- DuPont (Thailand) Limited – Thailand
- Green Era Bio-Tech - Philippines
- Huvepharma – Belgium
- Intervet-Schering Plough – The Netherlands/U.S.A.
- INVE Asia Services Ltd. – Thailand
- Jefo Nutrition Inc. – Canada
- Liptosa – Spain
- Novus International Thailand Co. Ltd. – Thailand
- Omega Protein, Inc. – U.S.A.
- Tekni-Plex Technologies (Suzhou), Co. Ltd. – P.R. China
- Wenger Manufacturing – U.S.A.
- Zhejiang Esigma Animal Health Co. Ltd. – P.R. China

Aqua Seminars
20 high-quality presentations among others focusing on:

- sustainable aquaculture farming
- food safety & human nutrition
- aquaculture and the ecosystem

For more information please contact:
VNU Exhibitions Europe, Mr. Steven Fockema Andreae,
email steven.fockema@vnuexhibitions.com, tel. +31 30 295 2302.

AKVA group, EWOS and PHARMAQ Jointly exploring opportunities in Vietnam

In September, three Norwegian companies opened a representative office in Ho Chi Minh City, Vietnam. The three companies share the office facilities, thus the group will save costs and utilise their synergies to investigate and to develop the market for their respective technologies and products in Vietnam.

Ribbon cutting by (from left) Dr Nguyen Huu Dzung, Kjell Storlokken, HE Norway Ambassador to Vietnam, Morten Nordstad (PHARMAQ), Einar Wathne (EWOS) and Knut Molaug (AKVAgroup)

The new office will play an important role for the Akva group, a recognised global supplier of aquaculture technology. It will be to meet its strategy that, by 2015, 50% of its revenues should come from species other than salmon. Ewos, feed division of Cermaq ASA and a market leader with salmon feeds and a multinational fish farming company, sees Vietnam as a country with a rapid development of aquaculture. Pharmaq, a global veterinary pharmaceutical company with its primary focus on aquaculture intend to supply novel, safe and effective fish health management tools for the Vietnamese aquaculture industry. Asia is a new geography for all companies.

Akva group's Regional Manager in South East Asia, Jan Erik Svensson, based in Bangkok, Thailand, said "The current aquaculture production and future growth potential in this region opens good long term opportunities for the group's technology. Although it will take some time to develop the business here as we will need to fully understand market needs, culture and business environment, before we can expect good results".

Preceding company presentations on their business plans in Vietnam, Dr Nguyen Huu Dzung , Vice Chairman, VASEP (Vietnam Association of Seafood Exporters and Producers) gave a short presentation on aspects of the aquaculture industry in Vietnam. He said that in 2008, pangasius catfish production will increase to 1.3 million tonnes. With intensive culture practices, vaccines for the pangasius catfish is now a priority and a vaccination program for marine fish should follow too. Norwegian technology can be used to utilise waste from processing which is 65-67% of the fish. Vietnam produces 2 million tonnes of feed valued at USD 1.5 billion and 170,000 tonnes were imported from Thailand and Taiwan in 2007. In marine fish culture, technology in feed development, farming technology, seed production will be required.

Dung said, “We need to achieve a higher level in technology and product quality. We wish for not only volumes and quality but for success as well”.

Flavio Corsin, Senior Aquaculture Advisor, World Wildlife Fund based in Vietnam, outlined the government funded disease surveillance program for catfish farming. The aim is to identify presence and level of diseases. Some drawbacks such as the total reliance on reports from farmers may have led to an underestimation of the problem. A future target should be a collection of information in a structured way which is accurate but expensive. Capacity building on analysis and data interpretation is also necessary. This will involve selection of farms and processing plants, monthly interviews and having database sets at the district and provincial levels. In another presentation, Dr Nguyen Huu Dung, Professor at Nha Trang University talked on the challenges in marine fish farming in Vietnam. This is detailed on page 23.

