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The talk on fish health

Our interviewees are five of the best known scientists working on fish health issues in aquaculture. The talk on fish health covers fish epizootics, viral diseases, among others, and ways to control them. In a nutshell, countries are enjoined to put in contingency plans for disease outbreaks and cooperate on worldwide disease reporting programs while individual farms are urged to practice good farm management to keep the fish healthy and happy.

DR. BARRY HILL

Containing the diseases in aquaculture

Dr. Barry Hill is an expert on disease zoning and advises governments on health management guidelines. He is the Secretary-General of the Fish Disease Commission of the Office International des Epizooties or the OIE (also known as the World Organization for Animal Health). OIE is an intergovernmental veterinary organization created through an international agreement of 28 countries in 1924, and as of May 2001, its membership totalled 158. Its central bureau is based in Paris.

One of OIE's main activities is to provide guidelines and standards for health regulations applicable to international trade in live animals and their products. OIE also coordinates investigations of communicable animal disease and collection of information on epizootics and control measures applied by its member countries. It has devised an early warning system to apprise its member countries of the occurence of disease outbreaks (listed as notifiable or contagious) that would have serious repercussions on public health or the economics of animal production.

What is an epizootic?
Epizootic is an animal disease episode equivalent to an epidemic in human health.

When do we know that an epizootic exists in an area?
When you get confirmatory diagnosis of an increasing number of cases. When you start to see it expanding towards the population, to a certain size, it becomes an epizootic.

Do epizootics have stages (such as early and alarm stages)?
Yes. The initial emergence or the original point of outbreak is the focal point, but it could be several focal points depending on how (the disease) came in. (The disease) could start in a few affected animals, in several places; this is the initial phase. Then (the disease) breaks out into the first farms until (the number of) farms increases. This is an expansion. If you don't intervene and start to

page 4

Training on Fish Health at SEAFDEC/AQD

Aside from actual classroom-laboratory classes on fish health (above) with 10 trainees, SEAFDEC/AQD has started a similar course ***online****-- called* ***AquaHealth*** *-- on April 29. The 24 participants presently enrolled in the latter are learning entirely through the internet. The online class has a moderator and its modules are presided over by fish health specialists. Learners are from seven countries in Southeast Asia and Egypt.*

More AQD news on page 12.

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DR. DONALD LIGHTNER

Ignorance increases risk of failure

Dr. Donald Lightner sits on the prestigious Fish Disease Commission of the Office International des Epizooties (also known as the World Organization for Animal Health).

Here's a self-description of his work on shrimp diseases: "I started working with shrimp and shrimp diseases in 1971 at the Galveston Laboratory of the U.S. National Marine Fisheries Service. In 1974, I began to work on super-intensive shrimp culture project in Mexico with the University of Arizona. The university was one of the pioneers in shrimp farm methods. In the mid 1970s, the University was developing in Mexico technologies for SPF broodstock and PL production, and the development of biosecure broodstock rearing, hatchery, nursery, and grow-out technologies based on super-intensive raceways. Today, Mexico uses mostly ponds for growout, but the raceway concept was developed initially. Technologically, the super-intensive raceway systems developed by the university made sense, but the concept was mostly abandoned for reasons of economics. At the time it was a great idea, but it proved to be too expensive. There are a few companies and research groups in the U.S. and elsewhere in the Americas that run entire growout cycles in super-intensive raceways. There are a few examples of that farm in Mexico and one in Hawaii. Arizona now has four shrimp farms. All use geothermal brackish ground water of approximately 0.5 to 5 ppt salinity as their water source."

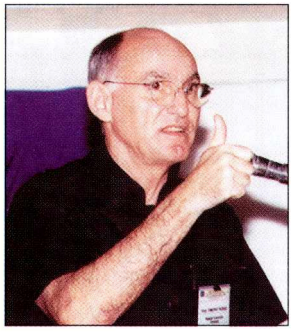
What is the current status of the shrimp industry in the US vis-à-vis coping and prevention of penaeid diseases as compared to Southeast Asia?

Some of the methods used in SEA are being used in the US in disease prevention or in the application of biosecurity. Things like water recirculation, water filtration, and other pond and water management methods are being employed. Perhaps the biggest difference in the US is that all of the farming industry now uses domesticated lines of specific pathogen-free (SPF) *Penaeus vannamei* stock.

With the use of high technology disease diagnosis, how can shrimp producers in developing countries make use of these innovations considering their prohibitive cost?

The principles are fairly simple. For the costs and the kind of facilities that are required, we look at other animal models to determine their application in developing countries. To compete in a global economy with a product that has a global market, the question becomes how can developing countries expect to compete successfully if it does not use those methods? This is a difficult and

page 5



DR. TIMOTHY FLEGEL

Viral diseases can strike lethal blow to shrimp farming

Dr. Timothy Flegel is originally from Canada and has stayed in Thailand for 29 years. He is currently the subject editor for crustacean diseases of the journal of *Diseases of Aquatic Organisms*. He serves in the Faculty of Science at Mahidol University in Bangkok, and is a published author of many books on shrimp disease.

What are the implications of bringing into Asia new shrimp like Penaeus vannamei*?*

It is dangerous to bring shrimp from another geographical region over a very far distance even if you know that it is SPF or disease free. What I'm worried about is not the diseases that we know (but) the ones we don't know. (An example is) one that Dr. Lightner described. IHHN* is a disease that came from Asia – people brought *Penaeus monodon* to the Americas in the early 1980s and it looked like normal, healthy *Penaeus monodon*. At that time nobody knew what IHHN was. It was discovered after it jumped from *Penaeus monodon* to American shrimp and then it killed all (of the latter) and that was the best species for rearing at that time. People had to switch to *Penaeus vannamei* (which) was also affected by the disease but not killed. So that's one example.

Another example is White Spot, the Japanese brought it into (their country) with PL from China and it jumped from Chinese shrimp to Japanese shrimp. The first description of outbreaks was from China and nobody knows still where it originally came from, but I think we have some pointers suggesting that it's possible that it might have come from Australia – there is a species of crayfish from Australia that was brought into China just before the outbreaks.

Is the White Spot Syndrome Virus the most prevalent shrimp disease in Thailand?

No, but it is the most serious and deadly disease of shrimp in Thailand right now. It has caused most of the losses since 1995. Diseases like White Spot affect many species. Every species of commercial shrimp is affected, and the list of crustaceans (has) more than 50 – shrimps, crabs, lobsters.

The most serious diseases for the shrimp are the viral diseases because there is no way to treat them – most other disease agents like bacteria (are) much easier to manage. If the shrimp are infected by bacteria you can treat them with antibi-

page 6

*Infectious Hypodermal and Hematopoietic Necrosis Virus Disease

DR. EINAR RINGO

Good vs. bad bacteria

Dr. Einar Ringo is with the Norwegian School of Veterinary Medicine. He has worked in the fields of microbiology and feed nutrition with lipid metabolism, intestinal microbiology, microbial ecology and lipid nutrition as his main interests. He has studied animals as diverse as reindeer and the fishes, salmon and arctic char. Dr. Ringo has been working for years on aquaculture probiotics.

What is the major problem in aquaculture probiotics today?
Little has been done so far, so we have a great challenge. We should be aware that probiotics has been known in mammalian systems for two to three thousand years, but we have only started on the probiotics concept for aquaculture during the last 10-15 years. When looking at how many research papers have been published in probiotics for the mammalian system, there are approximately 1000 that have probiotics as keywords but only 10 related to aquaculture. So this is a relatively new discipline. This presents a great challenge, as well as opportunities to do some healthy, interesting research in the future.

What scientific institutions in the world or in your region are the agencies to watch out for in terms of R&D in aquaculture probiotics?
Three (institutions in) – Bergen, Trondheim and Tromsø — in Norway* are partners that have done great work in probiotics. The research institute in Bergen, west coast of Norway has worked on antagonistic vibrios. Vibrios have been studied at SINTEF in Trondheim. The Norwegian Institute of Fisheries and Aquaculture Research in Tromsø has done a lot of studies on lactic acid bacteria.

Have you had any chance to observe work in probiotics in Asia? What can you say about aquaculture practice here?

page 7

***Interesting fisheries facts about Norway**
It is the first country in the world to establish an independent Ministry of Fisheries (1946). Norwegian upper secondary schools, since 1994, offer a craft certificate in fisheries science within all parts of the fishing industry. Since January 1, 2001, an R&D duty (representing 3 per thousand of the export value) on the export value of fish and other marine resources has been imposed to strengthen the funding for fisheries research and development (R&D). Source: Norway's Ministry of Fisheries website, www.mfa.no

DR. SUPRANEE CHINABUT

Disease threats to the freshwater fish industry

Dr. Supranee Chinabut is presently Director of the Aquatic Animal Health Research Institute, Thailand, and Chair of Fish Health Section of the Asian Fisheries Society. She completed her PhD at the University of Stirling, Scotland, and has worked on striped snakehead *Ophicephalus striatus* for her dissertation. She has published work on the comparative study on experimental mycobacteriosis between snakehead and the frog *Rana tigrina*, and the effect of fumagillin against microsporidia on infected African catfish *Clarias gariepinus* Burch.

What percentage does freshwater fish culture contribute to overall fisheries in Thailand?
Freshwater fishery is a major component. It contributes to the local people's consumption like the catfish (hybrid *Clarias batrachus* male and *C. macrocephalus* female), the snakehead (*Ophicephalus striatus*), the freshwater prawn (*Macrobrachium rosenbergii*), and various species of foliage fish from reservoirs, canals, and swamps. They're major fish food for the local people. Freshwater fish is not for export, though we export a very small amount to the Asian communities in some Western countries. In Europe and America for example, we export fresh frozen catfish and snakehead.

What about in Asia? Is freshwater fish a major product?
I think from the statistics, it is a major fishery product. Carp is very popular in Indonesia, while in Thailand, the Thai common carp, *Puntius gonionotus* is a very important species. Catfish is more popular in Thailand. We have now improved the genetics of the tilapia. Culture of the red tilapia is now widespread in the whole country. People enjoy its flesh because the texture is tender and nice. Thailand exports filleted red tilapia.

What hampers the productivity of freshwater aquaculture?
I'm a disease person. In many species, Epizootic Ulcerative Syndrome (EUS) infects most freshwater and brackishwater species. It is quite serious. It occurs in both fresh and brackishwater fish if the salinity is lower than 20 ppt.

Catfish is not as hardy as some people say. It is most likely to get bacterial septicemia because pond water quality is seldom good. Tilapia is more resistant. When water quality is poor, risks to the health is high. Most of the aquaculture conditions relate to health management. If farmers can improve their culture practice or try to do proper management like maintain water quality and use good

page 8

DR. BARRY HILL INTERVIEW / FROM PAGE 1

on epizootics

put measures in place to prevent (the disease from) further spreading, then it could go on spreading by means of the natural movements of animals, through the movement of water itself (which harbor) the pathogens, or the movements made by man. So, all these things contribute. If you'll let it, (the disease) would (magnify), it will peak first, then it will decline steeply because there will be fewer and fewer susceptible animals. It could reach its chronic level then maintain itself. In intervention, the trick is to get the decline very sharp or very steep, back to zero or total eradication.

> "The first and best thing you can do is to maximize the containment of the disease ... We would strongly recommend everyone to be prepared because epizootics could come anytime."

When is the possible time or season that the outbreak occurs? How do we know it exists?
It depends on the disease; some will be in high water temperature. If you get very (extreme) seasons, say, very severe winter or very hot summer, the disease tends to occur. In the tropics where climate is (constant) throughout the year, it would depend on the stage of development of animals and not on temperature. One would be during spawning. The stress in spawning lowers the resistance of the animal, making it susceptible to disease. But in latitudes with sharp differences between winter and summer temperatures, temperature is the major (trigger). So in Europe, we have fish diseases that occur only during summer that cannot be experienced during winter.

What measures should be taken if signs of the epizootic occur in an area?
The first and best thing you can do is to maximize the containment of the disease. Control everything to stop it from spreading out of the area. Find out as quickly as you can (how it is transferred). Check all the areas where the disease has transferred and (put in containment measures).

