1996

Aqua Farm News Volume 14(4-5) July - October 1996

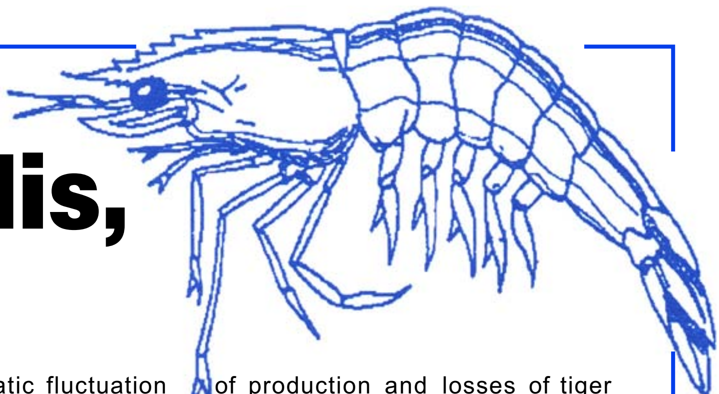
Aquaculture Department, Southeast Asian Fisheries Development Center

ISSN 0116-657

AQUA FARM NEWS

A publication of SEAFDEC Aquaculture Department, Tigbauan, Iloilo, Philippines

Vol. XIV Nos. 4 and 5 July-October 1996



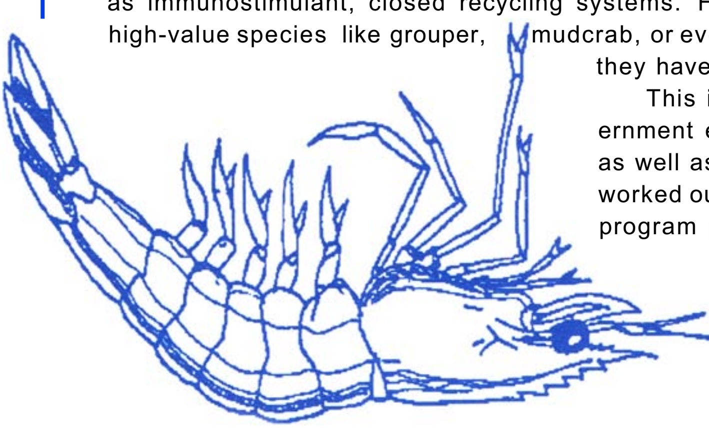
Quo vadis, shrimp?

Where to, tiger shrimp? The dramatic fluctuation of production and losses of tiger shrimp in the Asia-Pacific indicates an industry undergoing a boom-and-bust cycle. This is widely attributed to disease outbreaks linked to environmental deterioration, and questions about the industry's sustainability have been raised.

But in itself, shrimp culture is a very good business. Worldwide demand, for instance, has shown consistent growth of 2.5% per year which experts say can last well into the 21st century. In which case, there's no stopping profit-motivated farmers from going intensive as environmentalists fear. Shrimp farmers, however, can be convinced to totally change the way they run their farms, and to incorporate environment-friendly methods. Production losses from diseases brought about by deteriorating water quality may be reason enough. The industry needs to consider that shrimp farming is a part of a bigger ecosystem.

This issue presents the shrimp production trends in Asia-Pacific, along with notes on the diseases devastating the industry and interviews with shrimp farmers in the Philippines. The options of shrimp farmers -- which are really quite limited and largely experimental - are discussed. These options include probiotics, the use of beta-glucans as immunostimulant, closed recycling systems. Farmers may also opt to farm other high-value species like grouper, mudcrab, or even milkfish to make use of the ponds they have invested quite a lot on.

This issue also discusses Philippine government efforts to revive the shrimp industry, as well as AQD's R&D priorities for shrimp as worked out in various consultations with AQD's program partners and industry practitioners.



Production trends

FIGURES REPRESENT VARIANCE IN 1994 AND 1995 SHRIMP (HEAD-ON) PRODUCTION (FROM *ASIAN SHRIMP NEWS,* 4TH QTR 1995)

world cultured shrimp production (tons): 1993-1995

	1993	*1994*	*1995*	*variance '95/'94*
Thailand	209,000	250,000	270,000	+ 20,000
Ecuador	76,000	100,000	100,000	no change
Indonesia	100,000	100,000	80,000	- 20,000
China	30,000	35,000	70,000	+ 35,000
India	55,000	70,000	60,000	- 10,000
Vietnam	40,000	50,000	50,000	no change
Bangladesh	30,000	35,000	30,000	- 5,000
Taiwan	20,000	25,000	30,000	+ 5,000
Philippines	25,000	30,000	20,000	- 10,000
Mexico	9,000	12,000	12,000	no change
Others	45,000	51,000	40,000	- 11,000

In 1995, almost every shrimp producing country suffered from disease outbreaks which resulted in substantial mortalities. Thailand remained the undisputed leader for the fifth consecutive year (see map and table).

