

# AQUACULTURE ASIA

Small indigenous freshwater fish polyculture  
Sperm chilled storage of common carp

Central China  
Sea cage cobia, India





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## Aquaculture Asia

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### NACA

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

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# AQUACULTURE ASIA

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## Early mortality syndrome - when will we learn?

It is a continual source of frustration to me that I still regularly receive email from farmers, traders and entrepreneurs asking for assistance to import seed of all manner of species to their country. They don't ask for a reputable supplier, they aren't interested in health screening and on the rare occasion that they actually mention health certification, it is inevitably in the context of finding ways to rubber stamp or fast track the process.

It seems that the near-collapse of the shrimp industry in the 90's and the ongoing multi-billion dollar losses that are incurred by the aquaculture industry every year through senselessly introduced disease agents have not sunk in. Despite widespread awareness of such diseases, the common knowledge that they (in most cases) came from outside, and that new diseases continue to turn up on a more or less annual basis, there are a frighteningly large number of people in the aquaculture industry who just don't care. They are willing to put the future of their whole industry at risk for the sake of convenience or a fast buck.

The latest disease poster child is "early mortality syndrome", more accurately described as acute hepatopancreatic necrosis syndrome, which has caused widespread losses across several Asian countries. The cause has, until now, been something of a mystery, but it now seems likely to be a strain of *Vibrio parahaemolyticus* (see the Newsletter section for details).

Although the cause has not been clear until now, the spread of the disease has followed a familiar pattern, jumping borders and moving from country to country, in this case starting in China and Vietnam in 2010, to Malaysia in 2011 and more recently to Thailand in 2012. How is it moving such vast distances? Almost certainly the same way that every other major disease that has assailed aquaculture over the past twenty years has: Through the importation of live animals by the aquaculture industry, and quite likely through unregulated and undocumented movements. The aquaculture industry has in all likelihood brought this problem upon itself, and what little sympathy I had is now exhausted.

Before seeking to import seed, take the time to search for a national (or better, local) supplier. In most cases they do exist saving you considerable regulatory hassle and extra shipping expense (most people that contact me apparently have not bothered to look around themselves). Make sure you get your seed from a reputable supplier, preferably one that offers health screening and if at all possible (particularly for shrimp which is a long way ahead of finfish in this regard) from one that offers certified specific-pathogen-free stock. Importing seed or broodstock from overseas should be your absolute last resort, and if you really must do it, go through official channels as painful as they may be, demand that it comes with a health certificate from the competent authorities and comply with your local quarantine regulations. Otherwise, just don't buy it. You don't know what it's carrying and it just might come with a free sample of the next "disease of the year".

*Simon Wilkinson*

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# Rural Aquaculture

## A second trip to Hubei Province, Central China

Professor Wang Wei Min, an Asian Institute of Technology (AIT) Masters degree alumnus who is currently Dean of the Fisheries College of Huazhong Agricultural University in Wuhan invited me to visit again in October last year as a 'reward' for reviewing papers written by his colleagues and students (a previous column, 'Aquaculture in Hubei Province, Central China', was published in *Aquaculture Asia* Volume 17, number 3, based on my visit there in 2012).

Chinese universities are now encouraging research to be published in first class international journals with high impact factors so articles need to be written in high quality English as well as reporting high quality research. I confess to only having been able to address the first issue, that of language in the papers

I reviewed, as the molecular genetics subject matter was mostly beyond me. Reviewing the papers brought to mind a comment made by my own doctoral degree supervisor, Harold Bold, when I attended the University of Texas in the late 1960s, that 'his doctoral degree was obsolete'. As Bold was a distinguished botanist, Chairman of the Department of Botany as well as the President of Biological Sciences of the University with about 100 professors from several departments, and a member of the US National Academy of Sciences, I felt at the time that he was being rather humble. Now I fully understand his frustration in trying to keep up with rapidly expanding scientific fields, a task that's becoming increasingly difficult with the acceleration of papers being published.



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I presented a seminar to the faculty and students entitled 'Aquaculture environment interactions: past, present and likely future trends', which was a 'dry run' of a keynote I later presented at the Elsevier conference, 'Aquaculture: to the next 40 years of Sustainable Global Aquaculture' in Gran Canaria, Spain in November 2013. Professor Wang then kindly arranged a two day field trip to



*The writer interviewing Gong Siyuan about rice fish culture in China*





A farm worker with a harvested mitten crab from the integrated rice crab system in the background.

visit fish farms, followed by an inspiring visit to Wudang Shan, a sacred Taoist mountain dotted with Ming Dynasty temples.

I was especially interested during the field visit to see rice/fish farming and before leaving Wuhan I interviewed a university faculty member with expertise in the topic, Gong Shiyuan. We visited a rice-crab demonstration, an eel farm and the Permanent Agricultural Exhibition in Jingmen City; and a Chinese turtle farm in Jinshan County.

## Rice/fish interview

Rice/fish culture has a long tradition in China but until fairly recently was confined to upland areas in the southeastern part of the country. In an earlier column I described a visit to a rice/common carp system with a 1,000 year old history in Zhejiang Province (Edwards, P. 2006. Peter Edwards writes on rural aquaculture, Recent

developments in Chinese inland aquaculture. *Aquaculture Asia* 11(4): 3-6). With promotion from the government rice/fish farming started to increase throughout the country from about 1985 although it was not common in Hubei Province a decade ago and only began to develop rapidly about five years ago. I recall Professor Wang telling me at the World Aquaculture Society meeting in Beijing in 2002 that there was no rice/fish culture then in Hubei Province.

Most of the recent development of rice/fish culture involves high-value pelleted crustaceans rather than finfish. The most popular species is the exotic red swamp crayfish (*Procambarus clarkii*) farmed throughout the country in rice fields with 3m wide and at least 1.8m deep trenches. Unlike in other countries into which it has been introduced, it is not considered to be an invasive pest in China, and comprises 80% of the national rice/fish production.



Close up of a mitten crab.





Lunch with Dr Liu Xiao Ling, University researcher, left, Professor Wang Wei Min (centre) and Jin Gui Hua, Jingmen Technology Bureau.

The main farmed species in rice fields in Central and Southern China are red swamp crayfish and Chinese mitten crab (*Eriocheir sinensis*) although in Northern China finfish are commonly cultured (common carp, *Cyprinus carpio*; crucian carp, *Carassius carassius*; pond loach, *Misgurnus anguillicaudatus*; and ricefield eel, *Monopterus albus*). Culture

A dish of mitten crab.



A dish of red swamp crayfish.

of mitten crab was more popular in the past but since about five years ago has been displaced by red swamp crayfish. Farmers are given subsidies by both national and local governments to culture red swamp crayfish. Currently the farmed area of red swamp crayfish is around 1.3 million ha with about 25% of the total in Hubei Province. Average yield of red swamp crayfish is 750 kg/ha with an average farm







*The rice field eel farm.*



*The rice field eels raised in shallow water containers.*

gate price of Yuan 20 (US\$3.3)/kg although up to Yuan 35 (US\$5.7)/kg for high-quality produce. Mitten crab is mainly cultured in coastal provinces.

## Field visits

### Rice/mitten crab

This was a trial to assess the feasibility of rice/mitten crab integration on a Jingmen City agricultural extension station in Chang Tan District carried out in cooperation with Professor Wang and his university colleagues. Large size mitten crabs





*Close up of a rice field eel.*



*A dish of rice field eel.*



*The rice field eel farm located below a reservoir.*





The rice field eel farm (left) and rice fields planned for eel farm expansion (right).

of 150-250 g sell for Yuan 200 (US\$33)/kg. The trench was 80cm deep up to the level of the rice field and with a water depth of 1.5 m the crabs were able to enter the rice field to feed on insects although the main source of nutrition for the crabs was pelleted feed. The trench around the rice field was initially only 1m wide but it had to be considerably widened as drought made it necessary to increase the water volume in the trench as there was insufficient rain to flood the rice field to an adequate depth for the crabs. Mandarin fish (*Siniperca chuatsi*) was also stocked to control wild carnivorous rice field eel and loach. The field was surrounded by a plastic fence to prevent crabs from escaping.

Although the trial had only commenced in 2013, some 1,200 local farmers had received training in system design and construction, husbandry, and disease and predator control. Farmers were to be subsidised to integrate crabs in their existing rice fields.

### Rice field eel farm

This large 6.7 ha farm in Zheng Ji City raised paddy field eel in 80 plastic covered 210 m<sup>2</sup> sheds, each with twenty 2x2x1m deep plastic lined pools. As breeding was reported to have been unsuccessful, 7 kg (40 individuals/kg) of wild eel fingerlings were stocked in each pool which also contained emergent aquatic macrophytes. These were to provide hiding places for the eels as well as a substrate to allow them to climb to breathe air.

The farm was located below the 173 ha An Wa domestic water reservoir. Water was allowed to flow through the system continuously in summer and when needed to maintain water quality in winter. Previously to farming eels below the dam, the farm owner had obtained permission from the local



The Permanent Agricultural Exhibition in Jingmen City.



A Chinese turtle climbing out of a pond.



Intensive monocultures of rice, poultry and turtles illustrated in the exhibition.





Ponds of the Chinese turtle farm.



A dish of Chinese turtle.



Heated indoor tanks of the Chinese turtle farm.

government to raise silver and bighead carp in the reservoir which he reported helped to treat the water, although this practice had later been banned.