If humans eat an infected aquatic product, will it harm their health?
Some bacterial infections (*Vibrio*) can possibly leave toxins in fish. You can eat a clinically dead fish because only its shelf life is reduced; but a diseased fish is not suitable for human consumption. However, a fish dead from viral infection can be safely eaten if it does not show clinical signs.

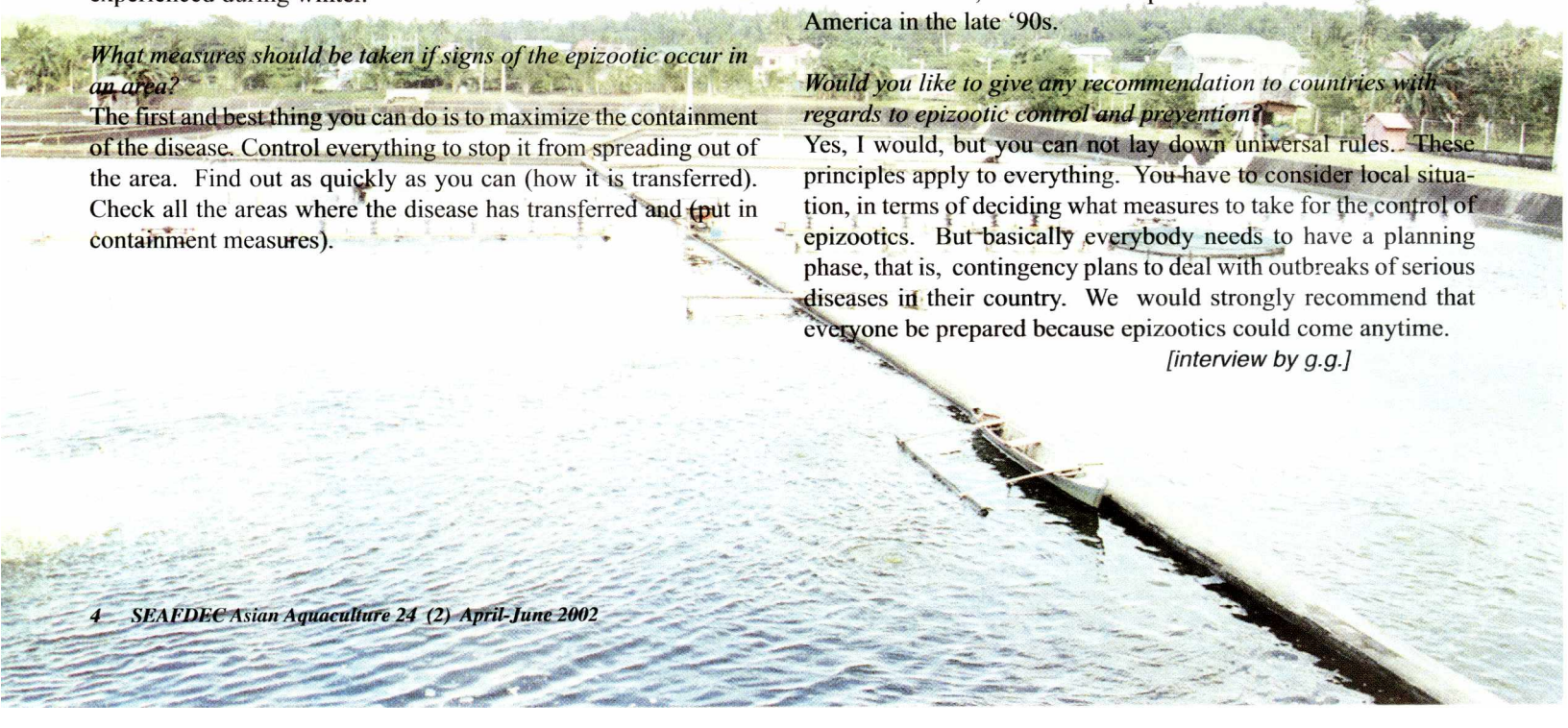
How bad are the diseases in wild aquatic animals?
(Wild fishes) have some very serious diseases. There is this one particular case that affected wild Atlantic salmon in freshwater and reduced that population by almost 99.9%, almost total eradication of the species. It's a major problem in Norway. An outbreak of (a virus) in Pacific herring caused a population to disappear. But most of the diseases we know and studied are actually in ponds and farms.

How do we know if aquatic products that are being marketed are free from infection?
The truth is that we don't know. There is a current practice in Australia wherein they check imported shrimps, frozen and fresh, for white spot virus and determine which is safe. They are afraid of introducing the disease through imported shrimps. Those free from the virus can come in.

Where and when did the most recent (epizootic) outbreak occur?
In terms of scale, it's the White Spot Disease outbreak in Central America in the late '90s.

Would you like to give any recommendation to countries with regards to epizootic control and prevention?
Yes, I would, but you can not lay down universal rules. These principles apply to everything. You have to consider local situation, in terms of deciding what measures to take for the control of epizootics. But basically everybody needs to have a planning phase, that is, contingency plans to deal with outbreaks of serious diseases in their country. We would strongly recommend that everyone be prepared because epizootics could come anytime.

[interview by g.g.]



DR. DONALD LIGHTNER INTERVIEW / FROM PAGE 2

complicated question with no easy answers. However, one can look at other agricultural industries and learn from their examples. For instance, in how many other modern agriculture practices are the industries dependent on the collection and culture of wild seed stock? In modern agriculture, there are components of those industries that specialize in being seed stock producers. While the shrimp industry has a large component that produces "seed" (postlarvae, PLs) for stocking, that segment of the industry relies almost exclusively on the capture of wild PLs (in the Americas) or on the production of PLs from wild-caught adults (Americas and SEA). As an industry, we are just beginning to see the development of specialized companies that produce seed stock from domesticated breeding lines of specific pathogen-free (SPF) shrimp. As the industry develops, we'll see more of this, and as the industry matures further, the shrimp stocks will come from specialized competing producers that will offer a proven supply of better seed stock than those available from the wild.

> "One of the biggest problems in the industry is just ignorance of the risks. For example ... as the white spot pandemic was occurring ... shrimp stocks which posed a high risk of being carriers were (being imported)."

What is the stocking density that predominates in the US?
Most US shrimp farms are located in Texas, but other states with some significant shrimp farming include South Carolina, Florida, Mississippi, Arizona, and Hawaii. Most of the farms are semi-intensive, without aeration, and stock anywhere from 10-15 shrimp per m^2. In more intensive farms that use aeration, stocking rates of 35-40 per m^2 are common.

Other than prevention and variation in culture systems, what other methods can you suggest for fishfarmers who wish to stay ahead in the business, especially here in SEA? Would you recommend high technology methods of disease prevention?
Aquaculture development and training centers like SEAFDEC and the companies that sell seeds and feed should be listened to because they are the best suppliers of information to advise farmers on what technologies make sense for their farming situation. I would presume that just taking information that's applicable to their particular location and situation, which is working in other places, is the first step. One of the biggest problems in the industry is just ignorance of the risks that they face. For example, with white spot, so many farmers were unaware of it as a threat to their farms as the white spot pandemic was occurring. Because of this, shrimp stocks from some locations in the world, which posed a high risk of being carriers of white spot, were not recognized as posing such a high risk.

You mentioned biosecurity. What does that mean?
To me, "biosecurity" means disease control through exclusion of specific pathogens. Stock control is an essential component of biosecurity. Stock control may mean that wild stocks of unknown quality and disease status should not be farmed. If wild stock must be farmed, at least the farmer should know that the broodstock to produce seed (and that the postlarvae themselves that were used to stock the ponds) tested negative for the pathogens that a given farming region wishes to exclude according to its biosecurity plan. This is the simplest kind of stock control. The next level of technology available are breeding companies with their domesticated specific pathogen-free (SPF) stocks. Typically, many breeding companies upon request (i.e., from a farming association) will provide the diagnostic records of their stocks that have been monitored by a health specialist or veterinarian. The best companies have two or more years history of not having positive tests for specific pathogens from a particular list of pathogens. In the U.S., no one uses wild broodstock. One of the first steps in implementing a biosecurity plan is to make a list of the pathogens that your biosecurity program wishes to exclude.

Please explain further the gold standard for validating the more widely used diagnostic tests in fish disease.
When a new diagnostic test is to be validated, its results are compared to the best available (or most trusted) test(s). That reference test (or tests) is called the 'gold standard'. In developing and validating a new shrimp disease diagnostic test employing PCR for example, the gold standard might be histology or a bioassay.

Do you conduct training for shrimp farmers?
We have a shrimp pathology course that we give every year (at the University of Arizona). It is more for people that work in diagnostic laboratories at farms, government agencies, or universities. The short course is directed not so much for shrimp farmers but rather for the biologists who might work at a shrimp farm and who will do or supervise the diagnostic work. The training is for a specific group or audience only. Our short course participants are trained in shrimp pathology and in the classical and modern diagnostic methods available for the most significant shrimp diseases. Students are trained to do and interpret diagnostic methods that range from simple wet mounts, through histopathology, microbiology, and immunology, or to molecular methods that include dot blots, gene probes, *in situ* hybridization, and finally PCR/RT-PCR.

[interview by m.b.s.]

DR. TIMOTHY FLEGEL INTERVIEW / FROM PAGE 2

otics.

The shrimp viruses don't affect people. But some bacteria like *Vibrio parahaemolyticus* and *Vibrio harveyi* affect shrimp and give people gastroenteritis.

What common prevention practices may be used by farmers to avoid shrimp diseases?

For prevention of viral diseases, many common things can be done. Set up a bio-secure system for raising shrimp; start with the breeders that have been cleared from disease either because they're domesticated or from a breeding program or after they have been checked using the most sensitive tools for presence of viruses; rear the larvae in a quarantine sort of facility and then check them again before stocking into ponds; release the shrimp in a secure system where you keep the carriers out; and store the water long enough to let the virus be destroyed – those methods are the same for all the viruses.

I think that if people raise shrimp in a suitable manner they will have very little reason to use antibiotics and chemicals but by the same token, I think it is possible under some circumstances that it may be beneficial to use antibiotics but it should be done under the supervision of a trained fisheries officer so that they'll do it properly.

If WSSV is the most serious disease in Thailand, would you say that this is also true in other Asian countries?

It's all over the world now, it spread from China to the rest of Asia – the route nobody knows but we suspect it's by movement of broodstock and fry. I think there's little doubt that for Thailand there are many fry producers and they send the fry to Malaysia, to India and to Bangladesh and certainly the virus went with the fry to Indonesia, but the Philippines had a ban – so probably it didn't come here because of that. (The most serious disease in the Philippines), from what I understand, is luminous vibriosis. We have it (in Thailand), but not quite so. It's a seasonal problem.

Which country do you think in Asia or the world would be the first to eradicate shrimp disease? How far is Thailand from that goal?

(*Smiles.*) We're working on it. I think it'll take quite a long time because the number of farmers is very big. (There are) about 80,000 shrimp farmers in Thailand... (at) all levels of production, very widely distributed and changing all the time. It's not always the same people so it's quite difficult to coordinate, but the Fisheries Department is working very hard on the code of conduct and their strategy is to work with groups and gradually expand. I think that's good strategy.

> "The most serious diseases (in) shrimp are the viral diseases because there is no way to treat them. Most other disease agents like bacteria (are) much easier to manage ... Shrimp viruses don't affect people."

Please mention new and exciting developments in shrimp research.

The most exciting thing for me is how the shrimp interacts with viral pathogens. We have some data to indicate that it's possible that the shrimp may have a specific way of accommodating viral pathogens – and if we can understand how this works – we may be able to prevent the shrimp from dying from viral infection. Sometimes they die, sometimes they don't die – and the question is why? – some of the information we have...it is not so much the quantity of virus (because) sometimes the same quantity will kill the shrimp, sometimes not. And when you look at the shrimp you can see the cells infected by the virus, but they don't die and we don't know why.

What would you like to pursue in the future?

Work in a shrimp events system (while trying) to understand how the shrimp interacts with the bio-pathogens in order to reduce the impact of viral diseases if they do occur.

Do you suppose there will come a time when all of these diseases will be eradicated?

Yes, I think when we work together and cooperate. If we can get these domesticated shrimp that are free of disease and then cultivate them in a bio-secured shrimp pond system...it will be like chicken or pigs. Well, it could happen in five years if everybody works together.