White spot disease outbreaks reduced Thailand's 1995 first quarter production by 9%. But subsequent quarters helped finish the year with an overall 8% growth over 1994.

On sustainability
Thailand, the world's biggest producer, requires farms with areas of 8 ha or more to construct a wastewater oxidation pond. This could be done by other countries as well.

Map by E. Ledesma

Thailand: lessons from the top producer

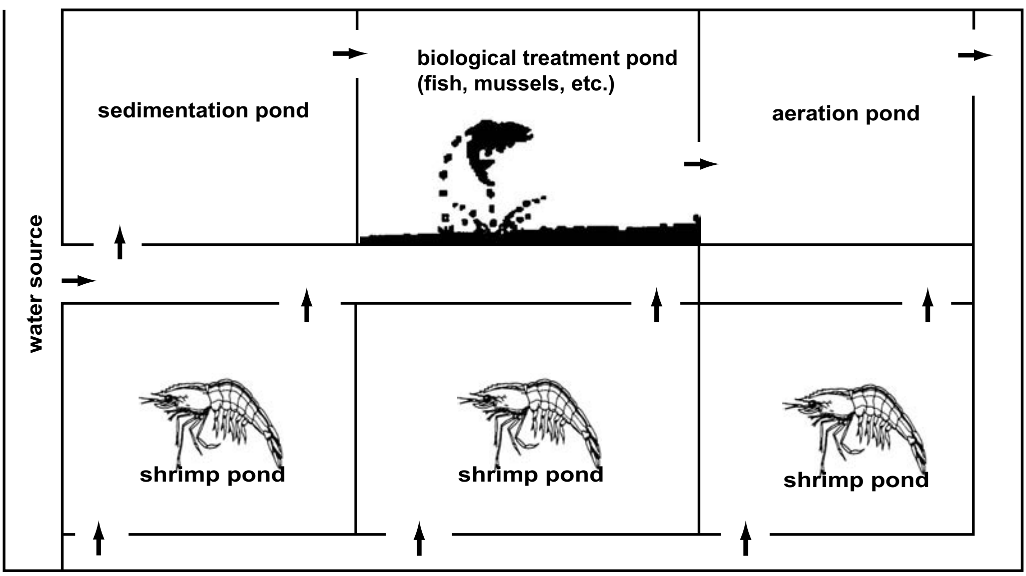
Thailand is favorable to shrimp culture because of climate (soil and water conditions), availability of wild broodstock, long traditional experience in aquaculture, seafood processing and trade, good infrastructure and transport, and locally produced equipment. Thailand has become the top producer of cultured shrimp by adopting the intensive culture system in 1991. During the disastrous 1993 shrimp crops in China and Indonesia, Thailand was able to increase its production to nearly 170,000 metric tons to make up for the shortfall in world supply. The sharp increase in shrimp prices in 1993, driven mainly by the high demand in the world market, spurred shrimp farmers to further boost their production. After lengthy experience, shrimp farmers have adapted culture techniques and feed formulations to their farm conditions. These techniques include the use of reservoirs for better waste management, utilization of undiluted seawater for culture, low-cost pumping systems, measures to neutralize acid sulfate soils, proper treatment of pond bottom, and solutions to disease problems. Thailand's improved technology has incorporated environment-friendly features based on previous experiences of farm pollu-

☞ *next page*

tion and diseases caused by mismanagement and wrong site selection. The Thai tradition and the long-standing government practice of seeding water resources with fish and shrimp fry on auspicious days have helped solve the shortage of broodstock in hatcheries. Efficient hatcheries and high production of small-scale grow-out farms enable the shrimp business to survive in an increasingly competitive environment. Most shrimp farmers prefer to develop ponds in non-tidal areas for several reasons: (1) to avoid the high costs of mangrove clearance and problems arising from peaty and acid sulfate soils; (2) to save on pond construction costs by the use of heavy machines; (3) to completely dry or remove the pond bottom layer; and (4) to use the land as collateral for bank loans.

Finally, the Thai government has issued several rules and regulations and established various projects to study or demonstrate practices compatible with environmental protection. One is the requirement for farms with areas exceeding 8 ha to construct a wastewater oxidation pond (see figure). Another is limiting effluent biochemical demand at 10 ppm.

Schematic of a water recycling system used for intensive shrimp culture in Thailand and Indonesia. The scheme is similar to a simplified version of domestic waste treatment, which includes sedimentation ponds, biological treatment - detritus and/or plankton feeding fish like mullet and milkfish and molluscs such as mussels and oysters -- and aeration. The treated water is stored in a reservoir pond and returned to shrimp grow-out ponds (Lin, 1995). An example of a closed water recycle farm is found on page 18, this issue.