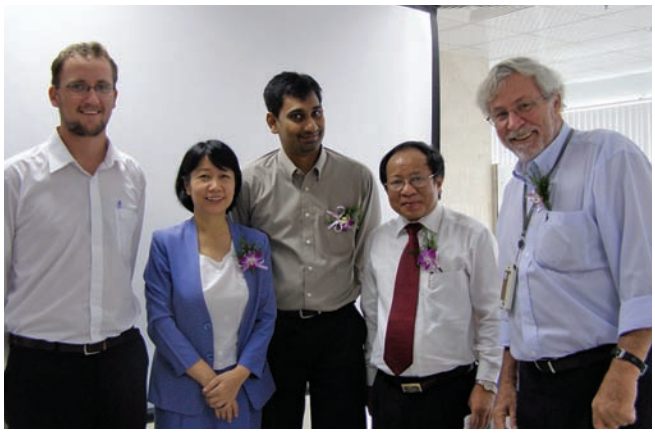
Einar Wathne, Deputy Managing Director of Ewos said that the company produces 850,000 tpy of fish feed, mainly for the salmon. Some 85% are sold in the free market and the rest is used for its farming operations. It spends USD 16 million on R&D in fish feed and has 65 employees and 17 scientists within R&D. In Vietnam, it has been collaborating with Research Institute for Aquaculture No 1 (RIA1). It has already entered the Vietnamese market with feeds imported from Canada for a cluster of intensive cobia farms.

“We hope that our experience in feed development in Europe for marine fish will boost development of new species in Vietnam. We will look at new areas provided we can apply our new knowledge here. We intend to sell the value of the feed; not the feed itself. Our functional feeds will carry components for growth as well as prevent health problems. The aim is to sell performance not mixed feed ingredients and to focus on cost per kilogram of fish and not cost per kilogram of feed”, said Dr. Wathne.

This was a big day for Pharmaq, a growing veterinary pharmaceutical company present in more than 10 countries and which dedicates 20% of its turnover to R&D. Morten Nordstad, CEO said, "We expect a reduction in the use of antibacterials and chemicals, as vaccines are being introduced. This will have a strong impact on food safety and sales of Pangasius. In Vietnam, the solutions and applications will be different from those used in other countries. The vaccines will be tailor made for Vietnam. We want to strengthened our position in the country and then improve the image of Vietnamese products and make the industry sustainable. Our ambition is to facilitate the introduction of best practices in health management".

"Vietnam is establishing marine fish farming and currently international markets require value chain software technology", said Akva group's President & CEO, Knut Molaug. "Technology can influence fish health with the use of disease free brood stock and fingerlings culture in 100% controllable recirculation systems which are also isolated environments. The environment can be manipulated for the health and well being of the fish. Cage technology should show better usage of limited space and maintain cage volume and limit handling of fish. Good husbandry practices include systems for net cleaning to allow adequate water flow".

The Chief Representative Officers at the new office are (from left) Dave Robb for EWOS, Kjersti Gravningen for Pharmaq and Jan Erik Svensson for the AKVA group.



Dr Nguyen Huu Dzung, Vasep (second right) with Philippe Serene, Proconco (right). Other guests included (from left), Xavier Bocquillet, Qualiservice, Vuong Ngoc Bich, AHBT Co Ltd and Mohan Jacob, Pesca Nova Foods.

Vietnam marine fish farm seeking partner

Sai-Pac Fish Farm Company is located in Loc An Village, Phuoc Hai Commune, Dat Do District, Ba Ria-Vung Tau Province in the southeast coast of Vietnam. It is building a marine fish farm comprising cement tanks on 5 hectares of coastal land. The construction phase is due to be completed by March 2009.

The farm is based on recirculation aquaculture system (RAS) technology and has a capacity to produce 2,000 tonnes per year based on a biomass of 25 kg/m^3.

The company is seeking a strategic partner who will manage the farm in exchange for equity. The future partner must be an established player in the aquaculture industry with experience in the following areas:

1. Biotechnology, disease control and fish health management;
2. Extensive background on recirculative aquaculture system;
3. Feed and water management techniques.

Interested parties should contact the following for information:
Sai-Pac Fish Farm Co., Ltd. – Representative office,
7th floor – The Golden Building, 19 Tan Canh Street, Ward 1, Tan Binh District, Ho Chi Minh City, Vietnam
Tel.: +84 8 449 5826 449 5827/449 5828; Fax : +84 8 449 5829
Email: Mr Byron: mrbyron@sai-pac.com and Ms. Minh Trang: mt@uspc.com.vn

ADDCON

Global marketing

The Addcon Group has announced that **Kurt Wegleitner** has joined the group of companies to direct its global marketing and sales activities. Kurt has more than 10 years of experience in the feed industry and has previously worked for a global supplier of feed additives in Europe, Africa, Australia and Asia.