The eels were fed with a 40:60% mixture of chopped silver carp (*Hypophthalmichthys molitrix*) costing Yuan 6 (US\$1)/kg for 0.7-1.0 kg sized fish, and pelleted fish feed. As low-cost farmed silver carp comprised a major source of feed, the system is an example of an aquaculture/aquaculture integrated farming system. Four months later 35-40 kg of 150-200 g eels were harvested and sold at Yuan 70 (US\$11)/kg, reported to be a very profitable operation.

The system was reported to be better than pond culture as eels could be raised year round in the covered sheds in the temperate climate. Furthermore, farmers raising eels in ponds had to harvest eels when the pond water level dropped but in this system below a reservoir eels could be harvested to attain the best market price as water was essentially unlimited.

The conversion of rice fields to fish ponds has been banned in China for several years due to concerns about national food security but this private farm had been built on former rice fields; and had been subsidized by the local government to the tune of Yuan 10 million (\$1.64 million). Furthermore, there was a plan to expand the farm using adjacent rice fields.

Use of the site for intensive aquaculture was clearly a much more efficient use of both the land and water than cultivation of rice as it was situated immediately below the dam of a reservoir with an excellent year-round water supply. With increasing concerns globally as well as in China about limitations of land and water for food production, sites should be used for the most efficient use of both land and water resources as well illustrated by this case study. Introduction of general bans on aquaculture on agricultural land may be counterproductive for both food security and improvement of the livelihoods of small-scale crop farmers as fish is also an important component of food security as well as usually providing more income for farmers than food grains.

### Jingmen City Permanent Agricultural Exhibition

The final visit in Jingmen City was to the most impressive Permanent Agricultural Exhibition which occupied the entire ground floor of a large municipal building in the centre of



The owner of the turtle farm with a natural turtle-shaped rock.



the city. The exhibitions included artifacts from the Neolithic Age as the area was established as an administrative unit in the late Shang Dynasty (16th - 11th century BC); as well as rather futuristic depictions of intensive monocultures of rice, poultry and turtles, no doubt intended to represent future food production landscapes. The turtle farm illustrated, however, bore a striking resemblance to the one visited next in Jinshan County.

### Turtle farm, Jianshan County

The 16 ha farm raising the Chinese pond turtle (*Mauremys reevesii*) was established in 1989 as a turtle seed farm. The owner previously was the general manager of a transport company although he also ran an integrated farm with chickens, pigs and fish. The farm had an impressive turtle museum with fossil turtles, carapaces of many species of turtles, natural rocks in the form of turtles as well as many types of turtle 'memorabilia'. The farmer was also an avid collector of huge bonzai which almost held as much interest for me as a botanist than the turtles. Many of the large bonzai were each worth Yuan 1 million (US\$164,000) with the prized specimen a 400 year old tree said to be worth Yuan 10 million (US\$1.64 million).

The farm had 63 large ponds and several enclosed heated tanks. It mainly functioned to produce small 4-8 g turtles which were sold to more than 50 farms in 8 provinces. Table sized turtles of 250 g were reported to sell for Yuan 200-300 (US\$33-49)/kg.

Turtles laid eggs in sand in brick sheds alongside the ponds in late May to September, three times /year with 5-10 eggs/ batch. Data were provided for one 2,655 m<sup>2</sup> pond which had been stocked in 1990 with 3,300 male turtles and 12,220 female turtles. On questioning stocking the pond nearly a quarter of a century ago, I was informed that some turtles live for more than 100 years. The adult turtles, the broodstock, were fed with pig intestines and trash fish (farmed silver carp purchased at Yuan 2 (US\$0.33)/kg), so another example of an integrated aquaculture/aquaculture system. However, young turtles were fed pelleted feed.

The farm produced 3 million small turtles annually but planned expansion was to produce 10 million by 2018. The expansion, as for the eel farm outlined above, was to take place in rice fields adjacent to the farm. I was informed that local rice farmers had land use rights for 50 years but would lease out their small-scale farms to the turtle farm for 15-30 years with guaranteed employment on the large farm. Thus, the small-scale farmers would be better-off as they would receive both rent for their farm from transfer of their land-use right and a salary from the expanded turtle farm.

Close up of turtles on floating rafts in the ponds.





# Sea cage growout culture of cobia *Rachycentron canadum* in shallow sea of Gulf of Mannar region, Tamil Nadu

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In India, marine finfish aquaculture is a low profile activity. In coastal farming, shrimp aquaculture alone is flourishing but recently sea bass culture has also started picking up. Before this project, cobia farming was practically nowhere to be found in India but now it is slowly starting to develop. Cage culture of cobia in shallow sea waters is a low-risk and a profitable venture. Effective utilisation of near shore waters will create alternative livelihoods to support fishers and their families, potentially allowing fishers to earn income during fishing holidays and non-fishing seasons. As the shrimp farming industry is increasing production with falling prices experienced in international markets farmers need to diversify to protect their incomes.

Cobia (*Rachycentron canadum*) is a marine finfish with high quality white meat and an extremely fast growth rate which can be developed as a high value, export oriented species for mariculture in India, as has occurred elsewhere such as China, Vietnam, USA and Australia. In the long-term, cobia could be one of the few leading marine species of the future for the world in general and India in particular. The maximum recorded size of wild cobia is two metres in length and 68 kg in weight. They can attain 1 kg after 6 months of culture, 5-6 kg after 1 year and around 8-10 kg after two years of grow out in cages.

Keeping the above in view, Indian Council of Agricultural Research (ICAR), sanctioned a collaborative National Agricultural Innovation Project (NAIP) on Export oriented marine value chain for farmed seafood production using cobia through rural entrepreneurship to the Fisheries College and Research Institute (FCRI), Thoothukudi, Central Institute of Brackishwater Aquaculture, Chennai and Central Marine Fisheries Research Institute, Mandapam for five years from the year 2009. The FCRI has standardised the onboard and outboard transportation techniques of cobia and quarantine protocols from sea to the research centre. Studies were also carried out on the gut content analysis, anaesthetic protocols, maturity assessment, growth and FCR using wet feeds and formulated feeds and disease diagnosis and treatment protocols. Technologies were developed on cobia broodstock development feeds, nursery rearing, pond growout culture, cage growout culture and preparation of ready to cook products such as fresh and frozen cobia, modified atmosphere packaging and ready to eat products such as canned cobia curry, hot chilled cobia curry, retort pouch cobia and fish pickle. Value added products such as collagen and leather were also developed from cobia waste.

Minister for Fisheries, Tamil Nadu, inaugurating the fish harvest function.





## Cage design

The sea cages used for the study were as follows:

- Circular HDPE sea cage – 6 m diameter.
- Circular HDPE sea cage – 2 m diameter.
- Square HDPE sea cage – 4 x 4 m.
- Square wooden sea cage – 4 x 4 m.
- Square wooden sea cage – 3 x 3 m.
- Square wooden sea cage – 3 x 3 m.

While HDPE cages were floated by inserting polystyrene inside the pipes, wooden cages were floated by providing fibre barrels. Cages were moored with gabion boxes containing gunny bags with stones and sand weighing 2.5 tonnes. In the case of circular HDPE cages, the nets were kept in shape by providing a ballast pipe of 5 cm diameter at the bottom of each net, inserted with an iron rope (3.25 cm diameter). In the case of square wooden and HDPE cages the inner and outer nets shape was maintained by hanging cement blocks at the bottom rope attached to the nets at regular intervals. The nets were changed as size of fish increased.



*Cobia cultured cages at Gulf of Mannar-Thoothukudi coast.*



*Cobia cultured in concrete tank before transfer to cages.*

*Cobia weighed during sampling.*







*Commercial feed used for cobia culture.*

## Location

The sea cages were moored at 1.5 km from the Tharuvai-kulam sea shore, Thoothukudi district of Tamil Nadu, India. The depth of the water column was 4.3 m with sandy bottom. The cages were tied with HDPE inner net of 2.25 metres depth and a braided outer net of 2.5 meters depth.

10%, crude fibre maximum 1.0%, and ash maximum 15%, with the feed size of 15.8-16.2 mm L6.0. Fish were usually fed once a day at a feeding rate of 2–3% body weight. The feed conversion ratio (FCR) was 1.9.

## Source of seed

The cobia seeds were purchased from Rajiv Gandhi Centre for Aquaculture (RGCA), Pozhiyur, Kerala, India.

## Water quality management

Salinity ranged between 33-38 ppt and dissolved oxygen was 6-9 mg/l. The presence of ammonia ranged between 0-0.25, and no such significant amount of nitrite or nitrate was

## Stocking

The cobia seeds were reared in the concrete tanks up to 150-200 g size for a period of 2-3 months and then transferred to sea cages. The fish were stocked at the rate of 4 fish per cubic metre in sea cages.

## Feed and feed management

A slow sinking grouper feed (Uni President) was used which was very well accepted by the cobia. Manual feeding was conducted once per day. Consumption was directly monitored with a feed boy and once satiation was observed feeding was stopped. To our understanding the feed wastage was negligible. The finished feed contains crude protein (CP) minimum 43%, crude fat minimum 10%, moisture maximum







*Harvested cobia.*

detected. Water freely flowed through the cage. We noticed that cloudy days with little wind lead to lower levels of water exchange and reduced feed consumption.