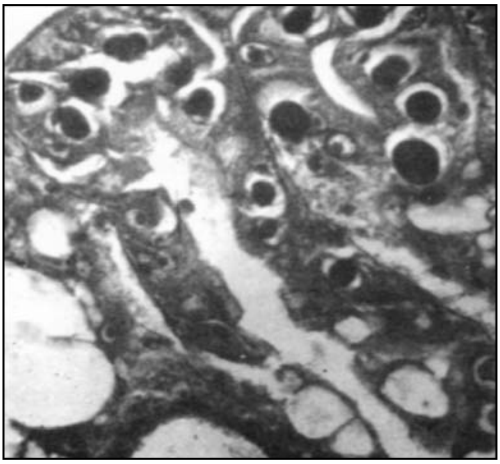
In the closed system, clean water during the highest tide is introduced into the grow-out ponds and the reservoir only once; at the beginning of the culture cycle. Water in the reservoir is gradually added to fill the grow-out pond until there is no water left. Later, the wastewater from the grow-out pond is gradually pumped back to this reservoir, which will now serve as sedimentation pond. Organic loads and silt will settle while living organisms such as phyto- and zooplankton will be consumed by fish and molluscs (the so-called biofilters) in the biotreatment pond. The clear surface water is allowed to overflow to an aeration pond or canal. This recycled water is pumped back into the grow-out pond.

Wastewater is pumped out of the grow-out ponds not on the first month but on the second and third months (about 20% every 3 days; increased to 30% on the final month). However, it is best to monitor ammonia and salinity levels in the grow-out ponds (not to exceed 0.1 ppm and 40 ppt, respectively). Water released to rivers or canals is disinfected by 300 kg per ha of chlorine.

SOURCES: (1) A year in review: 1995 shrimp production. *Asian Shrimp News* 4th qtr 1995, no. 4 published by the Asian Shrimp Culture Council. (2) C Kwei Lin. 1995. *Progression of Intensive marine shrimp culture In Thailand.* In: CL Browdy and J Stephen Hopkins, eds. **Swimming through troubled water**; Proceedings of the special session on shrimp farming. 1-4 February 1995, San Diego, California.

Pathogens after shrimp

A rogues' gallery of the industry's four most destructive adversaries



MBV occlusion bodies in the hepatopancreas of tiger shrimp postlarvae.

MBV, the monodon baculovirus

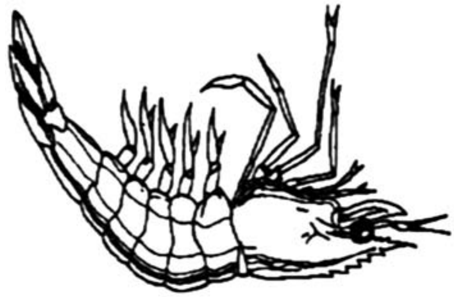
Shrimp stocks die gradually with MBV, and mortality of shrimp juveniles cultured in raceways and tanks can reach 70%.

MBV also affects postlarvae and adults.

MBV weakens shrimp by destroying the hepatopancreas and the lining of the digestive tract. Spherical occlusion viral bodies (picture above) may be found in the hepatopancreas The hepatopancreas appear yellowish-white.

HOW TO DETECT MBV Monitor shrimp health constantly. MBV-infected shrimp become pale bluish-gray to dark blue-black, have fouled exoskeleton, swim sluggishly, wont feed, and won't grow. Bring shrimp samples immediately to fish health laboratories to check the hepatopancreas for MBV occlusion bodies.

TREATMENT No treatment has been reported. But infected shrimp must be destroyed by burning or burying in pits lined with lime. MBV infection may be prevented from recurring (or occurring) by using MBV-free stocks, and reducing stress by using good husbandry practices and proper nutrition.



IHHNV, the infectious hypodermal and hematopoietic necrosis virus

More than 90% of shrimp juveniles in intensive culture systems can die because of IHHNV infection.

IHHNV also affects postlarvae and adults. Shrimp larval stages (zoea and mysis) are presumed to be latently infected.

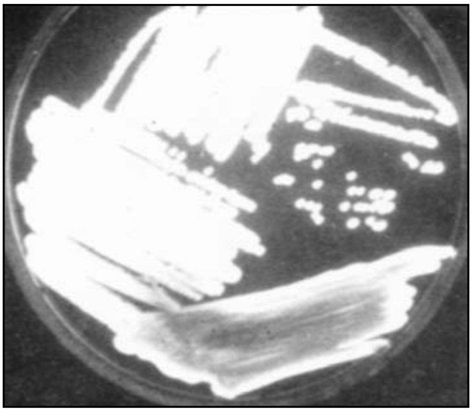
IHHNV destroys cuticle cells, bloodforming tissues, and connective tissues. Death of these tissues causes abnormal metabolism, and shrimp die.

HOW TO DETECT IHHNV Monitor shrimp health constantly. Suspect IHHNV if shrimp won't feed and if they swim erratically - its pleopods (or walking legs) and pereopods (or swimmerets) cease their motion; shrimp sink, right itself but remain weak. This is repeated until the shrimp die, usually within 4-12 hours.

TREATMENT No treatment has been reported. But if IHHNV is suspected, exposed shrimp must be destroyed and contaminated facilities or premises immediately disinfected. Farmers are advised to strictly follow quarantine procedures for all live and newly acquired shrimp.