"It is a huge opportunity to bring our know-how, experience and technology in feed preservation and natural growth promotion from Germany to our customers wherever they are. Addcon has more than 50 years of experience in working with organics acids- this knowledge shall help our customers to keep their feed clean and safe." says Kurt Wegleitner. "One of my main tasks is to strengthen the cooperation with business partners and customers for the mutual benefit".

Bernd Kochannek, CEO of the Addcon Group sees growth potential for its activities in various sectors and regions. "Our main advantage is the backward integration of our production. This backward integration will help us to guarantee stable supply of our products. Especially in times of volatile raw material prices, such backward integration is of major importance, and makes us a trustworthy supplier".

Expert for aquaculture

Dr. Kai-J. Kühlmann has joined the group of companies to promote its aquaculture products in the region. Dr. Kühlmann has more than 15 years of experience in tropical aquaculture and coastal resource management. Previously he has worked in aquaculture extension and development projects in the Philippines assigned through the German Development Service (DED).

"It is a challenging opportunity to synergize the European Addcon management technologies in feed preservation and natural growth promotion with the fast developing aquaculture industry in Asia. More than 50 years of its experiences in organic acids shall support our Asian customers to formulate supplemental feeds inline with the strict European import requirements." Dr. Kühlmann said during his inauguration. He underpinned, that one of his main tasks is to promote the feed additives for the aquaculture industry in 15 Asian countries.

The Addcon Group is supplying the agricultural feed industry with preservatives. Founded in the 1950s in Germany, the company has since grown in terms of product range, sales and manpower. Feed additives are produced in Germany and Norway.

For more information: www.addcon.net
Email: kurt.weigleitner@addcon.net

Alltech

Launches new global corporate website

The company has launched the new global corporate website which can be viewed at www.alltech.com

In addition to a new design and content, the new web environment provides direct access to a new section on Health & Nutrition, an area which focuses on a range of animal and aquaculture health issues. Dynamically generated links between the various sections allow the visitor to see the relevant news, videos, podcasts and events matching this area from other sections of the website.

Commenting on the new website, president and founder of Alltech, Dr. Pearse Lyons said, "The newly-redesigned Alltech.com reaffirms our commitment to help the online visitor find up-to-date, relevant information pertaining to the animal health and nutrition industry. It is essential for all those involved in the industry to support and provide good nutritional science, and this website will help us to share valuable information with the industry and our customer base."

The new website features improved usability and navigation, integrates video, podcasts, and photo galleries, and provides RSS feeds from the News & Media area. The site has been built on technology that will help with the next phase of development for the site which will include versions in other languages. For the aquaculture industry an interesting subject on the web site is a video on reimaging aquaculture.

GFT

ipura adds shrimp to its product launch

The California based bio-tech company , Global Food Technologies (GFT), specializing in food safety has announced in October its first shrimp contract in Vietnam. The contract includes the installation of its proprietary equipment in the Fimex Vietnam processing facilities in Soc Trang, Vietnam during January 2009.

iPura, GFT's food safety brand marketed as "The Highest Standard in Food Safety," will enter the U.S. seafood market with Chinese tilapia, Chilean salmon and Vietnamese shrimp in the first quarter of next year.

Mrs. Duong Ngoc Kim, General Director of Fimex Vietnam, stated, "Fimex has long been one of the top producers of high quality shrimp products in Asia and this association with GFT and the iPura label will ensure that Fimex not only maintains, but elevates that status."

Stan Bien, Director of GFT Operations SEAsia, said, "It is the goal of GFT to associate iPura with the highest quality seafood processors and the execution of this agreement with Fimex is a great step towards achieving that goal."

Fimex was established in 1996 in Soc Trang, Vietnam and is presently traded at the HCMC Securities Trading Floor under the symbol "FMC." Fimex, winner of numerous quality awards, has the capacity to process forty metric tons of shrimp a day. Presently, Fimex exports most of its finished product to high quality buyers in the U.S. and enjoys a favorable anti-dumping tariff. For more information please visit www.ipura.com

Omega Protein

International Sales Manager

Omega Protein, Inc. has announced the appointment of Michael Shane Brenan, Jr. as their new International Sales Manager, Agriproducts Division. Brenan is responsible for global sales of fish meal, fish oil, and fish solubles for use in aquaculture and animal feeds. He is a graduate of Texas A&M University with a Bachelor of Science in Animal Science.