## Sampling

Fish were sampled randomly using a long handled soft cloth net to minimise skin damage. Prior to the catching of fish, the inner net of cages were pulled upwards and tied in such a way to facilitate catching. During sampling the total number of fish was counted individually in small cages and 20 randomly selected fishes from each sampling were weighed and measured.

## Disease

No disease was observed in the sea cages regardless of feed used, however disease did occur in pond culture when trash fish was used.

## National Workshop on Cobia Culture and Cobia Harvest Festival

A National Workshop on Cobia Culture and Cobia Harvest Festival was organised on 1-2, March 2013 at Fisheries College and Research Institute, Tuticorin. The Honourable Ministers for Fisheries and Labour, Government of Tamil Nadu, inaugurated the workshop and harvest festival. 67

stakeholders from different parts of the country participated in the event. Production of averaged approximately 8 kg per cubic metre with an average weight of 4.5 kg over a ten month growout period. The Ministers initiated the first sales to a seafood company. The fish which were 4 kg and above were sold at the rate of Rs. 250 (US\$ 4) per kg.

## Factors to be considered for large scale commercial cobia farming in India

- Assured adequate supply of cobia seeds.
- Cobia hatchery units at farmer level need to be started.
- Channelised cobia export market need to be identified.
- Formulated feeds to be produced at reasonable price since the feed conversion ratio (FCR) is 1.9.
- Sea cage farming policy to be framed by the government.

Since the cobia aquaculture is new to Indian context, the fish-erfolk should be encouraged to involve in this cage farming by implementing incentive schemes in the early stages.



### Economics of cobia culture in 36 cubic metre wooden sea cage (4 x 4 x 2.25 metres) @ 100% survival

Recurring cost	Cost (Indian rupees)
Cobia seed (90 fish)	2,700
Labour	12,000
Formulated feed	57,713
Total	72,413
Income	
Harvest 405 kg fish sold @ Rs. 250 / kg	101,250
Profit	28,817

**Note:** Since the wooden cage along with cage nets already installed in the sea at Tharuvaikulam (Place) and FRP fitted with outboard engine were used, the capital cost was not included in the economics.

### Acknowledgement

The funding support by the National Agricultural Innovation Project (NAIP), Indian Council of Agricultural Research, New Delhi is gratefully acknowledged. The Consortium Principal Investigator expresses gratitude to Rajiv Gandhi Centre for Aquaculture, Pozhiyur, Kerala for supply of cobia seeds for conducting grow out culture in sea cages.



Adult cobia. Photo credit: Jorge Alarcon / Dr. Daniel Benetti, NOAA Photo Library.

## Culture of small indigenous freshwater fish species in polyculture with Indian major carps and high value crops along pond dykes

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Integrated farming is an age old practice even since our ancestral times. Small and marginal farmers along with ordinary households were practicing different agri-horticultural systems pertaining to their needs and dietary habits as a matter of their everyday livelihoods. Market chains were less extensive and less well connected, with people used to obtaining non-perishable products from distant markets on a weekly or fortnightly basis. However, increasing population and demands and a strong public distribution system (a food security system established by the government to distribute

essential goods to the poor) have greatly increased the availability of goods to the consumer, although the price of a good from a remote production site to the consumer has increased many folds, with middlemen contributing significantly to that cause.

The fragmentation of land, reduction in the agrarian structure of society, profiteering by middlemen, increase in input costs as well as demands of each individual (including small and marginal farmers) to live an easier if not more luxurious life





*Lettuce (left) and Chinese cabbage (right) growing on and around the pond pond embankments.*

have increased with the easy availability of modern amenities such as colour TV and mobile phones. Farmers who practiced integrated farming have slowly been shifting away from their traditional integrated farming practices to become increasingly specialised in order to increase their income.

Crop production is subjected to a high degree of uncertainty and farm income is highly variable. A crop failure can leave poor farmers unable to meet the basic needs of their families. As agricultural produce is perishable problems such as failure in time-bound payment of lenders or nonpayment of borrowers are being faces by farmers. The work is also seasonal. Fish farmers in West Bengal have much work from early monsoon to late monsoon i.e. April-October but must look for other options in the rest of the year. This is a

constraint for the farmers as during the lean period there is less work and their laborers lose their job. As a result a huge number of skilled workers migrate from West Bengal to other states such as Bangalore, Pune and Maharashtra in order to find employment operating machinery, building and road cutting and similar occupations. By doing these kinds of work laborers can gain employment year round and they are reluctant to return to West Bengal for seasonal employment. It is a matter of great concern that each year the number of skilled aquaculture laborers is decreasing; large farmers have some capacity to absorb their workers, but this is becoming a serious problem for the small and marginal farmers. Along with this critical skilled labour problem, the cost of inputs such

*Inspecting hybrid chilli.*







Broccoli.

as feed, fertiliser and electricity is rising alarmingly. As a result most farmers are reluctant to encourage their children to take up fish farming.

Low external input sustainable aquaculture (LEISA) farming system modules offer the potential to lower production costs through judicious reuse of farm waste materials in ponds and agricultural fields as well as to improve the availability of low cost protein to poor consumers and create employment over the lean season, while also increasing profit per unit area for the farmer. In this context, an experimental model farm has been set up in the Kalyani field station of the Central Institute for Freshwater Aquaculture (CIFA), by introducing culture of small indigenous fishes together with normal Indian major carp culture and high-value cash crops along the pond dykes.

## Importance of small indigenous freshwater fishes

The importance of small indigenous freshwater fish species is that until the recent past they were an important supply of nutrients, both protein and micronutrients, and a major contributor to nutrient security (Nandi et al., 2012). Essential nutrients such as vitamin A and C, iron, calcium, zinc, and iodine which are not adequately available in large cultivated fishes (e.g. Indian major carps) can be obtained from these smaller fishes<sup>1,2</sup>. They can also be a useful source of income during the lean period of agriculture, with particular reference to eastern region of India and Bangladesh. The nutritional advantage of these small fishes is that they are usually eaten

whole including the bones and organs which provide essential nutrients one way and reduce loss of required elements for health in other. In spite of their significant contribution with respect to nutritional security, these small fishes are now under tremendous threat and many have been listed as threatened by IUCN<sup>3</sup>. Combating undernourishment and malnutrition in developing countries is a big challenge. The nutrients provided by small indigenous freshwater fish species can contribute to solving this challenge<sup>4</sup>.

The Regional Research Centre of CIFA at Rahara has taken up this challenge of conservation and sustainable production of small indigenous freshwater fish species. An integrated approach has been adopted including diversified high value horticultural crops, livestock and aquaculture. This programme is specifically targeting the flow and recycling of nutrients among the different elements of the cropping system so as to minimise the nutrient loss and the need for external inputs.

Pabda, *Ompok bimaculatus* is non-air breathing catfish, popularly known as butterfish, and has a high consumer preference in India and neighbouring countries for its unique flavour, few bones and soft flesh. It is a highly priced, delicious and nutritious fish<sup>5</sup>. Unfortunately, it has also been listed as an endangered fish in India<sup>6</sup>. CIFA has already established the breeding technology of this species and it is an opportune time to incorporate this species in regular farming system. Pabda is compatible with mixed carp culture and does not compete for food with the carps<sup>5</sup>.





*Ompok bimaculatus*. Photo by Biswarup Ganguly. Distributed under Creative Commons Attribution 3.0 unported license.

## Importance of high value crops

The crops we selected are highly priced and in general have high market demand in and around Kolkata and various shopping malls because of their unique properties and excellent nutritional value. Most are not widely cultured in West Bengal, although they can be easily cultivated in the winter season (temperature ranging from 20-25 degrees) and are usually imported from other states. In West Bengal diversification in cropping patterns is a very recent phenomenon<sup>7</sup>. Farmers can easily earn more by cultivating such high value crops than by practicing traditional farming. Agricultural diversification towards high-value crops can potentially increase farm income, particularly in a country like India where demand for high-value food products has been increasing faster than that for staple crops<sup>8</sup>. The crops selected include:

- Broccoli, *Brassica oleracea* has anti-cancer properties<sup>9</sup> and is rich in anti-oxidants, nutrients<sup>10</sup>.
- Hybrid chilli, *Capsicum annuum* is rich in vitamin A, C, D and possesses many anti-oxidant properties which are thought to reduce cancer risk.
- Iceberg lettuce *Lacusa sativa* is a low calorie food rich in vitamins and anti-oxidants, reduces blood pressure<sup>12</sup>.
- Chinese cabbage, *Brassica rapa* is a good source of vitamins<sup>13</sup>.
- Red cabbage, *Brassica oleracea* contains vitamins including A, C, E, K and many of the vitamin-B complex as well as omega-3 and omega-6 fatty acids and many useful minerals. It lowers blood pressure<sup>14</sup>.





## Methodology

A freshwater fish culture pond of 0.1 ha area with water depth of 1m along with its pond dyke of 825 m<sup>2</sup>. located at Field Station, Kalyani, CIFA was selected for the study. High value small indigenous fresh water fish species such as pabda; *Ompak bimaculatus* were cultured along with Indian major carps rohu; *Labeo rohita*, catla; *Catla catla*, mrigal; *Cirrhinus mrigala* were grown in the pond while on the dykes were grown high value vegetables including red cabbage, *Brassica oleracea*; capsicum *Capsicum annuum*; hybrid chilli *Capsicum annuum*; iceberg lettuce *Lactuca sativa*; brocolli *Brassica oleracea* and Chinese cabbage *Brassica rapa*.