IHHNV infection may be prevented by not introducing IHHNV-infected postlarvae, juvenile or adult shrimp into the shrimp farm.

☞



Pure culture of the luminous bacterium *Vibrio harveyi.*

Vibrio harveyi, the luminous bacterium

Luminous vibriosis can cause death to nearly 100% of shrimp stock in the hatchery. In ponds, severe mortalities can occur in the first 30 days of culture.

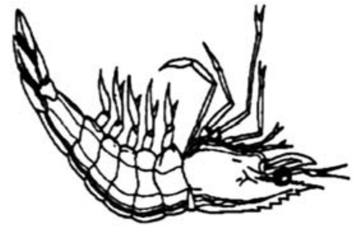
Vibrio harveyi also affects eggs.

Vibrio harveyi can be found densely packed in internal tissues of shrimp, destroying these tissues and killing shrimp.

HOW TO DETECT VIBRIOSIS Monitor fish health constantly. Shrimp have vibriosis if they become weak and opaque-white. Larvae and postlarvae appear luminescent if seen at night with the hatchery lights off.

In ponds, farmers can monitor the bacteria present in the water. (Farmers can send water samples regularly to fish health laboratories.) Usually, the bacterial profile or bacterial composition of pond water becomes altered (*V. harveyi* starts to dominate) 2-3 weeks after farmers change water. Once *V. harveyi* dominates, shrimp stocks start dying.

TREATMENT Farmers are advised to change water, about 80-90% daily to flush out bacteria. In hatcheries, luminous vibriosis may be prevented by chlorination, using UV-treated water or by employing a series of filters (sandfilters, filter bags, cartridge filters, 0.45 micron pore-sized microfilter). Farmers must avoid stressing shrimp by using good husbandry practices and proper nutrition. Vaccination and immunostimulation of larval shrimps by glucans, and probiotics for grow-out culture are suggested (see related articles, this issue).



WSBV, the white spot syndrome-associated baculovirus

WSBV was recently reported to devastate the Taiwanese shrimp industry. Outbreaks are characterized by obvious white spots on the carapace, appendages, and the inside surface of the body. In experimental infection trials, around 100% of shrimp can die within 5-7 days.

Researchers continue to study WSBV, its route of infection and what it can do to the shrimp.

Researchers suspect that infection is water-borne and/or transmitted orally. In one experiment, about 66% of healthy shrimp are infected within 12 hours if a diseased shrimp is placed in the same holding tank. At 48 hours, rate of infection is 100%. Researchers also found that 100% of healthy shrimp are infected within 24 hours if these ingest or eat diseased shrimp.

Researchers also noted cellular degradation and severe nuclear hypertrophy in skin tissues of diseased *Penaeus monodon* and *P. japonicus.* WSBV is non-occluded and rod-shaped.

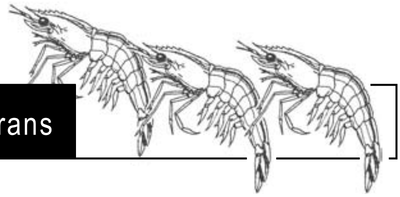
REFERENCES

MCL Baticados, ER Cruz-Lacierda, MC de la Cruz, RC Duremdez-Fernandez, RQ Gacutan, CR Lavilla-Pitogo, GD Lio-Po. 1990. *Diseases of Penaeid Shrimps in the Philippines.* SEAFDEC / AQD Extension Manual No. 16. Tigbauan. Iloilo.

CR Lavilla-Pitogo, EM Leaño, MG Paner. 1996. *Mortalities of pond-cultured juvenile shrimp, Penaeus monodon, associated with dominance of luminescent bacteria, Vibrio harveyi, in the rearing environment.* Book of Abstracts; Second International Conference on the Culture of Penaeid Prawns and Shrimps (SICCPPS); 14-17 May 1996; Iloilo City. SEAFDEC / AQD, Tigbauan, Iloilo.

HY Chou, C Huang, HG Kou, CF Lo. 1996. *Studies on transmission of white spot syndrome-associated baculovirus (WSBV) in Penaeus monodon and P. japonicus via waterborne contact and oral digestion.* Book of Abstracts/SICCPPS.

J Kasomchandra, S Boonyaratpalin, T Itami. 1996. *Microscopic observations and polymerase chain reaction detection of white spot syndrome in cultured penaeid shrimps in Asia,* Book of Abstracts/SICCPPS.



'Go slow, check your technology'

This is the most common advice shrimp culture veterans in Negros (west central Philippines) give other shrimp farmers in southeast Asia. The Negros entrepreneurs, always fond of monocrop culture, were hit hard with the tiger shrimp industry's boom-and-bust cycle that started in the mid-'80s. Four intensive shrimp farmers share their experiences and their outlook of the industry's future. It is not far off that these are the same experiences of farmers in other SE Asian countries that were also hit hard by disease outbreaks.