For more information: Email: halms@omegaproteininc.com ***Web: www.omegaproteininc.com***

Lallemand Animal Nutrition

New General Manager

Pascal Raoul, with over twenty years experience of the animal health sector is the new General Manager for Lallemand Animal Nutrition, since October 2008. He succeeds and reports to Olivier Clech, Vice President Human and Animal, responsible for the Nutrition business units. Before joining Lallemand, Pascal spent twenty years with Elanco Animal Health, a division of Eli Lilly and Company, holding various responsibilities both in Europe and in the USA. His nomination and the organisational changes within Lallemand Animal Nutrition result from the fast development of the group's nutrition activities over the past few years, driven in particular by the momentum gained by probiotics.

For more information: sroquefeuil-dedieu@lallemand.com

Novus

Scholarship in aquaculture with PKNU in Korea

Global leader in animal health and nutrition, Novus International Inc., has announced a two year scholarship with College of Fisheries Sciences of Pukyong National University (PKNU), Busan, Korea. The scholarship will cover tuition and expenses for two students for a period of two academic years.

"Through the Novus Scholars Program, we are creating a global community which enables collaboration among students, academia and professionals in our industry. Together we will build a collective knowledge base related to the science and practice of health through nutrition", said Dr Farshad Shishehchian, Global Aqua Manager.

He added that through this program with PKNU, the company is supporting aquaculture students who have demonstrated promise in areas associated with or related to nutrition, metabolism, growth and development or health and disease. In addition to the monetary award, one or more members from each of the awarding classes will be selected for a fully funded internship at a Novus International research center or another institution that does collaborative research with Novus.

For more information: www.novusint.com

BFT news

Some recent articles on Bio Floc Technology published by the group are detailed below:

Up to 50 tonnes shrimp/ha in Indonesia

Dr Nyan Taw and co-workers (Hendri Fuat, Naira Tarigan and Kaesar Sidabutar) reported recently on results of a commercial production of white shrimp *Litopenaeus vannamei,* using BFT technology and partial harvest. The shrimp were cultured in several ponds of 2,500 to 6,000m^2. A control, phytoplankton system pond was stocked with 100 PL/m^2. BFT ponds were stocked with 145-280 PL/m^2 and aerated with paddle wheels with a power input of 26-36 hp/ha. Feeding was with a low protein feed plus a source of carbohydrates to adjust C/N ratio.

Partial harvesting started on day 85. Further harvests were done approximately every two weeks. The production in the pond stocked with 280 PL/m^2 with 5 partial harvests was 49,484 kg/ha. Other BFT ponds gave yields of 23,000 to 38,000 kg/ha. Feed conversion ration(FCR) was less than 1.1. The authors reported that operational costs of facilities using BFT could be reduced by as much as 20%. The costs for the power required to support sufficient aeration for high stocking densities may be offset with income from the partial harvests. The full report was published in Global Aquaculture Advocate, September/October 2008.

Growth and performance of Nile tilpia using indoor BFT tanks.

Ekram Azim and David Little reported on a detailed experiment evaluating growth of Nile tilapia in tanks. Three treatments were compared: BFT treatment fed with 35% protein pellets, BFT treatment fed with 24% crude protein pellets and clean water control, also fed with 35% protein pellets. BFT tanks were agitated and aerated. Wheat flour was added to BFT tanks to get a C:N ratio of 20. Tilapia stocking density was 12 kg/m^3. Total suspended matter was maintained about 500 mg/l, reaching at the last 2 weeks a density of about 1000 mg/l. The bio flocs contained 38% protein, regardless of protein in the feed, 3% lipid, 6% fiber and 12% ash. Protozoa, rotifers and some oligochaetes were identified in the flocs. Fish growth and net yield were higher in BFT treatments compared with clear water control, whereas, the two tested BFT treatments were equal. Physiological and anatomic parameters did not indicate any stress in the BFT grown tilapia. The full report was published in Aquaculture 283, pp 29-35, 2008.