## Outcome

The return from carp culture of in 0.1 ha pond over one year is estimated to be around Rs. 13, 000<sup>10</sup> including pond lease and other expenditures. We have observed that some trophic niches within the pond cannot be utilised efficiently during the early period of carp culture due to the small size of fingerlings, which consume little early on. As a result lot of natural food organisms remain unutilised. The introduction of regionally preferred small indigenous fresh water fish species can generate additional profit for the farmers with a culture period of six months (October - March). As these small fishes grow faster they easily attain marketable size within six months, generating around Rs. 6,500 additional income from the water body<sup>10</sup>. In our experiment, in order to increase profitability over the lean period from the end of September to March, several high-value vegetable crops were grown on the pond dykes. The cost of cultivation, gross-return and profit are summarised in the adjacent table.

## Conclusion

Farmers, who have been practicing in general carp culture, can easily earn more profit by practicing different



Red cabbage.

module of farming with Indian major carps utilising their full farm area for a better livelihood. Farm owners can also increase their utilisation of labourers during the lean period of their fish culture, thus can retain their skilled workers, preventing them from migrating to other places and jobs which they do not actually prefer. Our experiment reflects a marked increase in economic gain per unit area by introduction of high value small indigenous freshwater fish species such as pabda and high value vegetable crops on the pond dykes.

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**Table 1: Cost, gross return & profit from different crops (rupees)**

Crop	Cost /m <sup>2</sup>	Gross return / m <sup>2</sup>	Profit / m <sup>2</sup>
Broccoli	9.82	30.74	20.91
Red Cabbage	29.98	61.90	31.92
Hybrid Chilli	10.81	27.78	22.52
Lettuce (iceberg)	15.74	37.14	21.40
Chinese cabbage	16.35	34.21	17.86



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# Study on sperm chilled storage of common carp *Cyprinus carpio* in Viet Nam

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Common carp *Cyprinus carpio* is a member of the Cyprinidae, the largest family of freshwater fishes (Nelson, 1994), and is widely cultured around the world with annual production of approximately 3.4 million tonnes (FAO., 2004). Common carp is a hardy species that can tolerate adverse environmental conditions and have a rapid growth rate and relatively high economic value in many countries (David et al., 2005). However, the harvest of wild carp has been decreasing because of overexploitation. Therefore, the storage of domesticated carp in Vietnam as a raw material for breeding and hatchery production is important (Trinh et al., 1996).

Storage of sperm is one approach to managing pure strains in fish species. Storage reduces the metabolic activity of sperm cells and extends their life span (Lim et al., 2005). Storage of fish semen is a simple technique that allows sperm to be retrieved at arbitrary times for fertilisation of eggs produced by hormone-induced females, facilitating reproductive productivity (Marques and Godinho, 2004). Successful sperm cryopreservation also has the potential to decrease expenses for holding male fish.

As a species of major economic importance studies of the reproductive biology of common carp are essential, including investigation of the semen component in order to bring out the best extender and dilution ratio for effective cryopreservation processes. Many studies on cryopreservation of sperm of other fish species have been published, for example salmon (Stoss and Holtz, 1983), catfish (Park and Chapman, 2005), sturgeon (Christensen and Tiersch, 1996) and yellow Croaker (Le et al., 2011). However, from studies on chilled storage of sperm for carp there are still many issues that need to be investigated in order to increase storage duration. The objectives of the present study were to investigate the effectiveness of extenders, dilution ratio and the addition of 25ppm penicillin plus 25ppm streptomycin on chilled storage of common carp sperm and to compare the results with those from other fish species.

## Materials and methods

### Semen collection

All experiments were conducted at the Laboratory of Fisheries Biology, Aquaculture Faculty. Semen was collected from common carp during the spawning season between March and May 2012 without hormonal stimulation. It was collected into 1.5 ml dry Eppendorf tubes by a gentle pressure on two sides of the belly. Care was taken to avoid contamination with faeces, urine and blood in samples designated for storage and cryopreservation as these can lead to activation of sperm. After collection, the samples were immediately placed on crushed ice until use.

### Analysis of quality sperm

The sperm motility of fish was immediately determined after semen collection. The percentage of spermatozoa exhibiting rapid, vigorous, forward movement was estimated under the microscope by diluting the semen in distilled water at a ratio 1:100 (semen: distilled water). Only samples with motility equal to or greater than 80% are recommended for storage experiments.

Motility was evaluated using a light microscope at 400X magnification and was expressed as percentage of motile spermatozoa. An activating solution of distilled water was used to estimate motility. Semen was diluted in distilled water at the ratio of 1:100 (1µl semen to 99µl DW). Then, 1µl was put on a glass slide without a cover glass and observed at 400X magnification under a microscope.

### Effect of extenders on motile sperm

To determine the optimal extender, semen was diluted at a ratio of 1:3 (semen: extender) with 0.3 M glucose, 0.6 M sucrose, common carp sperm extender (CCSE) (1-3) (Table 1). Diluted semen was stored in refrigerator at 4°C, storage treatments were replicated three times. The percentage of motile sperm in each tube was tested at 2-4 day intervals until sperm stopped moving.





Common carp, *Cyprinus carpio*. Photo by Dako99, Creative Commons Attribution-Share Alike 3.0 Unported.

### Effect of dilution ratio on motility

To determine the optimal dilution, semen was diluted in CCSE-2 at ratios of 1:1, 1:3, and 1:5 (semen: extender). Mixtures were placed in 1.5ml Eppendorf tubes and stored in a refrigerator at 4°C. Treatments were replicated three times. The spermatozoa motility was tested at 2-4-day intervals until spermatozoa stopped moving.

### Effect of antibiotic addition on motility

To assess the effect of antibiotic addition, semen was diluted at the ratio of 1:3 (semen: CCSE-2), the combination of penicillin and streptomycin at a concentration of 50ppm was added to diluted sperm. Treatments were replicated three

times and stored in a refrigerator at 4°C. The spermatozoa motility was tested at 2-4-day intervals until spermatozoa stopped moving.

### Statistical analysis

Data were expressed as mean  $\pm$  standard error (SE). Statistical evaluation was performed by one-way ANOVA using SPSS version 16.0. Results are presented as mean  $\pm$  standard error. Difference with a probability value (P) of 0.05 ( $P < 0.05$ ) were considered significant.

Table 1. Composition of extenders for chilled storage of sperm in common carp

Composition	Extender				
	0.3M Glucose	0.6M Sucrose	CCSE-1	CCSE-2	CCSE-3
NaCl	-	-	0.65g	0.35g	-
KCl	-	-	0.30g	-	0.47g
NaHCO <sub>3</sub>	-	-	0.02g	-	-
CaCl <sub>2</sub>	-	-	0.03g	-	-
Glucose	5.4g	-	-	-	2.14
Sucrose	-	20.52g	-	3.44g	-
NaOH	-	-	-	21 $\mu$ l	16 $\mu$ l
pH	6.8	6.7	7.8	7.7	7.7
Osmolality (mOsm/kg)	300	760	343	325	305

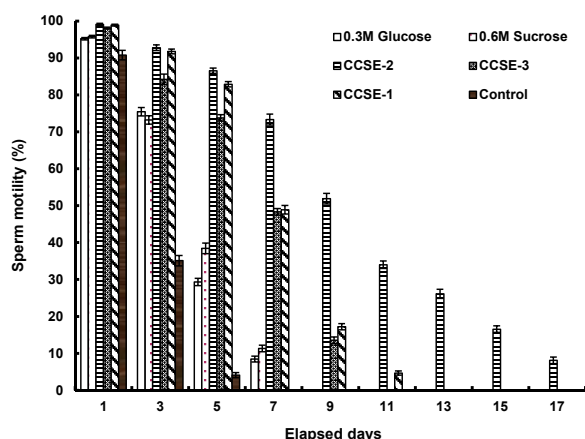


## Results and discussion

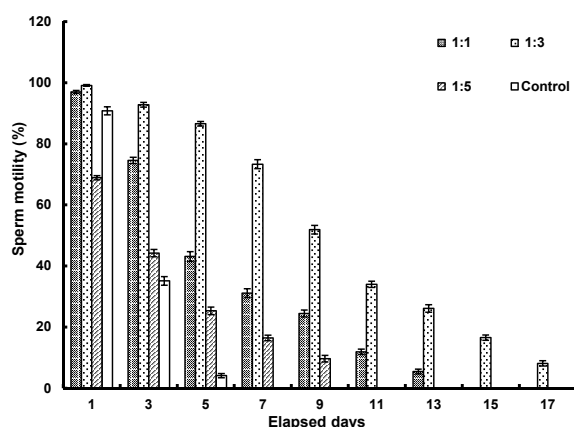
Effect of the extender on sperm motility: Semen was stored in CCSE-2 retained its movable spermatozoa longer than other extenders (Figure 3.1). They remained motile for 17 days, while sperm was stored in CCSE-1,3; 0.3M glucose and 0.6M sucrose remained motile for 11, 9 and 7 days, respectively.