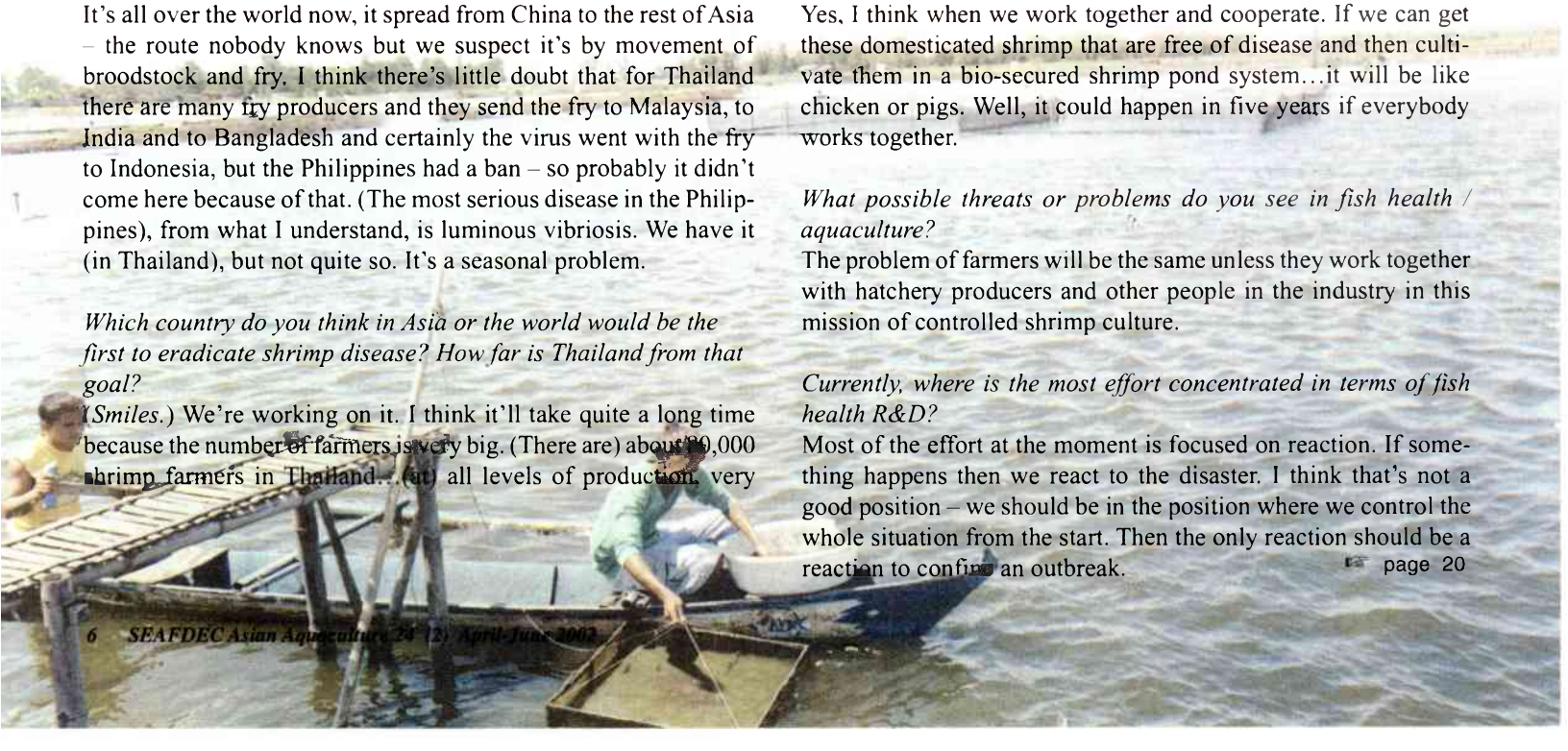
What possible threats or problems do you see in fish health / aquaculture?

The problem of farmers will be the same unless they work together with hatchery producers and other people in the industry in this mission of controlled shrimp culture.

Currently, where is the most effort concentrated in terms of fish health R&D?

Most of the effort at the moment is focused on reaction. If something happens then we react to the disaster. I think that's not a good position – we should be in the position where we control the whole situation from the start. Then the only reaction should be a reaction to confirm an outbreak.

page 20



DR. EINAR RINGO INTERVIEW / FROM PAGE 3

No, this is my first time in Asia for business. I am impressed by the profession of aquaculture in the Philippines. You have the advantage. First of all you have a product, which the consumer likes in both texture and taste. If you have a product of high quality, then it's easy to sell, not only in the Philippine market but also in all Asia. Look at the potential of exporting your fishes to other parts of the world. Norway exports Atlantic salmon to Europe, Asia, Japan and America.

on probiotics

> "We focus scientific interest on negative things, (when) we should focus on the positive ... There are a lot of bacteria which are not the bad ones. Why don't we look for (them)? This is the promise of aquaculture."

How do you find seafood in the Philippines?

In Norway, we produce mostly Atlantic salmon, a little bit of rainbow trout, some common wolfish but not the same as the species here in the Philippines, some arctic char and small numbers of halibut and turbot. Here you have quite different fish species...Seaweeds, for example, are not included in special restaurants in Norway. The shrimp industry here is quite enormous; you have a large potential here.

When I travel for 10-14 days and have fish everyday, I have something to compare ... The species here are delicious. I have tasted milkfish, snapper and seabass — three completely different tastes and textures — and all of them were delicious. For example, milkfish has a slightly mackerel taste. I think that these (fishes) have great potential.

What is your opinion about the usage of probiotics in bioremediation?

The first definition of probiotics was for mammalian systems to improve intestinal microbial balance. But in our terms, probiotics has a wider definition because we also include the environment — the water – for both improvement of water quality and improvement of intestinal microbial balance. We don't have to (stick) to the original definition given by those who work within endemic systems. The aquaculture point of view has a broader definition. There are three ways to use probiotics: as enrichment of larval food (either *Brachionus* or *Artemia*); inclusion in the diet; and addition to water.

If you do some studies on green water or mature water, is that probiotics? In the broader sense, yes; but in the narrow sense, no. Still if you use green water, you improve the water quality from the microbial point of view, and you also improve the microbial balance. So what's the difference?

What common microorganisms have the most promise in fish and shrimp probiotics?

I've been working on lactic acid bacteria for 15 years. I know the problem of lactic acid bacteria but also the potential... So far the most promising results (have been exhibited by) *Vibrio* and *Pseudomonas* for fish, and *Bacillus* for the shrimp system... But one shouldn't (disregard) any other antagonistic bacteria (though normally only one kind of bacteria is used in these studies), because in the real microbial world there is an interaction among bacteria. For example, one kind of bacteria can produce a compound that stimulates growth in another and can be antagonistic to yet another one. First, we should look at those bacteria that have no antagonistic effect. They would be colonized either in the surface of the skin, gills or digestive tract if possible. We should also look for bacterial (species) that stimulate the production of other (groups). One of the first studies on lactic acid bacteria shows that a bacillus can produce a substitute, which stimulates the antagonistic production of lactic acid bacteria. This was in 1980, but nothing has been done on the subject so far.

So is this an area that has been ignored in the study of probiotics?

Not ignored, but I think most people have concentrated on specific bacteria to see if they have antagonistic effects, to see if they could be colonized. We have to start from scratch in all aspects, we can't use all the information and knowledge from the aquatic animal because the two systems (mammalian and fish) are quite different. (Humans) whether they come from Asia or Norway have more more or less the same digestive tracts. But milkfish from the Philippines has a digestive tract that is completely different from that of a common wolfish in Norway. All fish species have digestive tracts that are totally different from each other.

Fish are eating different diets – fish caught off the coast of Norway have a different meal compared to fish caught in the Philippines. We can't take the food of the common wolfish and give it to the milkfish...

It's not been ignored, but it has not been done.

So if you had a choice, what area(s) would you like to emphasize in studies?

In 1995, I had a discussion with a professor in Belgium and our conclusion was this: If the same amount of money was spent in microbial ecology as was done in feed nutrition then we would have probably solved the disease problems.

☞ page 20

DR. SUPRANEE CHINABUT INTERVIEW / FROM PAGE 3

seeds and feeds, these practices would improve the health conditions of the fish.

How about biosecurity?
You cannot avoid all bad organisms; they're everywhere. And talking about biosecurity is like talking about being free from all undesirable organisms. This is the same as when we talk about stress, which is everywhere, because stress is not only in the fish but in other animals within the culture area as well.

> "Most of aquaculture conditions relate to health management. If farmers can improve their culture practice or try proper management (techniques) like maintaining water quality, using good seeds and feeds, these practices would improve the health conditions of fish."

Aside from diseases and parasites, what other causes contribute to poor productivity of freshwater aquaculture?
For fish health, what we need is rapid diagnosis because if you know the health condition of your animal as quickly as possible, the chance to prevent infection or protect your production is good. What we're looking for are rapid diagnostic kits or techniques for any particular disease. You cannot put everything in a single container, right? So we should try to develop specific kits. If you have the right kit for the right disease, expect to have something like this: you dip a piece of paper into the solution and expect a yes or no answer – whether it is infected with this disease or not. We are looking for something this quick. But the problem is, chronic disease is very difficult to detect. So if a rapid detection kit is available, it would help. Disease at an early stage can be prevented. For example, mycobacteriosis, which is like tuberculosis in mammals is a chronic disease. But today, we have to take a histology for detecting this disease which takes about two days. We can develop *in-situ* hybridization of this disease but again it takes a much longer time. We have to kill the fish. The idea is how to analyze before the fish is killed. We can try this kind of kit. The ornamental fish market will be happy.

How far is Thailand towards these quick diagnostic procedures?
We expect that within the next few years, we may be able to develop a cure for mycobacterium because we have been doing this work for the last 10 years. We are also looking into the viral diseases of groupers and we are expecting to develop techniques to shorten the time needed for the analysis.

What would you like to see or achieve in terms of controlling diseases and parasites in SEA to see a disease-free and parasite-free Asia?
That is a perfect idea but I know it is very difficult to achieve. My interest is how the Asian countries would share the knowledge on quarantine and how to strengthen quarantine in the region. If we can do that, we can prevent the spread of diseases in live aquatic animals. Transport of live aquatic animals without proper disease preventive measures is one of the big problems in Asia. Some countries may claim that they have operational quarantine systems but they are not enforced. Most countries have laws and regulations but they are not strictly enforced, particularly in Asia. Thailand is now in the process of implementing the laws on fishery but I can say quite frankly that this will take a much longer time. There are records of many diseases in aquatic animals spreading like the white spot disease in black tiger shrimp because of the import-export of live PLs to various places without proper quarantine. I think quarantine is one of the important tools in preventing the spread of diseases. Not only that. You can think of many diseases that are transferred to humans like tapeworm, lung fluke, and liver fluke. It is not killed in half-cooked fish of which Asians are very fond. They can also be found in some marine fish. Marine fish also have nematodes called anisakis. These are transferred to humans as well.

As Chairperson of the Fish Health Section of the Asian Fisheries Society, how do you perceive the importance of that society?
We need organizations like these as one of the vehicles to set up the network among scientists with interest in the same subject like fish health. We should have a center that brings people together to share the knowledge and information that is important for the region.

Do you have plans to make these societies affect policies within the region?
We try hard. When we started ten years ago, no one was interested in this kind of organization. Now, (AFS-FHS) is recognized by many government organizations, and even organizations in other parts of the world like the American Fisheries Society and the World Aquaculture Society. When we talk as an organization, people listen rather than when we talk as individuals. I didn't expect that our section would be that powerful at the moment but we are sure that in the future there will be more activities going on and then recom-

page 19

JIRCAS' Dr. Hiroshi Ogata: thoughts on Japanese aquaculture

Dr. Hiroshi Ogata describes the aquaculture industry in Japan as supported by thousands of local and small-scale fishers. Unlike Southeast Asian countries where big enterprises control the industry because aquaculture requires big initial capital and investment, Japanese fishers alone have the right to fish and engage in aquaculture in coastal areas. This right is not a license but a traditional right exercised for over 300 or 400 years. And as long as fishers keep their fisheries right, there is no room for any enterprises to be involved in aquaculture in the coastal areas of Japan. It is worth noting that the right has protected the coastal areas from environment degradation and destruction that may be caused by private enterprises. Aquaculture is not only a business but also the source of daily bread for Japanese fishfarmers.