"We used to earn P1 million from a 0.4 ha pond. But with over-intensification, the use of antibiotics in particular, we have created our own monster..."

- *Claudette Jalandoni*

Claudette Jalandoni's family owns fishponds in Silay (27 hectares for shrimp-milkfish culture) and Sarabia (20 ha shrimp). "I had no experience in the field," Claudette relates with gusto, "but I finally made it in 1978 after three years of trial and error. (The giant conglomerate) San Miguel Corp. first convinced me to culture shrimp." She related how she was cheated by a fry dealer, giving her "butete" (pufferfish) instead of what she thought was sea bass. "From then on, I get up at 2:00 in the morning to attend to buying our fry even though we had 40 people in our employ," she says. "I find it important to have a 'personal touch' and hard work in order to know the ins and outs of shrimp culture."

Her Silay farm has since been converted to milkfish ponds with stocking density of 5,000 to 10,000 per ha and with artificial feeding. In Sarabia, half of the area is still shrimp and the rest devoted to an AQD collaborative project on mud crab pond culture and milkfish culture using hatchery-produced fry. "Our capital includes 1 ton of merthiolate," she jokes, "for wounds caused by the mud crabs' pinchers. We may feed poachers to thin crabs."

They used to stock 18-20 shrimp per m^2, and harvest around 6-7 tons per ha. Claudette felt lucky that she allowed her farm to lie fallow in 1989 when she went on a European trip. That year, practically all farms in Negros were hit by MBV, IHHNV, among others.

On shrimp diseases, Claudette blames Taiwanese technologies. "Overintensification resulted in pollution and eventually diseases," she says. This luminous bacteria is dreadful. Our world-renowned aquaculturists should gather and work together on this problem. Do you know the movie *The Andromeda Strain?* Why not this kind of research? Why not seek the help of US scientists?" *The Andromeda Strain* is a 1971 tense science-fiction thriller film based on a Michael Crichton (who wrote the world hit *Jurassic Park)* novel about a team of scientists attempting to isolate and find a cure for a deadly alien microbe.

Though not as comprehensive or focused, something similar is being done. The task force *Oplan Sagip-sugpo* (transl. as Save-the-Shrimp), was formed by the Department of Agriculture in September (see pages 30-31). The task force is headed by AQD Chief Dr. Rolando Platon. *"Sagip-sugpo* may be part of the answers to all our problems," Claudette says, profusely thanking AQD for taking the initiative. "AQD can help. We need someone to focus the efforts of (donor or funding) agencies."

For now, she's readying a 7-ha pond for AQD to field-test crab culture as an alternative to tiger shrimp. "I wanted to have natural practices (like crab culture), meaning I do not want to use

☞ *next page*

antibiotics anymore. We have created our own monster," Claudette notes, referring to possible strains of bacteria that scientists fear are already antibiotic-resistant. She also cited regulations that shrimp farmers have to consider. "We don't want antibiotic residues to show in tests in export markets like Japan. We are aware of withdrawal periods ... But disease problems forced my hand to use antibiotics."

Other than king crab, Claudette is also planning to polyculture shrimp and milkfish. "But milkfish is not as profitable as shrimp. We used to earn P1 million per pond [0.4 ha]. If the industry doesn't get help, *kanugon sa* industry (what a waste)!"

"We lost with the luminous bacteria. Something should be done."

- *Freddie Ang*

The Ang farm is about an hour ride from Bacolod City. Juanito Ang started shrimp farming in 1979, and the farm is managed by his brother Freddie, a marine biologist and a management graduate. "I haven't had any technical background on shrimp culture," Freddie says, "My only experience is breeding freshwater fishes in aquaria as a hobby."

"We'll go with shrimp no matter where the industry takes us," Freddie declares. "Shrimp is very profitable and we hope that something will be done soon to address the problems on diseases." But this belief has not prevented his family from planning to go into grouper or lobster culture, the commodities farmers call the shrimp alternatives (see pages 22-27).

Freddie notes the luminous bacteria in shrimp grow-out caused them to lose heavily in 1989. "We used to get 4.5 metric tons per pond, our pond averages 0.5 hectare, but we can harvest only 2.5 tons now."

Like other shrimp growers, Fred laments the sorry state of the industry. "Something needs to be done because we seem to be running out of strategies to combat the (luminous bacterial) disease. We have tried everything we were advised to do but to no avail."

Freddie, however, hasn't heard of *Oplan Sagip-sugpo* but says "I'm thankful to learn that the government is concerned about saving the industry. Of course, any help SEAFDEC can extend is welcome."

"I'm banking on changing species to 'eliminate' luminous bacteria, then go back to shrimp again. My advice is - go slow and check your technology."