Glucose 0.3M is a widely extender that is used to store sperm of some freshwater fish species, such as sperm of Abant salmon (*Salmo trutta abanticus*) stored in glucose 0.3M indicated that motile was better than Ringer's solution ( $65.0 \pm 3.9\%$ ;  $44.0 \pm 4.9\%$ , respectively) (Hatipoglu and Akcay, 2010). For mirror carp (*Ctenopharyngodon idella*), sperm stored in 0.3M glucose also retained movable sperm better than NaCl 1% and Modified ionic solution containing 75 mM NaCl, 70 mM KCl, 2 mM  $CaCl_2$ , 1 mM  $MgSO_4$ , and 20 mM Tris (Bozkurt et al., 2009). According to Le et al. (2011) indicated that sperm of yellow croaker (*Larimichthys polyactis*) remained motile for 14 days when was stored in ASP (artificial seminal plasma) and 10 days in marine fish Ringer's solution.

**Figure 1. Sperm motility (%) was stored in different extenders includes: 0.3 M glucose, 0.6 M sucrose, CCSE-1, CCSE-2, and CCSE-3 (CCSE: common carp sperm extender) at 4°C.**



**Figure 2. Sperm motility (%) of common carp semen stored in dilutions of 1:1, 1:3, or 1:5 at 4°C.**



### Effect of dilution ratio: One of the factors affecting sperm motility is dilution ratio

The most motile sperm was observed when sperm stored in CCSE-2 at ratio of 1:3, which remained motile for 17 days and 9 days at ratio of 1:5 (Figure 3.2). Le et al. (2011) reported that yellow croaker sperm was stored at ratio of 1:3 remained motile longer than ratio of 1:1 and 1:5. For Atlantic cod sperm (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*), and rainbow smelt (*Osmerus mordax*), sperm was diluted at ratio of 1:3 also remained motile better than other ratios (1:1, 1:2, 1:5, or 1:10) (DeGraaf and Berlinsky, 2004). However, the optimal dilution ratio of Africa catfish (*Clarias gariepinus*) sperm is 1:5 that remained motile longer than ratios of 1:3, or 1:10 (Erdahl et al., 1987).

### Effective addition of antibiotic

Motility in sperm stored in CCSE-2 at ratio of 1:3 and added 25ppm penicillin plus 25ppm streptomycin was higher than sampled for the control. It remained motile for 29 days, whereas the control remained motile for only 17 days.

Addition of antibiotics either to the undiluted sperm or to the storage diluent usually improves storage duration, and this addition can be stated as the most important parameter for chilled storage of sperm. According to some studies, a combination of 50 IU/penicillin and 50 IU/streptomycin for sampled carp semen without dilution indicated motile and fertilisation capacity that can be remained more than 18 days when storing at 4°C (Saad et al., 1988). With same concentration, in sperm of Atlantic cod (*Gadus morhua*) and haddock (*Melanogrammus aeglefinus*) similar results are achieved (DeGraaf and Berlinsky, 2004). Paddlefish (*Polyodon spathula*) sperm storage was also improved by adding a combination of antibiotic penicillin/streptomycin (Brown and Mims, 1995). In African catfish (*Clarias gariepinus*), however, addition of 25 to 50 IU/ml penicillin + 25 to 50 µg/ml streptomycin did not improve sperm quality during short term storage (four days) and doses of 100 IU/ml + 100 µg/ml were toxic for the cells whereas addition of gentamycin sulfate at 1mg/ml did improve the motility of these stored sperms (Christensen and Tiersch, 1996).

**Figure 3. Sperm motility (%) of common carp semen stored in CCSE-2 with dilution of 1:3 at 4°C and added penicillin plus streptomycin.**

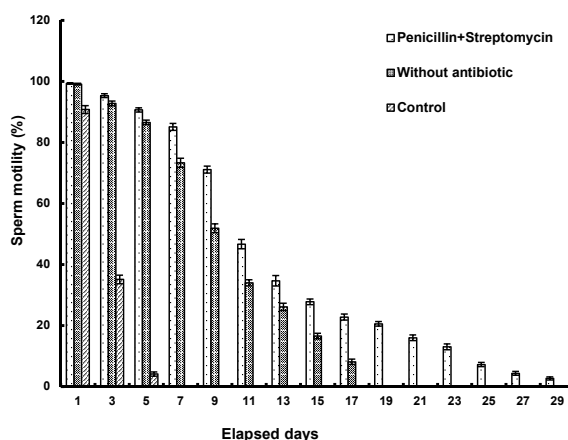






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## Conclusion

Sperm stored in CCSE-2 was resulted as the best storage duration (17 days) compared with others. The longest sperm storage duration obtained in CCSE-1 at ratio 1:3 was 17 days while the shortest storage period at ratio 1:5 was 9 days. Addition of antibiotics penicillin plus streptomycin at a concentration of 25ppm each extended storage duration of sperm up to 29 days.

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## Culture-based fisheries exchanges between Lao PDR and Cambodia

Under the ACIAR-funded project *Culture-based fisheries development in Lao PDR and Cambodia* a team from the Cambodian side of the project travelled to Lao PDR from 8-12 May. The exchange visits between the researchers and selected community leaders of both countries are a major component of the project, expected to facilitate networking and communication between the teams and to bring about an interchange of ideas and lessons learned.

The nine members of the Cambodian team included at least one representative from each of the four participating provinces engaged in planning and monitoring activities and two prominent community leaders, as well as the team leader and group engaged in coordinating the work at the Fisheries Administration. A comparable team from Lao PDR participated in the joint exchange meetings and activities.

The specific purpose of the visit was to apprise the Cambodian team of the culture-based fisheries activities that have been on-going in Lao PDR for the past five years, including aspects of community-based management of common water bodies. The exchange visit included field visits to reservoirs practicing culture-based fisheries, lectures from Lao project team members and interaction with community leaders.



The Cambodian team meets community leaders at Sivilay Village, Lao PDR.

The main component of the field visit was a one-day visit to the Sivilay community when there was an extensive exchange of ideas. The Sivilay community has 123 households (606 people) of which 109 are involved in the culture-based fisheries activities, which began in 2007. The community manages as 35 ha reservoir, which is stocked with advanced fingerlings of tilapia, common carp, silver barb, catla, bighead carp and rohu in July and August. Harvesting is normally allowed for 20-30 days in March and April each year, with around 10 tonnes of fish produced in 2012. The community is well organised with strict rules, regulations and responsibilities defined for its members. Harvesting, marketing and income distribution is well coordinated and organised.



Women play a prominent role in culture-based fisheries activities in the Sivilay community.

Through facilitated translation arrangements, the Cambodian team interacted with the Sivilay community leader and its members. About 20 Sivilay community members including women involved in culture-based fisheries activities were present for the interaction sessions, which were held under a shed near the community water body. All in all it was an excellent field visit with learning opportunity for all.

The Cambodian group obtained considerable information on the mechanisms and logistics of culture-based fisheries practices in Lao PDR; the powers the community have over management



Discussing financial aspects and income distribution amongst the community.

of the water body including to impose fines on poachers; and the manner in which income is distributed amongst the community. The Sivilay community has improved its management regimen with experience over the last six years and is maintaining culture-based fisheries activities completely independent of project support, but continues to be involved in disseminating the practice to adjacent village communities and in providing training.

It was evident that there are some fundamental differences in the approaches to culture-based fisheries between the two countries. In Cambodia water bodies are treated as a common property resource with free access, permitting any individual to fish at



Lao and Cambodian teams, background is the Sivilay community reservoir.



## Culprit behind massive shrimp die-offs in Asia unmasked

their discretion, any time of the year, unlike in Lao where water bodies are managed by the village community, primarily aimed at water management of downstream agricultural activities. As a result of the open access regime in Cambodia the stocked fish may not reach optimum size and thereby reduce the potential income from culture-based fisheries activities.

It was therefore agreed that the collation of baseline data on the project water bodies and subsequent monthly survey data on the fish catches / production would be required to document the benefits from the culture-based fisheries programme on the Cambodian side, and the need was recognised to introduce regulations to facilitate adoption of culture-based fisheries where communities wish to undertake such an endeavour. Some Cambodian communities will take steps to initiate a dialogue with the provincial government as a means of obtaining support for a change in regulations to protect fish stocked for culture-based fisheries purposes.

The success thus far in Lao PDR of culture-based fisheries was highlighted; basically all the communities that were involved in the first phase of the project, beginning in 2007-2008 continue to do so, in spite of the fact that a few may have had failures in some years due to adverse weather conditions, flooding and similar mishaps. All these communities are now self-sustaining in all aspects and provide leadership to adjacent communities who wish to adopt culture-based fisheries.

The Cambodian team also visited Nam Ngum Reservoir and interacted with a local Fisheries Officer to learn more about the management of the reservoir, which is one of largest in Laos, built primarily for the purpose of power generation.

A reciprocal visit of Lao PDR team to Cambodia is planned for May 2014. A regional workshop to share the findings of the project with other countries is tentatively scheduled for November or December 2014 in Siem Reap.

3 May 2013, Rome - In a major breakthrough, researchers at the University of Arizona have identified the causative agent behind a mysterious disease that has been decimating shrimp farms in Asia.

The disease, known as Shrimp Early Mortality Syndrome (EMS) or Acute Hepatopancreatic Necrosis Syndrome (AHPNS), has over the past two years caused large-scale die-offs of cultivated shrimp in several countries in Asia, where one million people depend on shrimp aquaculture for their livelihoods.

In 2011, the Asian region produced 3 million tonnes of shrimp, with a production value of \$13.3 billion.

Infected shrimp ponds experience extremely high levels of mortality early in their growing cycle — as high as 100 per cent death rates in some cases.

So far, the cause of the illness has baffled scientists, animal health authorities and farmers, making prevention and treatment difficult.