Dr. Ogata believes that the aquaculture industry in Southeast Asia can be made sustainable through education. There should be a consistent information dissemination on the importance of aquaculture, its effect on the environment, importance of mangrove systems and the responsibility of each person in keeping the industry sustainable. This education should be given to elementary and high school students and coastal residents. Unlike science and engineering, there is no need for sophisticated and expensive facilities and equipment to start education.

In relation to his collaborative study being conducted in SEAFDEC/AQD, Dr. Ogata believes that one limiting factor for the expansion and commercial production of new aquaculture species is the lack of available and adequate supply of quality fry and fingerlings. But this can be achieved with sufficient knowledge and skills on hatchery and larval rearing of cultured species. And this is possible, he says, through the conduct of studies on nutritional condition of broodstock. Researchers need to determine egg and larval quality, diet quality and nutrients to know the profound effect on egg nutritional composition and subsequent gonadal development, fecundity (total number of eggs produced), fertilization rate, normal embryo development, hatching rate and survival rate of hatched larvae.

Presently, nutritional information on broodstock is limited to a few species and little information is available on sub-tropical/tropical marine fishes. Dr. Ogata remarked that a high performance broodstock diet might increase production cost; however, it would reduce nutrient loading of surrounding water and eventually increases economic returns through high survival rates of fry in the hatchery. Moreover, the use of formulated diets in lieu of unprocessed raw fish would decrease the risk of disease transmission to the broodstock and fry.

As an expert in fish nutrition, Dr. Ogata related that due to the drastic decrease of sardine catch which is the most popular source of fish meal for feeds of marine fish for aquaculture in Japan, alternative protein sources (plant protein) are being studied to reduce the fish meal content in artificial diets. Low protein– high energy diets have been developed to reduce nitrogen loading that leads to environmental pollution.

Various nutrients and vitamins C, A, E, carotenoids, taurine and phospolipids are used to improve egg, larvae and seed quality. The relationships between nutrients and fish health have been investigated and dietary supplementation of certain nutrients are found to increase non-specific immunity of fish. However, complete artificial microdiets for marine larvae fish are not yet developed. Studies based on molecular nutrition have already started (relationship between nutrients/nutritional condition and gene expressions of fish).

Dr. Ogata describes the JIRCAS and SEAFDEC collaboration as a good chance for the JIRCAS staff to understand the importance of coastal fisheries and aquaculture as a primary industry in Southeast Asia. He thinks that SEAFDEC/AQD is the best organization for JIRCAS to collaborate with on aquaculture research because of its rich human resources and high level of research experience. This collaboration will help JIRCAS to move to the next step after the project has been successfully completed and evaluated.

Dr. Ogata wishes to thank AQD for the opportunity to work in the organization. And his message to the aquaculture industry: "Be good, be a good industry."

[interview by s.m.w.]

Dr. Hiroshi Ogata is a fish nutrition and breeding expert who worked with SEAFDEC/AQD researchers Dr. Arnil Emata and Dr. Relicardo Coloso on a study on "Egg and larval quality of the mangrove red snapper, *Lutjanus argentimaculatus* fed improved broodstock diets. His term in AQD was for a month beginning February 26 but he will be back for further research work. Dr. Ogata is presently a senior researcher at JIRCAS.

Price index for milkfish: An info tip for producers and consumers

By
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Knowing the price of milkfish in various months of the year is an important concern for milkfish grow-out operators. Generally, we aim to harvest when price is high in the markets or fish trading ports where we expect to sell them. However, traditional milkfish production is heavily influenced by climate cycles and other biological conditions. Markets are also characterized by seasonal and trend effects and they manifest in prices. These factors contribute to the seasonality in milkfish production, and consequently in prices.

The table on this page presents seasonal price indexes for milkfish in Manila and five regional markets. The seasonal indexes were derived using multiplicative technique applied on monthly wholesale and retail price data from 1990 to 2000.[1] Overall, the indexes show that wholesale and retail prices were relatively high (i.e., indexes are above 1.0) from December to May in all markets, except in Iloilo and Zamboanga where indexes remain <1 in December. Meanwhile, wholesale and retail price levels were relatively lower (<1) from June to November.

One important use of these indexes is that they could indicate the price levels of the marketable milkfish during the expected month of harvest relative to the other months of the year. Milkfish growers could benefit from these price indexes in terms of the indications on the nature of production systems and the extent of the associated cost they could afford to incur. For example, given that in the current period June, the prevailing wholesale price of aver-

page 19

Monthly seasonal indices for wholesale and retail price of milkfish in selected markets and consumption centers in the Philippines (based on 1990 to 2000 price data)

	Manila	Dagupan	Lucena	Iloilo	Cebu	Zamboanga
Wholesale price						
January	1.130	1.102	1.051	1.058	1.042	1.033
February	1.107	1.114	1.099	1.068	1.034	1.000
March	1.110	1.071	1.088	1.093	1.001	1.036
April	1.053	1.067	1.076	1.091	1.071	1.028
May	1.021	1.004	1.030	1.039	1.043	1.050
June	0.971	0.949	0.979	0.969	1.007	1.041
July	0.915	0.902	0.926	0.913	0.958	1.019
August	0.931	0.943	0.941	0.931	0.966	0.970
September	0.915	0.920	0.922	0.954	0.943	0.968
October	0.929	0.916	0.909	0.936	0.941	0.925
November	0.933	0.969	0.948	0.966	0.974	0.959
December	0.985	1.043	1.032	0.982	1.021	0.972
Retail price						
January	1.086	1.073	1.044	1.052	1.049	1.028
February	1.109	1.086	1.080	1.094	1.027	1.045
March	1.113	1.081	1.093	1.128	1.029	1.024
April	1.098	1.058	1.080	1.113	1.035	1.029
May	1.030	1.014	1.047	1.027	1.037	1.019
June	0.963	0.963	1.015	0.943	1.025	1.031
July	0.926	0.950	0.948	0.927	0.991	0.999
August	0.909	0.924	0.911	0.928	0.971	0.986
September	0.916	0.925	0.920	0.935	0.959	0.979
October	0.915	0.936	0.932	0.936	0.940	0.924
November	0.937	0.974	0.923	0.943	0.936	0.965
December	1.000	1.017	1.006	0.974	1.000	0.970

A crateful of milkfish ready for wholesale auction in a fish port

[1] These computations and indexes form part of the contributed paper titled *Price relationships in Philippine milkfish markets: Univariate and causality analysis* presented by ND Salayo at the 6th Asian Fisheries Forum "Asian Fisheries: Diversification and Integration", 25-30 November 2001, National Sun Yat-Sen University, Kaohsiung, Taiwan

Harnessing biotechnology for aquaculture

The Philippines held its first national planning workshop for aquaculture biotechnology on April 12. Hosted by SEAFDEC/AQD in Tigbauan, Iloilo and attended by six participating institutions

It may be beyond the ken of ordinary folks, but the results of biotechnology are touching daily lives and making it better. New strains of larger tomatoes with longer shelf-life, high-yielding varieties of rice with shorter cultivation period, or your favorite fish sauce to perk-up the taste of food are mundane examples that you can buy in your friendly neighborhood public market or grocery store.

Contrary to common belief, biotechnology is not entirely a new science. It has been used for sometime. Basically, biotechnology is the fusion of two major sciences namely: biology and engineering. It involves the development of marketable products using living organisms or their components. For example, by manipulating the genetic make-up of plants and lower animals, it is possible to produce plants and animals that are disease-resistant and have the capability to grow and reproduce fast. This has staggering implications for food security, including aquaculture production.

Seafoods are a major export commodity for many countries in the Asian region and thus a valuable source of foreign exchange. The increasing demand for seafood has led to the overexploitation of wild fish stocks in some regions of the world and has resulted in reduced catch for fishers. In order to redress this balance, there has been a dramatic global expansion in fish and shellfish farming, over the past twenty years. Today, aquaculture is one of the fastest-growing sectors of food production, particularly in Asia which accounts for about 90% of the total global production. In 1994, world aquaculture production supplied about 12 million tons of high quality food for direct human consumption that was valued at US$39 billion.

Many aquatic species of economic interest can be kept in ponds, but fail to reproduce spontaneously in captivity. Thus, it is necessary to unravel their reproductive biology, and on that basis to develop techniques in seed production.

The increase in aquaculture production, particularly the expansion into intensive and semi-intensive methods of production, has been paralleled by an increase in fish diseases, resulting from high stocking densities and stress, conditions that favor the occurrence and spread of infectious disease. For example, continued development of the shrimp aquaculture sector is constrained by a wide variety of reasons including: (1) recurrent disease epizootics with limited prevention and control measures; (2) lack of consistent broodstock and post-larvae quality, inconsistent quality and; (3) limited choices of feed and inadequate water control of water quality.

Biotechnology can focus on fast and accurate detection methods for fish and shrimp viruses, develop monoclonal antibodies against viruses, and screening for antibacterial properties in microbes and phytoplankton.

Controlled breeding programs and genetic markers are now being developed to enhance selection of genetic lines which are free of specific pathogens (specific pathogen free-SPF) or resistant to pathogens (specific pathogen resistant-SPR).

Advances in understanding of shrimp immunity are also assisting development of immunostimulants and vaccines.

Broodstock and post-larval quality are being improved through application of hormonal control of reproduction and development of genetic tags to identify and produce pedigrees with optimal health and productivity. Feed enhancement using micro encapsulation of nutrient supplements and probiotics may also play a role in enhancing quality of post-larvae.

Bioremediation, recirculation and biofiltration technology all show promise for improving water quality control. Bioremediation is the use of biological mechanisms to destroy, transform or immobilize environmental contaminants to protect potential sensitive receptors. Recirculation is the use of water systems to minimize or reduce dependence on water exchange and flushing in fish culture units. Water is typically recirculated when there is a specific need to minimize water replacement, maintain water quality conditions which differ from the supply water, or to compensate for an insufficient water supply. It is used mainly to accomplish: (1) aeration, 2) removal of particulate matter, (3) biological filtration to remove waste ammonia and nitrite, and (4) buffering of pH. Biofiltration is the use of equipment engineered to biodegrade volatile organic compounds (VOCs) in air by passing VOC contaminated air media into which biodegrading microorganisms are attached.

In the Philippines, SEAFDEC AQD is one of the few research and development institutions in the forefront of aquaculture biotechnology.

Recently, it hosted the National Planning Workshop for Aquaculture Biotechnology on April 12 in Tigbauan. The one-day workshop brought together representatives of various scientific institutions doing research on aquaculture biotechnology. It included among others: The University of the Philippines Marine Science Institute (UPMSI), the University of the Philippines in the Visayas National Institute of Molecular Biology and Biotechnology (UPV-NIMBB), and the Bureau of Fisheries and Aquatic Re-

page 16

AQD offers disease diagnostic services

Aquaculture production in Southeast Asia has grown rapidly. Unfortunately, a number of infectious diseases have emerged as well owing to deteriorating conditions in farms not practicing sound culture management.

Viruses have been long-time scourges of the aquaculture industry. Outbreaks of viral infections can cause massive mortalities among cultured fishes and shrimps, and have affected almost all penaeid shrimp-producing countries in the world.

The viral diseases significant to the shrimp industry include: (1) White spot syndrome virus (WSSV); (2) Hepatopancreatic parvo-like virus (HPV); (3) Monodon baculovirus (MBV); (4) Infectious hypodermal and hematopoietic necrosis virus (IHHNV); and (5) Yellow head virus (YHV). Several species of fish are also infected with Viral nervous necrosis (VNN) and Iridovirus. Mortality rate is from 50 to 100% depending on the disease.

Bacterial and fungal diseases, and parasitic infestations have also been known to cause mass mortalities in wild and cultured fish and crustaceans.