- *Bobby Sanson*

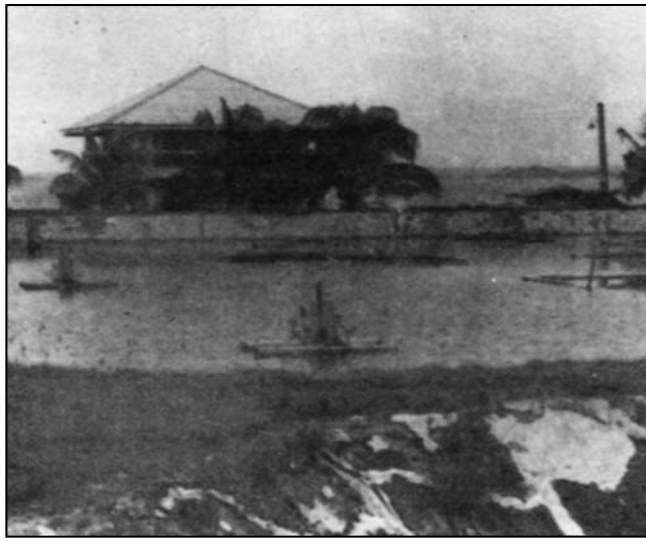
Bobby Sanson joined the Negros Prawn Producers Marketing Cooperative, Inc. in 1987 to avail of the government's tax credit for shrimp farmers and to get updated market information (more on NPPMCI on pages 28-29). He never regretted joining the 'Coop' and he never regretted going into shrimp culture. "We still make money," he says.

Bobby's family bought a 25-ha abandoned sugar farm near Bacolod City in 1986 and converted it to a shrimp farm. He now cultures shrimp (5 ha), grouper (1 ha) and milkfish (3 ha). "But I don't like milkfish. The profit is small and with our land tax, we can't earn anything." His farm is zoned residential-industrial, not agricultural.

Bobby used to stock 50 shrimp per m^2 but with the outbreak of luminous bacteria, he now stocks 25 per m^2. He used to harvest 5 tons per ha twice a year but with all the disease outbreaks, he was able to harvest only once a year. "The mid-1996 is our worst year," Bobby says. He uses brown sugar, about 10 kilos per 0.5 ha, to control the luminous bacteria (see related story on page 34). He also uses three kinds of antibiotics, alternating application and observing withdrawal periods. He is also waiting for the result of a product that is marketed as anti-residue for antibiotics by a US company.

"I'd rather go into other species like mudcrab than go semi-intensive on shrimp. But the next problem is fry supply. My advice to farmers is to go slow and check your technology," he says.

☞ *page 10*



AQD is collaborating *with the Negros Prawn Producers' Marketing Cooperative in Bacolod City (top right: Coop General Manager* ***Roy Balicas****) and with farmers in Iloilo on five projects: (1) documenting the use of probiotics to control luminous bacteria in ponds: (2) verifying grouper culture in brackishwater ponds; (3) verifying mudcrab and milkfish culture in brackishwater ponds; (4) evaluating the nursery and grow-out culture of hatchery-produced milkfish fry; and (5) documenting the nursery and grow-out culture of seabass in brackishwater ponds.*

NEGROS SHRIMP VETERANS
(top-down): Claudette Jalandoni, Freddie Ang, Bobby Sanson, Bob Gatuslao

"I'm banking on changing species to 'eliminate' luminous bacteria, then go back to shrimp again," he further explains. "With AQD, there is a better future for aquaculture in general, but maybe not for shrimp." But this outlook has not prevented Bobby from collaborating with AQD on field-testing probiotics (see page 12) to try to control luminous bacteria. Bobby also collaborates with AQD on grouper culture.

Bobby also worries about the future of shrimp in the country. "Processing plants are closing down and there might not be markets next year." He agreed with other Coop members that intensive farming methods did 'kill' the industry. He cited Sarabia where one river supplies water to about 300 hectares of shrimp farm. He wasn't surprised that the area was the first to go down.

"I actually prefer Iloilo entrepreneurs' slow but sure attitude. Negrenses are risktakers with a band wagon mentality. So, if one flops, all flop *...patas* (it's fair),' he says wryly. "Negros might become known as the province that killed the industry."

For Bobby who graduated from La Salle in 1990 (agribusiness management) and is raising a two-month old daughter, his stake in the industry is about survival. "Our lands are products of our efforts. We did not just inherit them. Thus, I'll be willing to pay for environmental clean-up, even 10% of my income," Bobby states.