But now the identity of the culprit has been cracked: a strain of a bacterium commonly found in brackish coastal waters around the globe, *Vibrio parahaemolyticus*.

A team of researchers at the University of Arizona have managed to isolate the strain and use it to infect healthy shrimp with EMS/AHPNS — a scientific method known as Koch's Postulate and the epidemiologist's equivalent of a smoking gun.

"We succeeded in isolating a pure culture of the *V. parahaemolyticus* strain and reproduced the EMS/AHPNS pathology in our laboratory," said Prof. Donald V. Lightner of the Aquaculture Pathology Laboratory at the University of Arizona (UA). "The high virulence of this agent to shrimp may be due to a phage which affects this particular strain of *V. parahaemolyticus*," he added.

The effort to study EMS, identify its pathology and respond to EMS was supported by a coalition of partners including UA; FAO; the World Organisation for Animal Health (OIE); the World Bank; NACA; the Global Aquaculture Alliance (GAA); the Ministry

of Agriculture and Rural Development of Viet Nam; CP Foods; the Minh Phu Seafood Corporation; Grobest Inc. and the Uni-President Feed Company.

This breakthrough finding by UA of a bacterial aetiology is a crucial first step in finding effective ways to combat EMS.

EMS/AHPNS initially surfaced in 2009. By 2010 outbreaks had become serious. In China in 2011, farms in Hainan, Guangdong, Fujian and Guangxi suffered almost 80 per cent losses. In Thailand, shrimp production for 2013 is predicted to be down 30 per cent from last year due to EMS. Production on some farms in eastern parts of the country has been cut by 60 per cent.

FAO first fielded a mission to Viet Nam through its Crisis Management Centre for Animal Health to investigate the disease in 2011 which pointed to an infectious agent and since 2012 is implementing an emergency technical assistance project in Viet Nam.

### No risk to human health

Some rare strains of *V. parahaemolyticus* do cause gastrointestinal sickness in humans — through the consumption of raw or undercooked shrimp and oysters — but only strains carrying two specific genes cause human disease.

Just 1-2 percent of wild *V. parahaemolyticus* strains worldwide contain these two genes — and the strain identified by Lightner and his team as responsible for EMS is not among them.

"The strain of *V. parahaemolyticus* we isolated appears not to have the genes that confer virulence to human infections," said Lightner.

"There have been no reports of human illness being associated with EMS, and these new findings would tend to confirm that EMS-infected shrimp do not pose a health risk to people," added Iddya Karunasagar, a seafood safety expert at FAO.



## Only shrimp vulnerable

EMS affects two species of shrimp commonly raised around the world, the Giant Tiger Prawn (*Penaeus monodon*) and Whiteleg Shrimp (*P. vannamei*).

Clinical signs of the disease include lethargy, slow growth, an empty stomach and midgut and a pale and atrophied hepatopancreas (an internal digestive organ that serves the function of a liver), often with black streaks. Within 30 days of a pond being stocked large-scale die-offs begin.

So far countries officially reporting EMS include China, Malaysia, Thailand and Viet Nam.

But anyplace where *P. monodon* and *P. vannamei* are cultivated is potentially at risk. This includes most of Asia and much of Latin America, where shrimp farming is also important, as well African countries where shrimp are cultivated (Madagascar, Egypt, Mozambique and Tanzania).

Disease spread would appear to be linked to proximity to already-infected farms or the movement of infected live shrimp, usually juveniles used to stock ponds.

Lightner's team was unable to reproduce EMS using frozen and thawed shrimp samples, suggesting freezing kills the responsible bacterium. Since international shrimp trade is mostly in frozen form, there is apparently no or very low risk of disease transmission from these products.

### Dealing with EMS

Now that EMS's causative agent is known more research is urgently needed to have a better understanding

of how the disease spreads from farm to farm and implement appropriate countermeasures.

At the same time, FAO is engaging with partners to organise a concerted, inter-regional effort to address the disease.

For shrimp farmers, reliance on already-established aquaculture and biosecurity best practices will help prevent EMS-related problems. These include:

Post-larvae shrimp used for stocking should be purchased from reputable sellers, be accompanied by animal health certificates prior to being introduced on-farm, and subjected to a temporary quarantine prior to stocking.

High quality feed should be used, and environmental stresses avoided, to keep shrimp healthy.

The health of pond environments should be carefully maintained and young shrimp should be closely monitored. Any illness should be immediately reported to the proper authorities.

Regular following of aquaculture ponds should be considered as part of a routine on-farm program of aquatic animal health, as this practice has been shown to break pathogen life cycles.

Off farm, any movement of live or unfrozen shrimp products should also comply with established best practices.

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## Presentations from the final technical consultation on EMS/AHPNS available for download

Under the FAO technical cooperation project (TCP/VIE/3304 (E)) Emergency assistance to control the spread of an unknown disease affecting shrimp, this final technical consultation on "Early Mortality Syndrome (EMS) or Acute Hepatopancreatic Necrosis Syndrome (AHPNS) of Cultured Shrimp" was jointly organised by FAO and Vietnam's Ministry of Agriculture and Rural Development from 25-27 June 2013, Prestige Hotel, Hanoi, Viet Nam.

The consultation presented all relevant project findings and outcomes of the work carried out under the project, and

provided updates on EMS situation and experiences in some affected Asian countries, as well as additional technical presentations to assist in further understanding this disease in terms of its aetiology and epidemiology. Nineteen presentations were made over three sessions, while the fourth session drew a number of recommendations and risk management measures pertaining to:

- Disease nomenclature.
- Diagnostics.
- Reporting/notification



Participants in the final technical consultation on EMS/AHPNS, 25-27 June, Hanoi, Viet Nam.



- International trade (live shrimp, shrimp commodity, shrimp feed).
- Farm and hatchery facilities.
- Affected and non-affected countries.
- Pharmaceutical and feed companies.
- Training/capacity building needs.
- Outbreak/emergency disease investigation.

### Workshop presentations

A total of 62 participants contributed to a successful technical consultation. The presentations from the workshop are available for download from: [http://www.enaca.org/modules/news/article.php?article\\_id=1993](http://www.enaca.org/modules/news/article.php?article_id=1993)

The final report (and eagerly awaited conclusions) are being finalised and an announcement will be made on its release from the press. Further informa-

tion about the consultation can be obtained by writing to [melba.reantaso@fao.org](mailto:melba.reantaso@fao.org) or [rohana.subasinghe@fao.org](mailto:rohana.subasinghe@fao.org).

## Aquaculture certification workshop held in Viet Nam

A special Workshop on Aquaculture Certification was held on 26 June in conjunction with the VIETFISH trade show, which ran from 25-27 June in Ho Chi Minh City, Viet Nam. The workshop was organised by the ASEM Aquaculture Platform, with contributions from partners Ghent University, Wageningen University, Can Tho University and NACA. Approximately 60 people attended including farmers, researchers, certification agencies, and regional and international organisations. Facilitation was provided by Prof. Patrick Sorgeloos and Marieke Douma.

The workshop was not focused on any single certification programme but instead concentrated on four key themes with an introductory presentation followed by a panel discussion, namely:

- Producer compliance constraints.
- Value chain arrangements.
- Auditing practices.
- Benchmarking

Dr Waraporn Prompoj from the Thailand Department of Fisheries gave the keynote address, sharing Thailand's experience in establishing and implementing its national certification programme. She explained the process, transition and changes that had been made to the programme in order to conform to the FAO Technical Guidelines on Aquaculture Certification. The Thai system had evolved over time from being a GAP (good aquaculture practices) based system through to a code of conduct to the present GAP-TAS 7401 system.



*Prof. Patrick Sorgeloos and workshop participants. To his left, Roy Palmer, WAS.*

### Producer compliance constraints

Dr CV Mohan of NACA gave a presentation on the constraints that small-scale farmers face in complying with certification programmes, and the NACA regional experience in how a cluster-based approach and better management practices could help small-scale farmers to improve compliance. This was followed by a panel discussion that addressed several questions on the role of government and the private sector in supporting small-scale farmers to participate in certification programmes, both public and private, and to improve their market access.

The panel clearly indicated that small scale farming sector is too important to ignore and should be strongly considered by all certification programs and that small-scale producers should not be marginalised. The role of better

management practice programmes in the region and their contribution to improving the capacity of small farmers to better comply with certification programs was acknowledged by all. It was strongly emphasised that small farmers need assistance from governments, the private sector and other service providers through extension services, better management practice programmes and the recently introduced aquaculture improvement programmes promoted by certain certification bodies, such as the Aquaculture Stewardship Council.

Members of the panel were Dr Waraporn Prompoj from Thailand DOF, Nguyen Can from the Viet Nam Ministry for Agriculture and Rural Development, Ken Corpron from the Aquaculture Certification Council / Best Aquaculture Practices Programme, Jack Morales



from the Sustainable Fisheries Partnership and Tim Moore from ASEAN Market Programme.

### Value chain arrangements

Dr Flavio Corsin provided a nice presentation on various value chain arrangements that are in place by various certification programs and also introduced the new initiatives being undertaken. The importance of emerging markets such as India, China, Indonesia and the future of seafood trade dynamics were also highlighted. Panel members included representatives from European importers and responsible sourcing agencies.