Of the bacterial diseases, luminescent vibriosis is the most significant to the local aquaculture industry, affecting various life stages of shrimp (eggs, larvae, postlarvae, juveniles, and adults). Fungi infect aquatic organisms as opportunistic invaders, but once established, they are often fatal and difficult to treat. Of the parasitic infestations, those caused by protozoans, monogeneans, nematodes, and leeches are the most common.

To aid the industry in dealing with its problems in diseases, the Diagnostic Service Unit of the Fish Health Section of AQD accepts samples for disease diagnosis. The services are available for a minimal fee.

If you would like to request more information regarding the services we offer and the protocol in sending samples, please contact:

DR. ERLINDA CRUZ-LACIERDA
Head, Fish Health Section
Email: eclacier@aqd.seafdec.org.ph
or
DR. LEOBERT DE LA PEÑA
Email: leobertd@aqd.seafdec.org.ph

Tel. (63-33) 335 1009, 336 2937, 336 2965
Fax. (63-33) 511 9070, 335 1008

Mailing address:
Fish Health Section
Southeast Asian Fisheries Development Center (SEAFDEC)
Aquaculture Department
5021 Tigbauan, Iloilo, Philippines

Service	Fee per sample:	PhP	US$
Direct microscopy of wet mounts or tissue smears			
MBV or HPV detection (1-10 PLs)		P130	$ 3
Parasite detection and identification (1-5 specimens)		P100	$ 2
Histopathology (H&E stain of routine paraffin sections			
Whole mount (per slide)		P 90	$ 2
Typical section (per slide or tissue)		P150	$ 3
Serial section (per slide)		P150	$ 3
Polymerase chain reaction (PCR) - based diagnosis			
For samples that require DNA or RNA extraction before analysis			
WSSV[1]: one-step PCR		P400	$ 8
nested PCR		P700	$14
VNN: RT-PCR		P500	$10
nested PCR		P800	$16
For samples that do not require DNA or RNA extraction before analysis			
WSSV, one-step PCR		P300	$ 6
VNN, one-step PCR		P400	$ 8
Microbiology: bacteriology/mycology			
Bacterial isolation (1-5 specimens)		P150	$3
Bacterial identification (per isolate)		P200	$4
Bacterial count			
Water		P 75	$2
Fry/larval/PL (1-10 larvae)		P100	$2
Juveniles/fingerlings		P100	$2
Fungal isolation (1-5 specimens)		P200	$4

[1]Up to 150 PLs per sample

Prevention is better than cure.

AQD Chief Dr. Rolando Platon reappointed for the fourth time

Dr. Rolando Platon began his fourth two-year term as SEAFDEC/AQD Chief in April 2002, and he is looking forward to continuing AQD's priority of technology commercialization and techno-transfer.

Added to this mission is a new direction for AQD -- biotechnology research -- which with the approval of P431 million *Laboratory for Advanced Aquaculture Technologies* will help the industry attain its goal of sustainability.

In his first three terms, Dr. Platon has established major infrastructures at AQD like the *Integrated Fish Broodstock and Hatchery Demonstration Complex* (a showcase of AQD's breeding-hatchery technologies), *Dumangas Brackishwater Station* (for field trials of fish grow-out technologies), and *Fish World* (an environment education center).

Dr. Platon also involved AQD in collaborative projects with the Australian Center for International Agricultural Research (ACIAR, on semi-intensive seed production of grouper), European Union (EU, on feed development for larval fishes and mudcrab), International Center for Living Aquatic Resources Management (ICLARM, on coastal resource management), and the Association of Southeast Asian Nations (ASEAN, on mangrove-friendly aquaculture and aquaculture disease management), to name a few.

Dr. Platon was appointed by the SEAFDEC Council (SEAFDEC's policy making body) on the recommendation of the Philippine government, the host country of AQD.

Top shell releasing reproductive cells (note the white "smoke-like" substance coming out of the shell)

SEAFDEC/AQD succeeds in spawning the top shell *Trochus niloticus*

SEAFDEC/AQD has began producing hatchery-reared top shells (*Trochus niloticus*) for its stock enhancement program after it first successfully spawned the species on February 1, 2002. Forty gravid spawners (50-80 mm in basal diameter) were made to spawn by subjecting them to static-water stimulus and thermal shock. This batch of spawners produced 337,000 active veliger larvae out of two million eggs.

Top shell is economically important to coastal communities because its aragonite shell is a primary material for mother-of-pearl buttons. However, increased fishing pressure caused its natural population to decline, hence, AQD's efforts on seed production and stock enhancement. But the extent of work will depend on the availability of funds.

The next successful spawning of the top shells came on February 27. Forty-one gravid spawners subjected to static water stimulus produced 319,000 active veliger larvae from 2.6 million eggs. The other batch with 42 gravid spawners subjected to thermal shock produced 46,000 active veliger larvae from 400,000 eggs.

The larvae stocked in settlement tanks with corrugated PVC plates are currently monitored to determine settlement, growth, and survival rates. Larval development and stocking density will also be determined. Benthic diatoms previously grown on PVC plates served as food for the larvae.

AQD researchers obtained the spawners as juveniles from Iris Hatchery in Palawan, western Philippines, in September 2001 and reared these in outdoor tanks. In January 2002, researchers observed some juveniles (about 2-3 months old), indicating spontaneous spawning since November-December 2001.

The scientists working on top shell seed production and stock enhancement are Mr. Rolando Gapasin, Dr. Clarissa Marte and Dr. Wenresti Gallardo.

Myanmar adopts environment-friendly schemes, gets bumper shrimp harvest

The government of Myanmar could not thank SEAFDEC/AQD enough for a successful technology transfer of shrimp culture in Yangon, says Mr. U Min Thame, coordinator for the Japanese Trust Fund project on mangrove-friendly shrimp culture in his country.

The project reported a bumper crop that was sold to an exporter with no shrimp rejected. The yield of the 7,226 m^2 demonstration pond was about 7,100 kg after 101 days of culture -- or about 10 tons per ha. The culture scheme included the use of a sludge collector, tilapia as biomanipulators to produce greenwater, long-arm paddlewheels, and a reservoir to improve water quality in the grow-out pond.

An AQD technician from the Philippines stayed in Myanmar for the duration of the run.

The Myanmar project is part of a region-wide program on mangrove-friendly aquaculture being implemented by SEAFDEC.

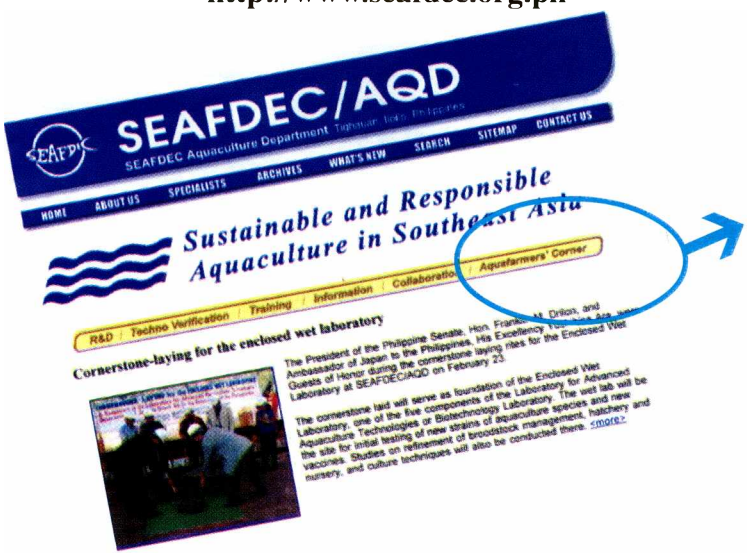
AQUAFARMERS' CORNER
An internet discussion board on aquaculture technology at the farm level

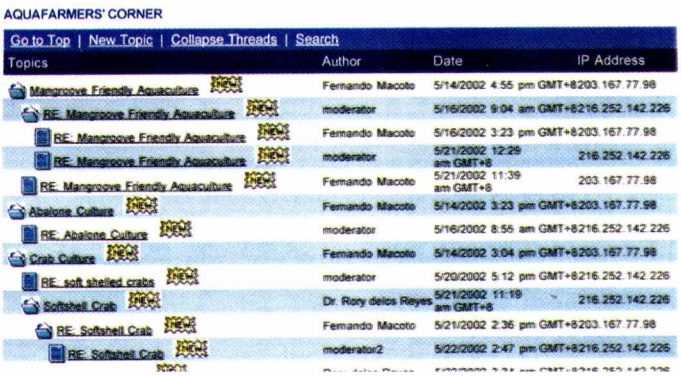
Check out the latest SEAFDEC/AQD discussion board on aquaculture technology online - Aquafarmers' Corner. The site was created to serve as venue for exchanging and sharing ideas and issues by various stakeholders of the industry to further aquaculture development in the country.

There is a need to push aquaculture production to higher limits in answer to the problem of ever-increasing population and decreasing marine fishery catch. The technologies for better aquaculture productivity are already found in research institutions, progressive aquaculture farms, and development agencies in the world. However, these technologies must reach the bottom level of production -- the farm itself. Under this scenario, the discussion board, and our vast pool of experts, hope to give answers to your queries on aquaculture technology at the farm level. We will also be glad to hear about your experiences so that we may build on it.

Come, visit us!

http://www.seafdec.org.ph





Next online course open for enrolment:

Aquaculture nutrition

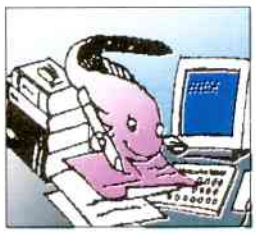
Needing to update your knowledge on aquaculture nutrition but want to learn at your own time, pace, and place? This online course is for you, and it will start on August 6.

The course on *Basic principles of aquaculture nutrition* teaches the essentials of aquaculture nutrition, feeds and feeding management. Course materials are research-based and products of more than 25 years of research experience in fish nutrition and feed development at SEAFDEC/AQD. Moreover, recent works from research institutions worldwide are included. The course is presented in 4 units consisting of 10 modules.

Learners are required to have a background in college chemistry, fish biology or fisheries; and access to the internet.

The course costs US$250 (or P6,500 for Philippine nationals). Learners from SEAFDEC member countries may avail of a fellowship grant through their Council Director. Availment of the grant is on a competitive basis.

For further inquiries, contact: Dr. Oseni Millamena, course officer, at email oseni@aqd.seafdec.org.ph or training@aqd.seafdec.org.ph; fax (63-33) 336 2891



AQD Research Publications

Reprints of papers listed here may be requested directly from SEAFDEC/AQD authors or from the AQD Library

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Amar EC, Kiron V, Satoh S, Watanabe T. 2001. Influence of various dietary synthetic carotenoids on bio-defense mechanisms in rainbow trout, *Oncorhynchus mykiss* (Walbaum). Aquaculture Research 32 (Suppl 1): 162-173

Abstract. This study examined the influence of different carotenoids on growth and some immune indices in rainbow trout. Six semipurified casein-based diets were formulated to contain one of three different carotenoids: astaxanthin, canthaxanthin and beta-carotene, at 100 mg kg^{-1}, each of them with vitamins A, C and E either added or omitted. The two control diets contained no carotenoids and were either with or without the vitamins. Rainbow trout weighing about 140 g were fed the diets for 9 weeks. Specific growth rate, feed:gain ratio and nonspecific immune parameters were determined. Growth and feed conversion were similar among the groups. Immune parameters like production of reactive oxygen species by head kidney leukocytes and plasma total immunoglobulin levels did not vary with the treatment. Serum complement activity in both beta-carotene groups and the vitamin-containing astaxanthin group were significantly higher than both the control fish. Serum lysozyme activity in the vitamin-containing carotene and astaxanthin groups were significantly different from both control groups. Phagocytic activity was also high in the vitamin-containing beta-carotene and astaxanthin groups compared with the controls. For phagocytic index, in addition to the foregoing groups, the vitamin-containing canthaxanthin group gave better results compared with the controls. The vitamin-containing astaxanthin and beta-carotene groups also exhibited better nonspecific cytotoxicity for the peripheral blood lymphocytes at all effector-to-target ratios. Thus, among the carotenoids studied, beta-carotene and astaxanthin elevated humoral factors such as serum complement and lysozyme activity, as well as cellular factors such as phagocytosis and nonspecific cytotoxicity. In the presence of the vitamins the carotenoids exerted a greater influence on the bio-defense mechanisms of rainbow trout.