The section was prepared by Yoram Avnimelech email: agyoram@tx.technion.ac.il

Beijing 2008

By Dr. Wing-Keong Ng

The Seventh Symposium of the World's Chinese Scientists on Nutrition and Feeding of Finfish and Shellfish (7SWCSNFFS) was held in Beijing from September 20-24 immediately after the Olympics and Para-Olympics Games. About 800 participants from academia, research institutions and aquafeed industries converged at the JiuHua Convention Center making it possibly the largest gathering of its kind for an aqua feed-based scientific symposium.

Group photo session after the opening ceremony of the Symposium. In the foreground are Dr. Silas Hung and Dr. Dong-Fang Deng, both from the University of California, Davis, USA.

In this year's symposium, there were 14 invited lectures, 79 oral presentations and about 138 poster exhibits. One afternoon was dedicated to an open forum "Technology Innovation for Aquafeed Enterprises" which featured an active dialogue and sharing of experiences between researchers and industry.

This 7SWCSNFFS was chaired by Dr. Shi-Yen Shiau (National Taiwan Ocean University) and hosted by the Feed Research Institute of the Chinese Academy of Agricultural Sciences under the local coordination of Dr. Min Xue. Foreign invited speakers included Dr. Ronald Hardy (USA), Dr. Marisol Izquierdo (Spain), Dr. Delbert Gatlin (USA), Dr. Wing-Keong Ng (Malaysia), Dr. J. Bøgwald (Norway), Dr. Craig Browdy (USA), Dr.Silas Hung (USA), Dr. Dong-Fang Deng (USA), among others. This symposium is the seventh in the series of symposiums held in China which started in 1992 and showed the emerging role Chinese researchers are playing in the global aqua feed industry. The sheer numbers of young and enthusiastic researchers present at the Symposium was encouraging. Twenty four aquafeed-related companies sponsored this year's successful Symposium, including international companies such as Uni-President Enterprises, National Renderers Association, International Ingredient Corporation and Novus.

The Symposium began with an invited lecture by Dr. Kangsen Mai (Ocean University of China) who spoke candidly on the topic 'Feed and Aquaculture Products Safety' which was a very timely presentation given the current food safety issues in China and elsewhere. He highlighted all the food safety incidents in recent years in China, including those related to aqua feed and proposed various aquaculture and aqua feed manufacturing guidelines to ensure that seafood products from China remain competitive in the international market. Dr. Marisol Izquierdo (Las Palmas de Gran Canaria, Spain) gave a comprehensive presentation on the advances made in larval nutrition

with emphasis on marine fish species, encompassing topics such as lipids, protein, vitamins and minerals. An in-depth overview on the topic "Aquafeed protein sources of the future" and "Challenges of fishmeal and alternative protein sources in today's aquaculture" was given by Dr. Ronald Hardy (University of Idaho, USA) and Dr. Craig Browdy (USA), respectively. Both highlighted the current high cost and limited supply of fishmeal and provided views of how the aquafeed industry will need to adapt to the ever changing and increasing need to evaluate alternatives to fishmeal in aquafeeds. Dr. Delbert Gatlin (Texas A&M University, USA) discussed 'Fish Nutrition and Immunology' and presented several research studies on the use of immunostimulatory compounds in aquafeeds with emphasis on the use of prebiotics in disease prevention.

Dr. Wing-Keong Ng (Universiti Sains Malaysia, Malaysia) gave an overview on the 'Potential use of palm oil and its minor components in the global aquafeed industry'. His presentation was timely since China imports more than 35 million tonnes of palm oil from Malaysia annually and some large feed companies in China have recently shown interest in using palm oil in aquafeeds. Dr. Ng highlighted the benefits and constraints in the use of palm oil and its minor components, vitamin E and carotenoids, in aquafeeds. Dr. Jonathan Shepherd (International Fishmeal and Fish oil Organization), Dr. J. Bøgwald (University of Tromso, Norway), Dr. Silas Hung (University of California, Davis, USA), Dr. Dong-Fang Deng (University of California, Davis, USA), Dr. Ping Zhang (Chinese Academy of Agricultural Sciences), Dr. Shouqi Xie (Chinese Academy of Sciences), Dr. Chyng-Hwa Liou (National Taiwan Ocean University, Taiwan), Dr. Liqiao Chen (East China Normal University) constituted the rest of the invited speakers, each with a presentation in their area of expertise. Topics ranged from NIR fingerprint technology to the nutritional requirements of Chinese mitten crabs. Oral and poster presentations were given by Chinese researchers and their collaborators over the next 2 days. The next Symposium will be held in Chengdu, Sichuan Province.