### Auditing Practices

Prof. Peter Vandergeest from York University Canada provided a presentation highlighting the different auditing practices followed by public and private certification bodies. The panel discussed issues of auditing vs coaching, conflicts of interest, need for best practice in auditing procedures.

Panel members included representatives from Control Union Vietnam, Bureau Veritas Vietnam, Thai GAP and the Aquaculture Certification Council / Best Aquaculture Practices Programme.

### Benchmarking

Professor Simon Bush from Wageningen University provided a very good presentation on the concept, purpose and approach of benchmarking and informed the participants of the various on-going benchmarking initiatives, which included: The FAO conformity assessment framework likely to be approved at the next COFI Sub-committee on Aquaculture meeting scheduled for October 2013 in Russia; the Sustainable Seafood Coalition benchmarking program; the Global Sustainable Seafood Initiative and the GlobalG.A.P. benchmarking programme. The panel members strongly emphasised the need for all certification programs to get involved in benchmarking exercises so that some degree of harmonisation and equivalence can be accomplished for the benefit of primary producers and consumers.

Panel members included representatives from GIS, Sustainable Ethical Aquaculture Trade (SEAT) Project, GlobalG.A.P. and ISEAL.

### Conclusions and way forward

The final session was facilitated by Prof. Patrick Sorgeloos. The Chairs of the four panels summarised the discussions highlights and provided few recommendations on follow up work. Patrick concluded with strong remarks on the need to involve small farmers in the whole process and also to build awareness of consumers in importing countries of the value and benefit of aquaculture and to make attempts to change the negative image of aquaculture.

A detailed report of the workshop is in preparation and will be circulated to all participants and made available on the NACA, ASEM and partner websites in due course.

## Aquaculture in a genetic plunge towards extinction?

The NACA Secretariat and Department of Fisheries, Thailand, were privileged to host a special guest lecture on 31 May by Prof. Roger W. Doyle, current President of Genetic Computation Ltd., retired Professor of Biology, founding Director of the Marine Gene Probe Laboratory at Dalhousie University in Canada and former President of the International Association for Aquaculture Genetics. Prof. Doyle is well known to many people in the NACA network due to another of his former roles as Coordinator of the Aquaculture Genetics Network in Asia under IDRC, and his role in training many students that now occupy prominent positions in research and government in the region, including the current Director General of NACA.

Professor Doyle gave a thought provoking lecture "Artisanal tropical aquaculture in a genetic plunge towards extinction", a timely reflection on the relationship between inbreeding and disease, given the current problems with acute pancreatic necrosis syndrome ("early mortality syndrome") of shrimp.



*From right to left: Roger Doyle and his former students Ambekar Eknath (current NACA Director General), Supattra Uraivan (former Director, National Aquatic Genetic Resources Institute), Wongpathom Kamonrat (Senior Fisheries Expert, Thailand Department of Fisheries), and Padermsak Jarayabhand (Associate Professor, Chulalongkorn University).*



After the lecture Prof. Doyle was presented with an award by NACA and the Thai Department of Fisheries in recognition of “his significant contributions to the science of aquaculture genetics and related human resource development in the Asia-Pacific region.”

The abstract of the lecture is reproduced below. A video of the presentation (highly recommended viewing) is also available from: [http://www.enaca.org/modules/podcast/soundtrack.php?soundtrack\\_id=144](http://www.enaca.org/modules/podcast/soundtrack.php?soundtrack_id=144)

### Abstract

Artisanal shrimp aquaculture is in a disease-induced crisis of lost production, into which are falling farms, gene pools adapted to farms, and small-hold farming as a way of life. The immediate cause is biological: rising levels of inbreeding and an exceptionally strong, positive relationship between inbreeding and disease which is described here. The root cause is social: a nexus of human behavior in which breeders protect their intellectual property by generating inbreeding (which is

expressed only when broodstock is “copied”), local hatcheries sell copied, inbred shrimp to farmers, and farmers suffer the consequences. The likely outcome is replacement of small-hold shrimp farms by capital-intensive corporate aquaculture over vast areas of Asia, North Africa, the Middle East and the Americas. Alternative outcomes in which artisanal shrimp farming does survive are conceivable, but measures to implement them are neither in place, encouraged nor contemplated by the responsible agencies.

## NACA implements World Bank training program on Good Aquaculture Practices

NACA was selected by the World Bank to implement a 6 day training program on “Good Aquaculture Practices” in Surabaya, Indonesia from 17-22 June 2013 under the on-going World Bank Global Food Safety Partnership (GFSP) initiative. NACA implemented the activity in collaboration with the Directorate of Processing and Marketing and Directorate of Aquaculture under the Ministry of Marine Affairs and Fisheries (MMAF), Government of Indonesia.

The objective of this training was to deliver a comprehensive certificate level aquaculture food safety and supply chain management training program aimed at providing factory level food safety supervisors and managers and government inspection staff with sufficient competency to design and implement Good Aquaculture Practices (GAqP) through the supply chain including food safety management systems and HACCP.

The training comprised a six-day classroom and field based face-to-face program. A total of 40 trainees from Indonesia participated in and completed the training program, of which around 30 were mid to senior level technical people with responsibility for food safety and HACCP implementation in seafood processing plants. Five were from the aquaculture production sector while another five were from government and academic institutions engaged in research and extension, inspection and monitoring of food safety and compliance to national and international regulations. A team of five



experts delivered the course, which was based on five modules developed by Michigan State University, concerning:

- Introduction and background.
- Food safety hazards.
- Food safety practices for aquaculture production.
- Food safety in postharvest and processing.
- Food safety management systems-HACCP.

The course modules were translated to Bahasa Indonesia for use in the training programme. MMAF has expressed interest in repeating the training in other provinces including Medan and South Sulawesi, which are seafood processing hubs. The regional experts strongly suggested that similar training be carried out in other member countries.

Participants visited a Naturland-certified organic aquaculture farm and a seafood processing plant to understand the management practices that could impact on food safety and how to manage such hazards.

[www.enaca.org](http://www.enaca.org)



## Study tour on aquaculture and wetland management for delegation from Assam, India

NACA was pleased to coordinate an aquaculture study tour to Bangladesh, Vietnam and Thailand from 19-26 April for a delegation of twelve fisheries development officials from Assam, India. The delegation included Mr Sri Hemanta Narzary, Commissioner and Secretary for Fisheries; Mr Sri Kailash Chang Damria, State Project Director for the ARIAS Society, Mr Sri Siddhartha Purkayastha, Deputy Directory of Fisheries, and district fisheries development and extension officers.

In Bangladesh the delegation visited carp hatcheries, nurseries and farms producing carp and giant freshwater prawn as well as ox-bow lake fisheries that are receiving World Bank support and the Department of Fisheries. On arrival in Vietnam, the group visited the National Breeding Center for Southern Freshwater Aquaculture and the Research Institute for Aquaculture No. 2 in Tien Giang Province, before travelling to Tram Chim National Park in Dong Thap Province to observe community-based wetland management sites.



The group finally visited integrated rice-fish farms, catfish farms and cage culture in Mekong River, before heading to Thailand to visit the Department of Fisheries and NACA Secretariat in Bangkok.

NACA wishes to thank our partners in Bangladesh, Viet Nam and Thailand for their assistance in organising the tour and for their hospitality.

## Koh Yao Noi Tree Bank and mangrove replanting continues

Koh Yao Noi, an island in Thailand's World Heritage listed Phang Nga Bay and famous for its extensive mangrove forests, was one of the areas affected by the Indian Ocean tsunami disaster of December 2004. Many communities throughout the bay were badly affected. In the case of Koh Yao Noi, the damage included the destruction of around 48 hectares of mangrove forest fringing the island. The local community, which depends heavily on eco-tourism and fishing, decided to do something about it.

Since 2005, students from the Koh Yao Noi school, working together with the Chiba Environmental Council (Japan), Koh Yao Noi Eco-Tourism Club and with coordination from NACA have endeavoured to restore the environmental damage from the tsunami, and to improve the livelihoods of local people through a variety of initiatives.

One of the main activities has been the annual replanting of seedlings of locally occurring mangroves and tropical forest trees to regenerate the damaged areas, carried out each year since 2005, on the anniversary of H.M. The King's birthday, with financial assistance principally from the Chiba Environmental Council but also from NACA. Over the years more than 12,000 seedlings have been planted, and the activity continues to grow.

Each year since 2006 members of the Chiba Environmental Council, mainly retired teachers, scientists and engineers, have visited at their own expense to teach at the Koh Yao Noi School on subjects including biodiversity of tropical rain forests, reducing global warming, natural paper making techniques and many other environmental issues.

In July 2009 the Koh Yao Noi branch of the community-based Tree Bank was formally established, with its headquarters in Chumporn Province. The main objectives of the tree bank are to:

Increase rainforest coverage on the island by planting timber and wood trees in privately owned land.

Certify the planted trees as assets for collateral of loans.

Assure sufficient wood supplies on the island without causing net deforestation.

Plant mangroves in public areas for conservation purposes.

Within its first 12 months of operation, there were more than 145 members in the bank and it was planting more than 27 species of timber and more than five species of mangrove. Initially, the bank provided saplings free of charge which members used to plant both public



areas and private plots. In 2010, the tree planting programme extended to cover Tah Kao Village on the northern part of the island where the damaged area was much greater.

The tree planting programme will continue in 2013. Over the past year many of the replanted areas have been impacted by a very serious drought affecting the island, but the tree bank has managed to save more than 80%

of the trees by arranging pumps to supply heavy watering. However, some species have been more badly affected than others, and the least tolerant species will not be selected for the next afforestation.