Bautista-Teruel MN, Millamena OM, Fermin AC. 2001. Reproductive performance of hatchery-bred donkey's ear abalone, *Haliotis asinina* Linne, fed natural and artificial diets. Aquaculture Research 32 (Suppl 1): 249-254

Abstract. Hatchery-bred donkey's ear abalone, *Haliotis asinina* Linne broodstock were given diets consisting of natural food, seaweed (SW), *Gracilariopsis bailinae*, D1; combination of SW and artificial diet (AD), D2; and AD alone, D3. Equal numbers of 1:1 female and male abalone were stocked in 24 units, 60 L tanks with eight replicate tanks per dietary treatment. Reproductive performance, e.g. number of spawnings, instantaneous fecundity and egg hatching rates, was monitored over 270 days. The mean number of spawnings was not significantly different among treatments. The mean instantaneous fecundity and percent hatching rates were significantly higher in abalone fed D2 or D3 compared to those given D1. Survival of abalone broodstock fed D1 was, however, significantly higher at 88% than those fed either D2 or D3 at 75%. Fatty acid analysis showed that the n-3/n-6 fatty acid ratios of abalone hepatopancreas reflected those of their diets. Mature abalone ovary had n-3/n-6 fatty acid ratio of 1:3. A higher amount of essential nutrients in the artificial diet such as protein, lipid and the highly unsaturated fatty acids, e.g. 20 : 4n-6, 20 : 5n-3, 22 : 6n-3 in abalone fed D2 or D3, may have influenced the increased reproductive performance.

Borlongan IG, Satoh S. 2001. Dietary phosphorus requirement of juvenile milkfish, *Chanos chanos* (Forsskal). Aquaculture Research 32 (Suppl 1): 26-32

Abstract. Seven isocaloric and isonitrogenous diets with graded levels of monopotassium phosphate to yield total phosphorus levels of 0.28 (no P supplementation), 0.43, 0.58, 0.73, 0.88, 1.03 and 1.18% were prepared and fed to five replicate groups of 10 juvenile milkfish (initial weight = 2.5 g). After 16 weeks of feeding, significant differences in growth (300-570%), survival rates (70-100%), and bone and scale mineralization were found among treatment groups. Weight gains of milkfish increased linearly up to the 0.88% dietary phosphorus concentration and levelled off beyond this dietary level. Bone and scale ash, calcium and phosphorus concentrations showed similar patterns as weight gain in response to dietary phosphor-L is concentration. Broken-line regression analyses of these data indicated that the dietary phosphorus level required for optimal growth and mineralization of juvenile milkfish is approximate to 0.85% of dry diet.

Guanzon NG, Nakahara H. 2002. Growth and photosynthesis inhibition by agricultural pesticides in three freshwater microalgae. Fisheries Science 68 (1): 144-151

Abstract. Growth rate and photosynthesis *of Microcystis aeruginosa, Scenedesmus quadricauda* and *Aulacoseira granulata* exposed to different concentrations of the agricultural pesticides CNP (p-nitrophenyl-2,4,6-trichlorophenyl ether), MEP [O,O-dimethyl-O-(3-methyl-4-nitrophenyl) thiophosphate], ISP [isoprothiolane (C12H18O4S2)], and TBT (tri-n-butyltin chloride) were determined. The effective concentration (EC50) for growth and photosynthesis in each species of microalga was then calculated. Inhibition of growth and photosynthesis in the three microalgae was greatest when exposed to CNP and TBT. *Microcystis aeruginosa* and *A. granulata* showed a higher tolerance, whereas *S. quadricauda* showed a higher sensitivity. Except for MEP, the EC50 values for growth obtained in the three microalgae were higher than those for photosynthesis. The growth-photosynthesis response relationship showed that, for CNP and TBT, growth of the three organisms tested were less inhibited than their photosynthesis at a lower exposure (0.001-0.05µg/L). At a higher exposure (0.10-1.0 µg/L), the response between relative growth rates and relative photosynthesis was proportional. For MEP and ISP, a proportional response existed between relative growth rates and relative photosynthesis in all test organisms. These results suggest that the inhibition of growth and photosynthesis by agricultural pesticides differs for the three microalgae. The differences can be explained in terms of the physicochemical properties of the four pesticides and the physiological and morphological properties of the three microalgae.

Lebata JHL, Primavera JH. 2001. Gill structure, anatomy and habitat of *Anodontia edentula*: Evidence of endosymbiosis. Journal of Shellfish Research 20 (3): 1273-1278

Abstract. Surveys and interviews were conducted to determine sources and habitat *of Anodontia edentula*. Results showed that they inhabit muddy substrate of mangrove areas or the adjacent mudflats, burying at 20-60 cm deep in the mud. They are strategically situated in the sulfide-rich, low-oxygen layer of the substrate but have access to oxygen through their inhalant tube; both sulfide and oxygen are essential for their survival. Study of the clam's gross anatomy revealed thick, fleshy, deep purple to blackish brown gills; reduced digestive structure; and a highly elastic foot capable of extending several times longer than its body length. These observations conform with the anatomy of fellow lucinid clams. Furthermore, scanning electron micrographs showed coccoid or spherical bacteria occupying bacteriocytes in the clam's gills. Intermediate cells separating bacteriocytes observed in other lucinids were also noted in the SEM.

Millamena OM, Golez NV. 2001. Evaluation of processed meat solubles as replacement for fish meal in diet for juvenile grouper *Epinephelus coioides* (Hamilton). Aquaculture Research 32 (Suppl 1): 281-287

Abstract. Feeding experiments were conducted to determine the efficacy of low fish-meal-based diets for juvenile grouper *Epinephelus coioides* (Hamilton). A diet containing 44% protein was formulated using fish meal as the major protein source. Processed meat solubles, a rendered by-product of slaughterhouses, was tested as a replacement for fish meal at increasing percentages from 0 to 100% in isonitrogenous diets. Eight dietary treatments representing fish-meal replacements were arranged in a completely randomized design with four replicates per treatment. Twenty-five fish were reared in circular fibreglass tanks of capacity 250 L, maintained in a flow-through seawater system and fed at 5-6% of total biomass, provided daily at 08:00 and 16:00 for 60 days. Results indicate that processed meat solubles can replace 40% of fish-meal protein with no adverse effects on weight gain, survival and or feed conversion ratio of *E. coioides* juveniles. Higher inclusion levels resulted in a significant decline in growth performance and inefficient feed conversion ratios, which may partly result from the lack of essential nutrients such as essential amino acids in meat solubles. This study has shown that the use of processed meat solubles substantially lowers the level of fish meal required in juvenile grouper diet and can be an efficient means of turning byproducts from slaughterhouses into a useful feed resource.

Millamena OM. 2002. Replacement of fish meal by animal by-product meals in a practical diet for grow-out culture of grouper *Epinephelus coioides*. Aquaculture 204 (1-2): 75-84

Abstract. A feeding trial was conducted to evaluate the potential of replacing fish meal with processed animal by-product meals, meat meal and blood meal (4:1 ratio), in practical diets for juvenile grouper (*Epinephelus coioides*). Eight isonitrogenous diets were formulated to contain 45% protein and 12% lipid. Fish meal was replaced by 0%, 10%, 20%, 30%, 40%, 60%, 80%, and 100% of meat meal and blood meal (4:1) mixture (diets 1-8). The diet with 100% fish meal (diet 1) or trash fish as feed (diet 9) were used as controls. Grouper juveniles were reared in 250-l circular fiberglass tanks maintained in a flow-through seawater system. Each dietary treatment was tested in quadruplicate groups of 25 fish per tank arranged in a completely randomized design. Fish were fed the diets twice per day at a daily feeding rate of 5-6% of biomass and trash fish at 10-12% of biomass for 60 days. Percentage weight gain, specific growth rate (SGR), survival, feed conversion ratio (FCR) and body composition of grouper juveniles were measured. There were no significant differences ($P > 0.05$) in growth performance among fish fed diets 1-7 (0-80% fish meal replacement) with those fed diet 9 (trash fish as feed). However, fish fed diet 3 had significantly higher ($P < 0.05$) growth than those fed diet 100% fish meal replacement. Survival among fish fed the experimental diets did not significantly differ (96-100%) but was significantly higher ($P < 0.05$) than survival (90%) of fish fed trash fish. These results showed that up to 80% of fish meal protein can be replaced by processed meat meal and blood meal coming from terrestrial animals with no adverse effects on growth, survival, and feed conversion ratio of *E. coioides* juveniles.

[Note: Abstracts from journals covered by **Current Contents** are downloaded from the CD-Rom version (Agriculture, Biology & Environmental Sciences; Week 14,16 April 2001 – 08 April 2002). 2002. Institute for Scientific Information, Pennsylvania, USA]

HARNESSING BIOTECH / PAGE 11

sources (BFAR). Also present were representatives, from the Department of Science and Technology, Region VI, UPV-College of Arts and Sciences (CAS), and the Department of Agriculture (DA). The aim of the workshop was to map a comprehensive program on aquaculture biotechnology and to explore areas for collaboration between institutions engaged in aquaculture biotech research.

SEAFDEC AQD's research activities on aquaculture biotechnology are focused on the following major areas: genetic characterization of wild and cultured populations of selected aquaculture species, development of strategies for growth enhancement and the control of reproduction in selected fish and crustaceans, control of diseases, feed technology, and seaweeds biotechnology. SEAFDEC AQD is currently building a Laboratory for Advanced Aquaculture Technologies otherwise known as Biotechnology Laboratory (see also the back page story, this issue).

This initiative addresses issues concerning capability-building in marine biotechnology such as: formulation of appropriate national programs in this field, setting of priorities for directed R&D, securing long-term funding for R&D, technology transfer, and industry initiatives.

In summary, the aquaculture sector will confront the issue of biotechnology through:

- developing and applying biotechnological innovations for advances in nutrition, genetics, health and environmental management.
- addressing the potential implications for aquaculture of biotechnology, including genetically modified organisms (GMO) and other products, in a precautionary, safe and practical way; and
- encouraging public awareness and providing information to consumers on the potential applications of biotechnology.

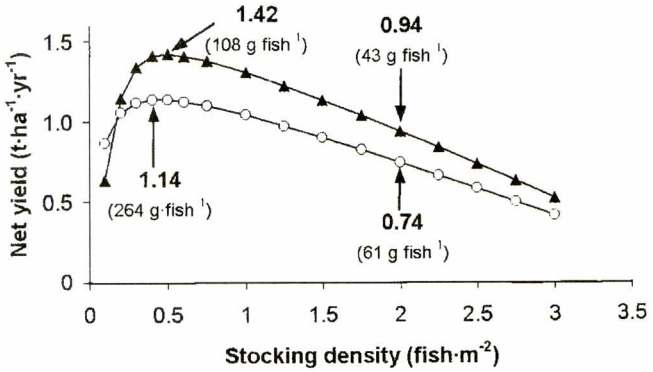
- APS

FROM AROUND THE WORLD

Africa and France: models for optimizing tilapia yields

Extensive culture of Nile tilapia has not always given tropical African farmers a good deal. The most critical decision appears to be stocking density given the limited inputs. For instance, stocking 2 fish per m^2 (considered "high" in low productivity environments) has led to stunted populations and very low yields. This led researchers of the Association Pisciculture et Developpement en Afrique Tropicale Humide in France to develop models whereby farmers can decide their stocking density based on the length of culture they can afford to maintain or on the size of fish they want to market. Researchers Frederic Glasser and Marc Oswald then validated the model in Cote de'Ivoire farms.