From Left, Dr. Shi-Yen Shiau, Dr. Min Xue and Dr. Wing-Keong Ng.

What to expect in AQUA CULTURE Asia Pacific Magazine in 2009

Vol 5 2009	Issue 1	Issue 2	Issue 3	Issue 4	Issue 5	Issue 6
	January/ February	March/ April	May/ June	July/ August	September/ October	November/ December
Issue focus *current trends & challenges*	**Aqua Feed Production**	**Food Safety**	**Responsible and Sustainable Aquaculture**	**Health Management**	**Cage culture**	**Hatchery Management**
Industry review *with profiles & outlook*	Marine shrimp	Marine fish	Catfish	Freshwater prawn	Tilapia	Offshore cage culture
Shrimp/fish culture and developments	Features best practices and experiences from industry. Coverage on role models, benchmarking and breakthroughs in industry throughout the region					
Feed technology	Feed ingredients Additives	Extrusion technology Moist feeds	Feed regulations/ Organic feeds	Fish meal & oil replacements Novel meals	Feed processing/ Immunostimulants	Nutrition & formulation Larval feeds
Technical contributions	Certification & standards Disease management	Recirculation technology Fish/shrimp breeding programs	Hatchery management Pre and probiotics	Biosecurity Aeration technology	Fish diseases Biotechnology	Risk assessment Pond culture technology
Markets	Reports on opportunities, market trends, regulations and certifications, branding and product development					
Show preview/ issue	Aqua VIV Asia 2009, Bangkok 11-13 March	World Aquaculture 2009, Mexico 19-23 May	Vietfish 2009 Ho Chi Minh City 12-14 June	Asian Pacific Aquaculture TBA	Cage culture Asia TBA	Aquaculture China 2009 TBA

AquaVision 2008

"Be distinct or extinct": Aquaculture companies must make their story interesting

Tell your story but be different was the message from restaurant marketing specialist Aaron Allen to around 400 delegates at AquaVision 2008, the international multi-stakeholder aquaculture conference in Norway.

Allen who is adviser to more than 4,000 restaurants across the world, gave some clear marketing advice.

"Be distinct or be extinct, have a 'cause' not a business. Advertising to create an international brand would be too expensive for most companies so they must use other means. Think like a journalist and create a unique and interesting story and then the press will write about you and people will talk about you."

He added, "Remember the power of the Internet and that is more than your website. An entertaining story can move around the world in hours thanks to the Internet, especially through the phenomenon of social networking sites. A recent survey most people rate the Internet as a more important source of information than television, newspapers or word of mouth. That means companies should keep their websites up to date, with rich and dynamic content."

A very good product

Speaking in the same final conference session, Åse Aulie Michelet, CEO of Marine Harvest, made a similar point: "The aquaculture sector should give more attention to presenting its products and not focus only on production. We must explain better what it is and how good it is."

Aquaculture production will grow to meet the demand for fish but there are sustainability challenges. She presented the Marine Harvest Qmarine global quality programme as an example of how an industry leader can establish the way to go in addressing these issues.

Promising tuna farming

Hagen Stehr delivered a great example of a unique and entertaining story of Clearwater Tuna Farming in Australia, which is pioneering the way to close the cycle in southern blue fin tuna production. The company is now close to success having raised tuna broodstock over the past seven years which are now 200kg per fish. Along the way, Stehr's company created a new species in aquaculture by using kingfish as a model. It will have 10,000 tonnes of market-ready kingfish in three years.

Enormous aquaculture production in China

At the other end of the production spectrum, Dr Chingchai Lohawatanakel, Vice Chairman of the Charoen Pokphand Group, pointed out that aquaculture in China produces more than 32 million tonnes of fish a year, mainly carp. The Chinese are also major consumers of fish and that will grow.

Market research in China shows fish is the fastest growing protein option in low, middle and high income groups, with increases exceeding 100% in all three categories. Turning to pangasius in Vietnam, he declared it the low cost fish of the future for low income earners. The environment offered by the Mekong river means fish farmers there can produce 360 tonnes of fish per hectare per year; ten times the productivity of Chinese carp and currently farmers only use 2% of the potential production area.