2013 will also mark the first cooperation with Global Change Systems for Analysis, Research and Training (START), a non-profit organisation that promotes research-driven capacity

building to advance knowledge on global environmental change in Africa and Asia-Pacific. The Chiba Environmental Council will offer a training course on "Nature Conservancy for Promotion of Community Based Ecotourism" for the Koh Yao Noi Ecotourism Club and for junior guides (students from the Koy Yao Noi school), with support from both START and NACA.

## Consistent fish names key to consumer confidence

Consumer confidence is vital to the long term sustainability of the \$2.5 billion Australian seafood industry. The development of the Australian Fish Names List and Standard goes a long way to addressing some of the key concerns.

Confusion over fish names can undermine this confidence, create market impediments, undermine effective species-based fisheries management, and impede management of food safety.

Seafood consumers want to know that when they ask for a specific fish anywhere in Australia they are getting the right fish. As early as the 1920s, meetings were held in Sydney to discuss fish names as the local and regional variations had become apparent.

In 2006, a process to develop a fish name standard was commenced by Seafood Services Australia. On 16 July 2007, the Australian Fish Names List and its inclusion in the Australian Fish Names Standard (AS SSA 5300) were endorsed by Council of Standards Australia.

The list was created in consultation with a wide range of stakeholders, including the commercial and recreational fishing sectors and government, so that an Australian Fish Names Standard could be established to meet both the seafood industry and consumers expectations for safe food, fair-trading and truth in labelling.

The Fish Name List and Standard remains a world first. No other country has been able to achieve national consensus on fish names. This list now contains 5000 names of Australian and imported species.

"The standard has made labelling and marketing in Australia easier. All seafood must now be labelled with the correct Standard Fish Name and consumers are able to make informed choices when purchasing seafood or dining at restaurants" said Michelle Christoe, Executive Officer, Seafood Services Australia.

"Consumers want to know both fish name and country of origin. The Fish Names Standard helps us provide clarity and gives us an edge as subject matter experts in seafood" said Shane Geary, Operations Manager at Coffs Harbour Fisherman's Co-op.

Anyone concerned that the fish ordered may be mislabelled, should ask the supplier for more information on where it is from or to see the sales document or original packaging, to confirm it. If you have information or evidence of fish mislabelling, contact your supplier first. If you are dissatisfied with the explanation or response, contact the Australian Competition and Consumer Commission at [www.accc.gov.au](http://www.accc.gov.au) or telephone 1300 302 502.

### Changing names, an informed approach

Three months public consultation is required before any amendment is made to the Australian Fish Names Standard. In March 2013 the Australian Fish Names Committee met to consider two applications to amend the standard.

The first application has been made to add the new group name Deepsea Dory to cover the four Oreodory species (Spikey Oreodory, Smooth Oreodory, Warty Oreodory and Black Oreodory). While there are concerns that the group name Deepsea Dory is similar in

name to the iconic species John Dory, Mirror Dory and Silver Dory, they do not compete in the marketplace. Market research conducted by the applicant has indicated an overwhelming preference for Deepsea Dory over Oreodory. The name is not deceptive as the species is harvested in deep waters.

The Deepsea Dory species are caught in the deep-water areas off the continental shelf and used in the manufactured fish products industry. The individual species names are unchanged.

The second application has been to legitimise the use of the name Flake by adding a new group name Flake to cover two species, Gummy Shark and the species known in New Zealand as rig. Flake has been the name used, especially in the fish and chip industry, since about 1920 especially in Southern Australian states. The issue that the industry had identified is that the meat from other inferior species of shark has been sold under the name Flake. If this application is successful, the name Flake will apply to the flesh of the animal in the marketplace and not the whole animal that will continue to be referred to as Gummy Shark.

Anyone with an opinion on these two applications is welcome to make comment by using the form available on the fish names website at [www.fishnames.com.au](http://www.fishnames.com.au) or by email to [fnc@seafoodservices.com.au](mailto:fnc@seafoodservices.com.au). Comments close by 15 August 2013.



## We are hiring!

NACA is seeking expressions of interests from persons interested in applying for the posts of:

- Coordinator, Sustainable Farming Systems Programme.
- Coordinator, Genetics and Biodiversity Programme.
- Coordinator, Food Safety and Certification Programme.

The successful applicants will be expected to:

- Foster regional collaborative networks of people and institutions in relation to the relevant programme.
- Develop a work plan that addresses strategic issues of common interest to NACA member countries/states, with an emphasis on small-scale farmers.
- Identify potential funding sources and prepare regional grant proposals to support the work plan.
- Coordinate work plan activities, which will principally be implemented in-country by network partners.

To be eligible to apply, you must have:

- A post graduate degree with a specialisation relevant to the position to which you wish to apply.
- 5 years of relevant work experience in the Asia-Pacific region.
- Excellent writing and communication skills, with a successful track record in preparation of funding proposals.
- Good inter-personal skills and an ability to work in a highly multi-cultural environment.
- Citizenship of a NACA member country/state.

The position is subject to a one-year probationary period, which will include satisfactory progress in preparation of grant proposals and raising funds to support the programme. The remuneration package includes provident fund, relocation, healthcare, child education

and dependency allowances. The duty station is Bangkok, Thailand and travel within the region is required.

### Applications

**This is an abbreviated notice**, please see the full advertisements and application requirements for these positions on the NACA website, at:

[http://www.enaca.org/modules/news/article.php?article\\_id=1987](http://www.enaca.org/modules/news/article.php?article_id=1987).

Interested candidates are requested to submit i) their resume with ii) a concise statement (two page limit) concerning the key issues in the region for the relevant programme and a vision for a work programme to address them. The precise subject of the statements requested varies for each position, so please **ensure that you check the website advertisements**.

Only short listed candidates will receive communication from NACA. The closing date for submitting your expression of interest is **31 July 2013**.

Submit applications by email to: Dr Ambekar Eknath, Director General, [ambekar.eknath@enaca.org](mailto:ambekar.eknath@enaca.org).



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NACA is a network composed of 18 member governments in the Asia-Pacific Region.



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## Request for contributions: Global Advances in Ecology and Management of Golden Apple Snails (2nd edition)

In 2006 the first edition of the book *Global Advances in Ecology and Management of Golden Apple Snails* was published and it gained international recognition.

The second edition will be published by mid-2014. Therefore, we are inviting participants from throughout the NACA network to share their knowledge on the past and present status of the golden apple snail and future directions on its management.

All contributions should not exceed 10 pages double-spaced; Tahoma 12, with text aligned to both left and right margins. We encourage high resolution photos with proper photo credits. All

contributions will be peer-reviewed, and edited prior to their inclusion in the book. Please send your contributions by June 30, 2013 to [rcjoshi4@gmail.com](mailto:rcjoshi4@gmail.com) or [ravindra.joshi23@yahoo.com](mailto:ravindra.joshi23@yahoo.com). Thank you very much for your kind support.

*Dr Ravindra C. Joshi and Dr Leocadio S. Sebastian*  
Editors

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### **Special guest lectures in aquaculture**

A series of occasional lectures on important topics in aquaculture, given by visiting scientists and aquaculturists .

### **FAO - APFIC - NACA Regional Consultation on the Sustainable Intensification of Aquaculture in Asia-Pacific**

The objective of the consultation was to develop a regional strategic policy framework to guide national governments and regional organisations in promoting sustainable intensification of aquaculture in the Asia-Pacific region. The consultation specifically focussed on intensifying aquaculture through more efficient use of resources and environmentally sound practices. Farm productivity and environmental performance must be improved through a combination of forward-looking policies, better management practices and technological improvements, rather than by increasing inputs to the system.

### **Emergency regional consultation on acute hepatopancreatic necrosis syndrome**

Recently, an emerging disease known as acute hepatopancreatic necrosis syndrome has caused significant losses amongst shrimp farmers in China and Vietnam (2010), Malaysia (2011) and Thailand (2012). The disease affects both *Penaeus monodon* and *P. vannamei* and is characterised by mass mortalities during the first 20-30 days of culture, an abnormal hepatopancreas, cork-screw swimming, loose shells, pale colouration and slow growth. The cause is unknown at this time. Considering the severity of the disease, NACA and the Australian Department of Agriculture, Fisheries and Forestry convened an emergency consultation in Bangkok, 9-10 August 2012, involving international shrimp health experts, regional governments and industry to share information on this emerging disease, its occurrence, pathology and diagnosis, and to develop a coordinated regional response to the issue. The recordings in this collection are the technical presentations made at the consultation.

### **Global Conference on Aquaculture 2010**

The conference was the third in a series of aquaculture development conferences, following on from the Conference on Aquaculture in the Third Millennium held in Bangkok 2000, and the FAO Technical Conference on Aquaculture, held in Kyoto 1976. The programme included seven regional and global reviews on aquaculture development, nine plenary and invited guest lectures, and twenty expert panel discussions across six thematic sessions. This audio collection represents the entire conference proceedings.

### **Expert Workshop on Inland Fisheries Resource Enhancement and Conservation in Asia**

FAO and NACA convened an expert workshop to review inland fisheries resource enhancement and conservation practices in Pattaya, Thailand, 8-11 February. Experts from 10 Asian countries attended the meeting to share experiences and lessons learned.

**Free to download or listen/watch them online!**