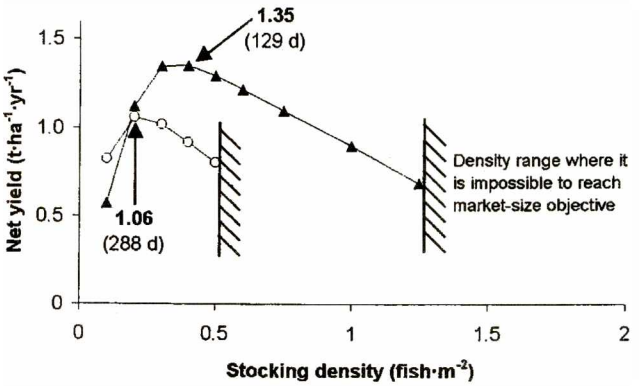
Supposing the tilapia farmer has two choices of culture period – 100 or 300 days – what stocking density should he use? The researchers say that based on model 1 shown below, stock density of 0.5 fish per m^2 can net the farmer 1.42 tons per ha per year in 100 days; density of 0.4 fish per m^2 can net him 1.14 tons in 300 days. Beyond these densities, the tilapia farmer will start losing.



Model 1 Simulated net yields at different stocking densities, for different rearing periods: 100 days (▲) or 300 days (o). The calculated values are compared for optimal density and 2 fish per m^2 (values in bold correspond to net yields, numbers in brackets indicate final mean weight reached [cf. *Aquatic Living Resources* 14: p 323 (2001)]

Supposing the farmer bases his decision on the size of fish he wants to sell? His choices could be 150 or 450 g. Based on model 2 below, it is best for the farmer to stock at 0.4 fish per m^2 to get 150 g fish (his maximum yield would be about 1.35 tons per ha per year); or to stock at 0.2 fish per m^2 to get 450 g fish (yield ~ 1.06 tons).

The French researchers emphasized that in decreasing stocking density, a tilapia farmer can obtain higher yield with a shorter rearing period and a higher final mean weight. If a longer period and a lower density is chosen, the farmer would produce fish with a much higher market value and obtain higher yields. [REF: oswaldm@planetepc.fr; Aquatic Living Resources 14: 319-326 (2001)]



Model 2 Simulated net yields obtained at different densities for different fish mean weight objectives: 150 g (▲) or 450 g (o). The maximal net yields are indicated in bold; the numbers in brackets correspond to the rearing period [cf. *Aquatic Living Resources* 14: p 324 (2001)]

Kaohsiung, Taiwan: scientists for sustainable management

Over 2,900 scientists of the Asian Fisheries Society (AFS) have adopted a resolution on the status of the aquatic resources and the urgent steps that need to be taken for the sustainable management of resources. The ensuing document has been named The Kaohsiung Declaration (see overleaf), and will be brought to the attention of the forthcoming Johannesburg Summit 2002 (World Summit on Sustainable Development) as official statement of the members of the Society.

The summit will be a gathering of thousands of participants from all over the world, including heads of states and governments; national delegates; representatives from research, training and educational institutions; nongovernment institutions; the industry; and other concerned groups. Focal point of the summit will be action plans for sustainable development.

In a related development, AFS will hold the next *Asian Fisheries Forum* in Malaysia. The forum will be hosted by Universiti Sains Malaysia, Universiti Putra Malaysia, Malaysian Ministry of Agriculture, Malaysian Fisheries Society, ICLARM-The World Fish Centre, and Fisheries Development Authority of Malaysia.

The theme is *New dimensions and challenges in Asian fisheries in the 21st century*. Background information may be accessed through http://www.cgiar.org/iclarm/afs or www.navon.com/afs.

Asian Fisheries Society:
Working for Fisheries, Aquaculture, and the Environment

THE KAOHSIUNG DECLARATION

Adopted by the 6th General Assembly of the Asian Fisheries Society
Kaohsiung, Taiwan, 28 November 2001

The **Asian Fisheries Society** is an international, non-government professional body of 3,000 members from 75 countries and territories. Its purpose is to address fisheries issues, promote global cooperation, link fisheries scientists, sponsor and support young scientists, disseminate information through publications and scientific conferences. The Society is affiliated with several like-minded national and international fisheries societies.

This **Declaration of the Asian Fisheries Society** adopted by the Sixth General Assembly is hereby submitted to the Johannesburg World Summit on Sustainable Development, in view of the great importance of fish and other aquatic products to Asia and the rest of the world. Such importance was recognized at the Earth Summit in Rio de Janeiro in 1992 and Articles 17-18 of Agenda 21 provide for the development and management of fisheries and aquaculture in the context of the oceans and the freshwater environment.

The Asian Fisheries Society declares that:

The importance of fish, fisheries and aquaculture in the context of the natural and human environment should be reaffirmed at the Johannesburg Summit.

Fisheries and aquaculture should continue to be developed to their optimum sustainable levels so that they contribute to the food and nutritional security, livelihoods, economic growth, and improved living standards in Asia and the rest of the world.

Cooperation is needed at national, regional and international levels among sociopolitical and academic institutions and the fisheries and aquaculture sectors to achieve sustainable aquatic production, environment protection, and socioeconomic development.

National governments and the development assistance community should increase their commitments to the fisheries and aquaculture research and development so that they can meet the challenges of industry sustainability and globalization, and ecosystem protection and rehabilitation and contribute to welfare of poor in developing countries.

Background: Current realities in Asian fisheries and aquaculture

- Fish and fisheries products are the primary sources of animal protein in Asia and make a major contribution to the world's food supplies.
- Asia is the world's largest producer, consumer, and exporter of fish and fish products.
- Inland and marine capture fisheries and aquaculture are major contributors to the food security and livelihood of millions of Asians, and the economies of the Asian countries.
- Despite the large harvests from fisheries, the vast majority of Asians who depend on fisheries are mired in extreme poverty.
- Rapid population growth in Asia and elsewhere in the world increases the demand for fish and the pressure on fisheries resources.
- International trade and globalization place greater demands on Asian fisheries and aquaculture.
- The open-access commons nature of most capture fisheries has led to the degradation of many marine and freshwater ecosystems and the decline of fisheries stocks in Asia and around the world. A Code of Conduct for Responsible Fisheries has been formulated to protect ecosystems and ensure the sustainability of the fisheries industry.
- Aquaculture has long produced additional fish for a larger Asian population and is expected to increase its contribution to the global food supply. Some aquaculture practices have caused environmental problems, but public vigilance and a Code of Conduct for Responsible Aquaculture are expected to keep the industry environment-friendly and sustainable.
- Marine and freshwater ecosystems in Asia contain the greatest diversity of species in the world, but many species are now vulnerable or threatened with extinction due to overfishing, habitat destruction, and pollution.
- Enhanced capabilities in science and technology, resources management, and people empowerment are needed in all developing countries of Asia, to meet the challenges of fisheries and aquaculture sustainability, environment protection, and globalization.

Asian Fisheries Society: Action Plan for the Decade

1 Support research and development in fisheries, aquaculture, and the environment.
2 Bring greater awareness among national governments, multilateral financial institutions, and donor agencies the importance of fisheries and aquaculture and encourage them to increase their commitments to the sector.
3 Communicate scientific knowledge on the state of fisheries resources and help national and local governments and communities to implement effective management measures to sustain fisheries.
4 Disseminate scientific knowledge and appropriate technologies for sustainable development of aquaculture.
5 Disseminate and support the implementation of the provisions of the FAO Code of Conduct for Responsible Fisheries (and Aquaculture) and the recommendations of the International Commission on Dams for the integrated management of aquatic ecosystems and fisheries in river basins.
6 Facilitate the implementation of watershed and coastal resources development and management that integrates fisheries and aquaculture.
7 Help formulate and implement policies, regulations, and biosafety protocols that safeguard Asia's aquatic biodiversity, including endangered and threatened species and ecosystems.
8 Strengthen human resource development among fisheries and aquaculture professionals in Asia, and emphasize youth and gender representation in capacity building.
9 Enhance global and regional cooperation and advocacy on fisheries, aquaculture, and environmental issues through better use of existing networks among professional fisheries organizations.

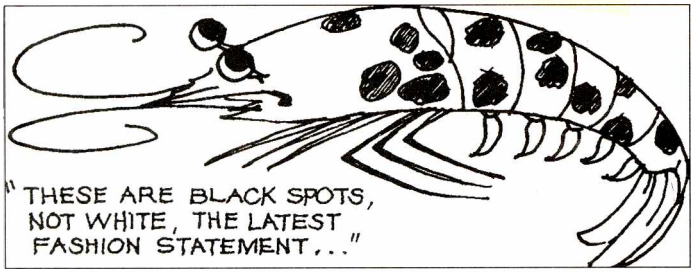
5th Symposium on Diseases in Asian Aquaculture (DAA 5)

25- 28 November 2002
Gold Coast International Hotel, Australia
Organized by Fish Health Section of the Asian Fisheries Society

http://afs-fhs.seafdec.org.ph

Two satellite workshops will follow symposium:
Epidemiology and risk assessment, 29-30 Nov
Asia-Pacific Regional Molluscan Health Management Training Program Phase II, 2-6 Dec

For further information about the workshops:
Dr. Chris Baldock, +61 7 3255 1712 (epidemiology)
Dr. Rob Allard, +61 7 3840 7723 (molluscan health)



DR. SUPRANEE CHINABUT / PAGE 8

mendations from the section would be solicited. I'm sure that when we announce our recommendations, people would listen. We can also use those recommendations as a starting point for the initiation of a law or regulation. Next year, we will hold our 5th *Diseases in Asian Aquaculture* conference in Australia around November 2002. Members of the society are not only Asian scientists, but also Europeans and American scientists who register to be members. Around 200 participants attended the previous one. Our activities are published in a newsletter, which is circulated two times every year.

Do you have a word of advice to aspiring young aquaculturists in Asia?

We have doors open for young scientists who pursue this career. There are many interesting things for them to explore and there is a very friendly atmosphere in fish health work. They won't feel lonely. We have lots of support from the senior and junior scientists who work in this area. We are like a friendly family. I encourage young scientists to get into this discipline. There are a lot of vacant spaces for them to do a lot more work in this field of aquatic animal health. It is an interesting subject. I have been in this career for over thirty years and I'm still very interested to look at it everyday. *[interview by m.b.s.]*

support sustainable aquaculture

PRICE INDEX / PAGE 10

age-sized milkfish in Manila is 65.90 pesos per kilogram, what could be the approximate price when you expect to harvest by September? Using the indexes on the previous table, we multiply the current month's price (65.90) with the price index at harvest month (0.915), then, divide by the current month's index (0.971). We get 62.10, an approximation of the wholesale price in Manila in September.

As a resource-conscious milkfish grower, we should strive for a low-cost production operation because the expected selling price at P62.10 is relatively low. Another option is to engage in low-input yet longer growing period and say for example, harvest in November where the wholesale price index in Manila is at least 0.933, a little higher than the September index. Meanwhile, the milkfish grower could at one time plan the stocking period and aim to harvest in January when the wholesale price index in Manila is 1.13. The grower may then invest even in high-cost yet short growing period production operations (such as supplementary feeding) because the expected price is high.

These indexes also give us the idea on the relative level of prices of milkfish between or among various locations (i.e. Iloilo vs. Dagupan) and across markets (wholesale vs. retail). Note that these indexes are not absolute answers to questions about price behavior, nor a tool for price forecasting. But these indicators are useful guides, especially when prices are the only short-interval time-series information available to motivated market researchers in developing countries. ###

DR. EINAR RINGO / PAGE 7

If you had a large sum of money and had access to all the expertise and technology, what kind of study would you like to undertake?
First I will put together a group of specialists from different countries and scientific backgrounds – it's most important, because I've been working in microbiology. I have worked with people who are specialists in chemistry, electron microscopy and fish behavior. We put these specialists together, and maybe also include people in immunology and physiology and answer for example, what should we do with the milkfish? Then we start — how does the fish behave in its natural system? How does the fish react in artificial rearing? Then we could ask the fish physiologist, how does this fish react to different kinds of feed? In lipid chemistry – what is the ultimate need for special fatty acids, lipids and so on? Electron microscopy – is there a difference between this species and other species? We discuss, prepare hypotheses and then we do our work. I don't think that as a microbiologist, I can solve the problem alone. We can solve it together with other specialists.

Are there any dangers that you see in the future?
The danger is that we might believe that we can solve the whole aquaculture (puzzle). I think that we couldn't solve all the problems.

How do you see aquaculture in the next one hundred years?
I see promise in it, but I also see some dangers. I don't know the problem areas in the Philippines but in Norway, the young generation doesn't eat fish. We have to convince the coming generations that fish is good for their health, and not to eat only junkfood such as hamburger and Coke. We have to find new alternatives to rear fish and to export high-quality products from one country to another. We should focus on fish as a healthy product.