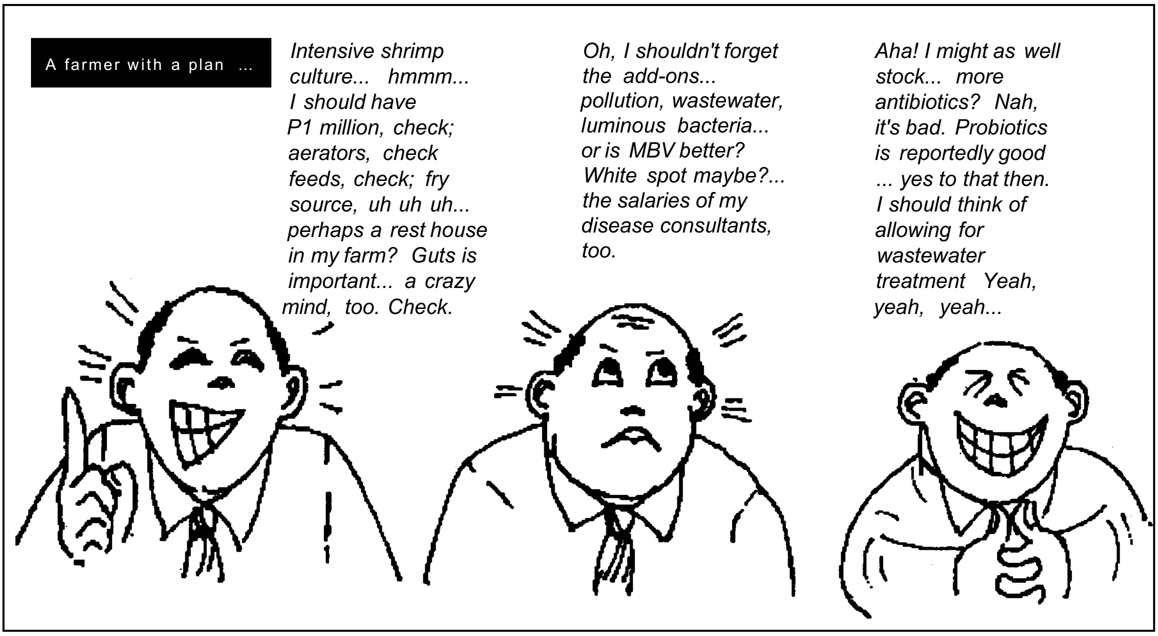
"I'm concerned about the lack of education of most fisherfolk on environmental issues, and the consequences of their actions."

- Coop President Bob Gatuslao

"I can now look forward to a bright future," comments Bob Gatuslao on AQD's involvement with the shrimp industry in Bacolod. "This is the first time we felt AQD's presence. It is indeed a very welcome move of Dr. Platon in taking the initiative to save the industry."

Bob is a member of a shrimp growers' cooperative in Negros (more on pages 28-29). A civil engineer by profession, Bob is also a lawmaker by heart. He was a national legislator for eight years and is still active in politics. He has a daughter and two sons.

"I shifted to shrimp farming only after the collapse of the sugar industry, but with diseases plaguing the industry, we seem to be facing another collapse. But the shrimp



A farmer with a plan ...

industry is not dead. It's only dormant," he insisted, " and I hope this state is temporary. The shrimp growers in Negros are very willing to cooperate with the experts to save it."

Bob offered to the Department of Agriculture his 110-hectare shrimp ponds for collaborative studies. AQD is also using his ponds for a study evaluating the nursery and grow-out of milkfish from hatchery-produced fry. "I am anticipating good results." But Bob worries about the commodities dubbed shrimp alternatives. "While shifting to milkfish farming may be good for the farmer, there's the problem on fry supply. But if AQD can go big-scale in milkfish hatcheries, we can have a steady and inexpensive supply of fry. Two months ago, the fry was only P0.60 a piece but it's now P0.80. In Taiwan, it's only P0.30. Feed costs P13 a kilo here but only P9 in Taiwan. We really need to have a very strong, concerted effort to help the industry deal with all its problems."

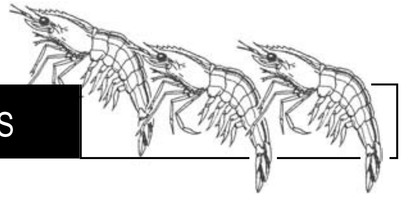
"I believe so much in AQD because I know a lot of shrimp growers in other countries were trained by AQD," Bob says. "The industry's slump in the late '80s due to overintensification has taught us a good lesson. My colleagues in the industry are now slowing down on antibiotics. If we follow the recommendations and advice of experts then I think the industry will regain its lost glory."

Upon the advice of the Department of Environment and Natural Resources, Bob initiated a barangay project in Himamaylan (south of Bacolod City) to plant 30,000 seedlings of mangroves along a river bank. "Mangroves," he said, "is necessary to protect river banks. But I am concerned about the lack of education of most fisherfolk on environmental issues, and the consequences of their actions." Bob supports the creation of a Department of Fisheries that can address the issues of sustainability and profitability of the industry. "Looks like the industry has been neglected for a long time," he says.

FROM INTERVIEWS OF ***E. Aldon, J. Carreon-Lagoc,*** AND ***M. Castaños*** IN BACOLOD CITY; PHOTOGRAPHS BY ***E. Gasataya***

NOTE

Prawn is the common name the industry in the Philippines uses for the tiger shrimp *Penaeus monodon*. **Prawn** and **tiger shrimp** are used interchangeably in this issue.