Cry for new knowledge

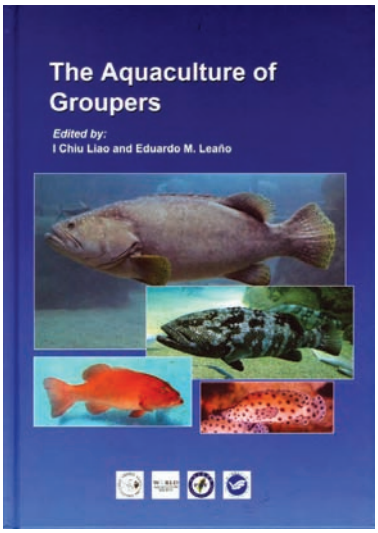
"Innovation is essential for future food security," said Wout Dekker, CEO of animal nutrition company Nutreco, when closing the conference. "At this AquaVision the cry for new knowledge has been louder than in any previous AquaVision or Agri Vision conference. We are in a period of 'agflation' with high food prices and volatile commodity markets and agflation will drive innovation."

"While there have been common themes running through previous conferences, today the themes are dominated by the realisation that with a growing world population of people with more money to spend and limited world resources, food security is no longer a given. To feed the world, we need innovation. More than that, the companies that will succeed are those that ensure food safety and sustainability." Additionally, he said they must follow the advice of Aaron Allen to "differentiate their products, position and market them effectively."

The Aquaculture of Groupers

Editors: I Chiu Liao and Eduardo M. Leano

August 2008



This book reviews the research and development status as well as commercial production of groupers in Asia and Australia. The first five chapters deal with research and development activities intended to improve mass larval production, nursery and grow-out culture groupers in Japan, Taiwan, Korea, Indonesia and the Philippines. Culture trials of groupers as well as its prospects in India are presented in Chapter 6. Chapters 7 to 10 summarize the current status of grouper aquaculture in China, Hong Kong, Thailand, Malaysia and Australia, where reviews on culture methods employed for larval production, nursery and grow-out, some problems associated with culture operations, recent innovations to improve production, as well as trading and marketing are presented and discussed. Health and nutrition of groupers are discussed in Chapter 11, while a detailed study on the prophylaxis of two major viral disease (iridovirus and nodavirus) of groupers is presented in Chapter 12. Finally, a simple economic analysis on the grouper industry of Taiwan is discussed in Chapter 13. As a way of promoting increased consumer acceptance of groupers, some delicious grouper cuisine recipes are included in the Appendix, which will guide readers on the step-by-step procedures in preparing simple but wonderful grouper-based dishes. (Hardbound, pp.241).

The book is available from the Asian Fisheries Society for USD 40.00 (USD25 for active AFS members) excluding postage.

For more information: Ms. Emi Y. Flores, Executive Officer,Asian Fisheries Society

Email: members@asianfisheriessociety.org Website: www.asianfisheriessociety.org

Shrimp Partial Harvesting Model: Decision Support System User Manual

CTSA Publication No. 153

In the July/August 2008 issue, we introduced the conference presentation, "an optimal partial harvesting model for intensive shrimp culture", given at the World Aquaculture 2008, Busan, Korea. The same research group at the University of Hawaii; Lotus E. Kam, Run Yu, and PingSun Leung, Department of Molecular Biosciences and Bioengineering, College of Tropical Agriculture and Human Resources and Paul Bienfang, Department of Oceanography, School of Ocean and Earth Science and Technology, have now released this shrimp partial harvesting model and its user manual.

The recent released 'shrimp partial harvesting model' is a spreadsheet-based decision support system. To use this model, all one needs is the Microsoft Excel and the standard Frontline Solver (which is a standard add-in in Microsoft Excel). Given the biological and economic factors of a particular shrimp farm (e.g., survival rate, growth, feed cost, operation cost, etc), the model could automatically identify the best harvest strategy that maximises overall net revenue for a crop. All one needs to do is to click a few buttons and input the necessary biological and economic information that characterizes the operational condition of the farm. The model will navigate the user to see the identified best production schedule and its associated economic performance such as revenue and cost. The user manual reviewed here (CTSA Publication No. 153) describes the basic structure of this decision support system and provides a step-by-step navigation on its application.