People emphasize eating of coldwater fish because it's very high in HUFA, omega-3. But what about warmwater fishes?
There may be yet other components good for the health found in warmwater fishes. We should also look at the by-products of fish production (that may have impact) on the cosmetics industry, human medicine and so on. We should not only concentrate on the fish product but also on enzymes and bioactive compounds produced by the fish.

Parting words?
I think that the milkfish, your national fish, has enormous potential because it can grow very fast and it tastes delicious. You should export this fish to other countries.

We in Norway should learn how fish and fish products are preserved in Asia. Here you have one fish species and different products from it.

One of the most important (issues I've learned) was milkfish disease. (When we discuss that), we're only looking for trouble. It's the same as (discussions on) virus in the shrimp industry in Asia or coldwater vibriosis in Norway. We focus scientific interest on negative things, (when) we should focus on the positive. Is there something about the milkfish? Are there any diseases? Why? Does the fish produce something? We have to shift (our attention) from the negative. *I'm a simple person. I say,* let's also look at the good ones. It's the same when you hear about "microbiology," most (studies) focus on *Vibrio logei*, *Salmonella* or *Listeria* in food poisoning. There are a lot of bacteria out there in the sea or in the jungle, wherever, which are not the bad ones. Why don't we look to the good ones? This is the promise of aquaculture. Of course, we can do a lot of research on fish diseases, but we should also concentrate on the positive things...as in that song from the movie, "Life of Brian" (Dr. Ringo then lapses into singing) — Always look at the bright side of life. *[interview by n.j.d.]*

DR. TIMOTHY FLEGEL / PAGE 6

Would you recommend to shrimp farmers the purchase of shrimp disease diagnostic tools?
I think it might be difficult with the current state of the art – the kind of tools we use are too difficult for farmers – they will probably have to cooperate with government or private laboratories to help them.

For White Spot – the only reasonable tool at the moment for checking the post larvae is the PCR. It's expensive – (both) the treatment and the reagents, but I'd say in Thailand, to check one batch of PL... depending on who's doing it, (could cost) anywhere from 350 baht (baht and peso are about the same) to 700 baht. If you consider the PL themselves, they're already worth, maybe 30,000, so what is 700 baht? Nothing.

Some parting words?
The future of the aquaculture industry is very bright. It's a very good business for countries like the Philippines and Thailand because we have year round growing conditions, and it (gives) good income for the farmers. It doesn't have (to have) negative impact on the environment. Shrimp farmers (should) regard themselves as aquaculturists — not just shrimp farmers but farmers of any aquaculture species. *[interview by n.j.d.]*

Training, websites, EXTENSION MATERIALS

Year 2002
SEAFDEC/AQD TRAINING COURSES

Freshwater Aquaculture, *completed April 2 to 30*
Health Management in Aquaculture, *completed April 10 to May 14*
Crab Seed Production, *accepting participants to the second session, Sept 4 to Oct 3; first session completed May 2 to 31*
Marine Fish Hatchery, *ongoing May 28 to June 26*
Management of Sustainable Aquafarming Systems, *accepting applicants, July 2 to 31*
Mangrove Friendly Shrimp Aquaculture, *accepting applicants, July 9 to 29*
Responsible Aquaculture Development (Third Country Training Program funded by JICA), *by invitation, August 6 to October 4*

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Principles of Health Management in Aquaculture, *ongoing, April 29 to August 3*
Basic Principles of Aquaculture Nutrition, *accepting applicants, August 6 to December 3*

For application forms and further information, please contact
Tel/fax: **63 (33) 336 2891, 335 1008**
E-mail: **training@aqd.seafdec.org.ph**

For local applicants who wish to apply for fellowships, contact
Hon. Cesar Drilon, *SEAFDEC Council Director for the Philippines*
Office of the Undersecretary for Fisheries and Legislative Affairs
Department of Agriculture, Elliptical Road, 1104 Diliman, Quezon City
FAX: (02) 927 8405

For fellowship applicants from other countries, please contact your respective SEAFDEC Council Director

SEAFDEC websites on the internet

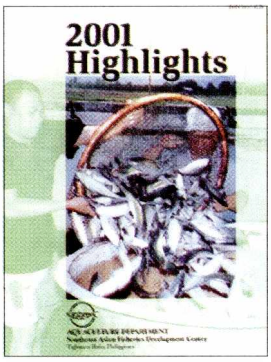
- **www.seafdec.org**
  about the SEAFDEC family; regional programs are highlighted
- **www.seafdec.org.ph**
  about the SEAFDEC Aquaculture Department based in the Philippines
- **www.mangroveweb.net**
  about the ASEAN-SEAFDEC mangrove-friendly shrimp culture project
- **www.agrolink.moa.my/dof/seafdec**
  about the SEAFDEC Marine Fishery Resources Development and Management based in Malaysia

New website!!!

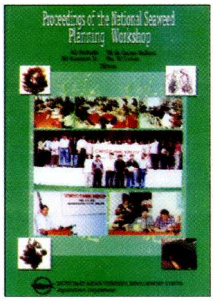
http://afs-fhs.seafdec.org.ph

Home of Fish Health Section of the Asian Fisheries Society whose Secretariat is presently hosted by AQD. The webpage is the official information clearing house for the forthcoming *5th Symposium on Diseases in Asian Aquaculture* to be held in Australia from November 25 to 28, 2002.

NEW!



Highlights 2001, 32-page report of SEAFDEC/AQD's priority programs and accomplishments in 2001

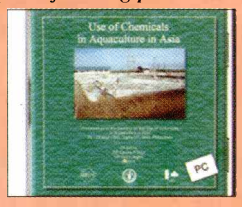


Proceedings of the (Philippine) National Seaweed Planning Workshop, 100 page volume on a conference held August 2-3, 2001. Edited by AQ Hurtado, NG Guanzon Jr, TR de Castro-Mallare, Ma RJ Luhan

CD-ROM format of these two books are now available!

Email: sales@aqd.seafdec.org.ph

Regional guidelines for responsible fisheries in Southeast Asia: Responsible aquaculture, prepared by the SEAFDEC Aquaculture Department, 94 p



Use of chemicals in aquaculture in Asia, edited by JR Arthur, CR Lavilla-Pitogo and RP Subasinghe, 235 p

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Grouper book now available in five languages

The fully illustrated, full color book entitled "Husbandry and health management of grouper" is now available in five languages – **Bahasa, Thai, Mandarin, Filipino** and, of course, the official **English** original version.

The Bahasa version was translated by the Gondol Fisheries Station and Research Institute for Coastal Fisheries, Department of Marine Affairs and Fisheries, Indonesia. For copies, inquire from Dr. Ketut Sugama at *crifidir@indosat.net.id* or *sugama@indosat.net.id*.

The Thai version was translated by the Aquatic Animal Health Research Institute of the Department of Fisheries, Thailand. Contact Dr. Suprance Chinabut at *aahri@fisheries.go.th*.

The Mandarin version was translated by the Tungkang Marine Laboratory - Taiwan Fisheries Research Institute. Email Dr. Huei Meei Su at *tmllib@mail.tfrin.gov.tw* or *hmsu@mail.tfin.gov.tw*.

The Filipino version was translated by SEAFDEC/AQD. Contact Dr Erlinda Cruz-Lacierda at *eclacier@aqd.seafdec.org.ph* or fax (63-33) 336 2891, 335 1009. The English version can be requested from AQD as well.

The book was prepared in 2001 by SEAFDEC/AQD for the Asia-Pacific Economic Cooperation (APEC) Fisheries Working Group FWG 01/2000. The project team writers were from AQD (Erlinda Cruz-Lacierda, Celia Lavilla, Joebert Toledo, Nelson Golez) and AJ Aqua Intercon Pty Ltd Australia (Nepheronia Jumalon-Ogburn).

The 94-page book, which is divided into seven sections, will help farmers improve production and reduce mortality, and thus utilize existing grouper seed resources more efficiently. The chapters are: (1) species of grouper farmed, (2) farm location and facilities, (3) culture systems; (4) sourcing grouper seed, (5) nursery and growout operations, (6) harvest and marketing of live fish, and (7) keeping the grouper healthy.

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AquaNutrition text

A textbook on aquaculture nutrition for fisheries students will soon be available from SEAFDEC/AQD. It will cover the essentials of fish nutrition, feed and feeding of tropical aquatic species, and the economics of feed management. The chapters are written by AQD researchers who have had more than 20 years of research and training- extension experience. Order the textbook from *sales@aqd.seafdec.org.ph/*

The Southeast Asian Fisheries Development Center (**SEAFDEC**) is a regional treaty organization established in December 1967 for the purpose of promoting fisheries development in Southeast Asia. Its Member Countries are Japan, Malaysia, the Philippines, Singapore, Thailand, Brunei Darussalam, the Socialist Republic of Viet Nam, Union of Myanmar, and Indonesia.

Four departments were established in the Member Countries; one of them, the Aquaculture Department (**AQD**) located in the Philippines, pursues aquaculture research and development

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Contributions

We accept articles that focus on issues, developments, and information on all phases of sustainable aquaculture for publication in this newsletter. Photographs and line drawings must be camera-ready, glossy B&W prints or colored slides. The newsletter editor reserves the right to edit contributed articles for brevity and style.

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Biotechnology wet laboratory breaks new ground

Philippine Senate President Drilon and Ambassador Ara shake hands over the biotech wet laboratory groundbreaking

The President of the Philippine Senate, Hon. Franklin Drilon, and Ambassador of Japan to the Philippines, His Excellency Yoshihisa Ara, were Guests of Honor during the cornerstone laying rites for a new laboratory at SEAFDEC/AQD on February 23.

The cornerstone laid will serve as foundation of the Enclosed Wet Laboratory, one of the five components of the Laboratory for Advanced Aquaculture Technologies or Biotechnology Laboratories. The Wet Laboratory will be the site for initial testing of new strains of aquaculture species and new vaccines. Studies on refinement of broodstock management, hatchery and nursery, and culture techniques will also be conducted there.

The establishment of the Biotech Laboratory was the result of the initiative of AQD and Department of Agriculture (DA) as a bilateral project between the Governments of Japan and the Philippines. It is funded by the Japanese Grant Aid for Fisheries.

The other components of the Laboratory include: Endocrinology and Genetics Laboratory, Feed Technology Laboratory, Algal Production Laboratory, and the Microbiology Laboratory. The biotech laboratories will enable AQD to develop advanced aquaculture technologies needed by DA to boost production of major fish species. AQD will conduct various research activities in coordination with the Bureau of Fisheries and Aquatic Resources (BFAR), results of which will be extended to the fishfarmers for adoption.

Among the guests at the cornerstone laying rites were: Undersecretary Cesar Drilon Jr, SEAFDEC Council Director for the Philippines; Undersecretary Rene Villa, Assistant to President Gloria Macapagal-Arroyo for Western Visayas; Mr. Eiji Ueno, First Secretary of the Embassy of Japan; Mr. Hiromichi Sakuma, Embassy of Japan; and several Philippine government executives.

In his welcome address, AQD Chief Dr. Rolando Platon thanked the Governments of Japan and the Philippines for the grant of the proposal in establishing the Biotech Laboratories.

Over a month after the formal groundbreaking ceremony, the construction of the wet laboratory has progressed to building lay-out, excavation, marking of access road elevation and soil grading/compaction. Taisei Corporation of Japan is the contractor with CRC Overseas Cooperation Inc as consultant. The construction period is expected to last through March 2003.

The wet laboratory has a total area of about 3,100 m^2 and a floor area of about 2,650 m^2

In turn, Ambassador Ara said he "hopes that the Biotech Lab would be a symbol of friendship between the Governments of Japan and the Philippines and would aid AQD in facing challenges in aquaculture such as increasing fish production in the region."

In response, Senate President Drilon expressed his gratitude to the Government of Japan for funding various infrastructure projects in Iloilo, AQD's host province, including the soon-to-be built International Airport and flood control facilities. He also urged Dr. Platon to continue focusing AQD's research efforts to directly generate practical applications and to continue intensifying efforts to extend packaged technologies that would benefit fishfarmers.