To apply this model, the user need to supply farm operational information such as the size of the farming facility, the carrying capacity of the facility, estimated growth and survival rates, market price, weekly labor cost and maintenance cost, harvest cost, etc. Although the present settings of the model records these data in the U.S. conventional units (i.e., acre for pond area and USD /lb for price and feed cost), the user could input these data in different units as long as all the data are recorded in a consistent manner. The model is flexible and could be tailored to reflect the operational characteristics of a particular farm. For example, the model gives the users the chance to determine their unique target criterion when producing diverse sizes of shrimp (e.g., to meet the minimum, or average, or maximum weight requirement of a size category).

The model eventually will work out and compare the scenarios of partial harvesting vs. single batch harvesting, i.e., what is the cost and benefit of engaging in multiple small "partial harvests" in comparison to a single very large harvest. Of course, to estimate the benefits of the partial harvesting strategy, one must specify the cost for both a traditional full harvest and a partial harvest. It should be noted that the accuracy of prediction/assessment in the summary report is highly contingent on the quality of input information.

For further inquiries regarding this publication and associated software, please contact: PingSun Leung, Department of Molecular Biosciences and Bioengineering, University of Hawaii at Manoa, 3050 Maile Way, Gilmore 111, Honolulu, HI 96822, USA, Email: psleung@hawaii.edu

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Indaqua 2009 Promise of plenty

21-23 January, 2009, Bhubaneswar, India

The Marine Product Export Development Authority (MPEDA) has organised three INDAQUA expositions since 1993. The last in 2007 in Chennai helped in developments in coastal aquaculture, in particular the marine shrimp. In 2009, the exposition will move to Bhubaneswar, capital of Orissa and temple city of India on the eastern coast of India. In the next few years, MPEDA plans to develop aquaculture in Gujarat, Maharashtra and Orissa. This is expected to generate 5 million jobs and export earnings to increase to USD 6billion from the current USD 1.6 billion.

The theme of the show in 2009 is "Bringing together the most promising heads in Aquaculture"

In 2007, more than 700 stakeholders in the aquaculture industry in India attended the show in Chennai. Similarly, in 2009, members of aqua clubs, aqua farmers, entrepreneurs, farm associations, technical personnel, seafood processors, exporters and importers, feed manufacturers, policy makers and from academia are expected to attend the show. The trade show will be held at Janata Maidan, Opposite the Swosti Plaza from 21-23 January. It will bring together scientists, financiers, farmers and manufacturers to meet and network. The conference to be held from 21-23 January at the Convention Centre, Swosti Plaza will address crucial issues in the development of the industry in India.

For more information: The Marine Products Export Development Authority, (Ministry of Commerce & Industry, Government of India), MPEDA House, P.B.No.4272, Panampilly Nagar, Kochi-682 036, Kerala, India.
Tel: + 91 484 2321722, 2312812, 2311979
Fax: + 91 484 2312812, 2313361, 2314467
Email: premchandran@mpeda.nic.in, or bbsmpeda@dataone.in
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Practical Short Course on Feeds & Pet Food Extrusion

Feb. 1-6, 2009

This one week course on Feeds & Pet Food Extrusion will be presented at Texas A&M University by staff, industry representatives, and consultants. The program will cover information on designing new feed mills and selecting conveying, drying, grinding, conditioning and feed mixing equipment. Current practices for production of pet foods, preparing full-fat soy meal; recycling fisheries by-products, raw animal products, and secondary resources; extrusion of floating, sinking, and high fat feeds; spraying and coating fats, digests and preservatives; use of encapsulated ingredients and preparation of premixes, and least cost formulation are reviewed. Practical demonstration of pet food, vacuum coating, and several others are demonstrated on four major types of extruders - (dry, interrupted flights, single and twin screw), using various shaping dies. Reservations are accepted on a first-come basis.

For more information, programs and application forms, contact: *Dr. Mian N. Riaz, Food Protein R&D Center, 2476 TAMU, Texas A&M University, College Station, Texas 77843-2476 Tel: +1 979/845-2774 Fax: +1 979/845-2744, E-mail: mnriaz@tamu.edu* ***Web: www.tamu.edu/extrusion***

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