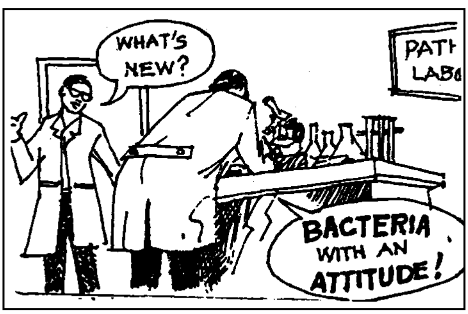
option 1 PROBIOTICS

Using bacteria to fight bacteria

Experience has shown that intensive shrimp aquaculture often results in good yields for a few years, but is usually followed by a collapse due to viral and bacterial diseases (especially caused by the *Vibrio* species).

Following medical and veterinary practices, farmers initially respond by using antibiotics or antimicrobial chemicals in large doses. But antibiotics exacerbate the disease problem, and its use in aquaculture is doomed to failure (see related article, pages 14-15).

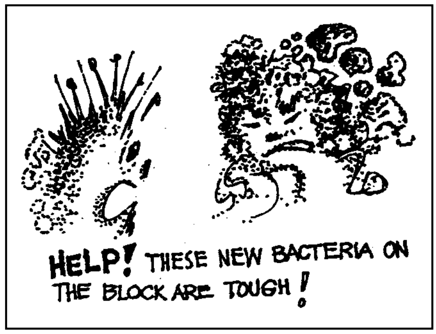
Instead, the use of beneficial bacteria to "fight" pathogenic bacteria (by competitive exclusion, see box next page) is an accepted practice in agriculture, being seen as a better remedy than antibiotics. It is slowly gaining acceptance in aquaculture.



What are probiotics?

Probiotics are single or mixed culture of live microorganisms (selected strains of bacteria, among others) that when applied to culture systems benefit the farmed stock by improving the indigenous microflora. The probiotic bacteria modify the microbial composition of the water and sediment; increase species diversity; and minimize the effect of, if not eliminate, pathogens directly.

Probiotic bacteria also enter the gut (ingested with food) or attach to external surfaces of farmed stock. In aquaculture, these are used as feed supplements and water conditioners.



How do probiotics work?

In natural aquatic ecosystems, bacterial growth and biomass are controlled mainly by the rate at which large compounds or polymers (such as protein or starch) are broken into small units. These particles are present in ponds as dead algae, uneaten food, and feces. Bacteria that are efficient at breaking down polymers would have a selective advantage and hence, dominate, provided that other conditions are not limiting (dissolved oxygen, pH, and essential nutrients like phosphate). Gram-positive bacteria (the *Bacillus* in particular) are among the most efficient in breaking down polymers. However, these are not normally present in high proportions in the water column; their natural habitat is the sediment.

When certain *Bacillus* strains are added to the water sufficiently, they can make an impact. They compete with the bacterial flora naturally present for the available organic matter (leached or excess feeds and shrimp feces). The result is less accumulation of slime or organic matter on the pond bottom, better penetration of oxygen into the sediment, and a better environment for farmed stock in general. And because shrimp are not stressed, its natural resistance can fight off diseases. Pathogens can not invade and can not proliferate.

Competitive exclusion is one of the ecological process that can be manipulated to modify the species composition of a soil or water body or other microbial environment. Species composition of a microbial community in a pond is determined by chance and by factors that allow a particular species to grow and divide more rapidly than others. Chance favors those organisms that happen to be in the right place at the right time to respond to a sudden increase in nutrients (e.g., from the decomposition of feed pellets that fall around them).

Shrimp farmers can manipulate species composition by seeding large numbers of desirable strains of bacteria or algae. In intensive culture, farmers often can not afford to wait for natural processes to readjust and deal with new conditions. Bioremediation and the use of probiotics are significant management tools, but their efficacy depends on the correct number of bacterial strains, viability of bacterial strains, and correct application procedures.

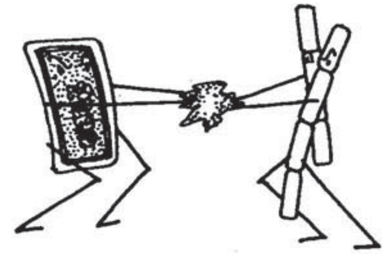
Probiotic field tests

AQD HELD TEST. AQD fish health consultant Rogelio Gacutan is spearheading the field-test of three types of commercially available probiotics in eight ponds in west Negros. These probiotics are made up of selected strains of bacteria, fungi and yeasts which can rapidly convert solid sediments into simpler and utilizable substances.

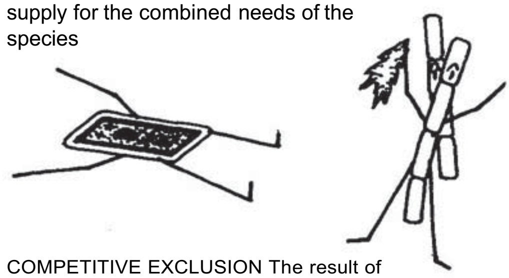
The jury is still out, so-to-speak. The results are not yet conclusive. The researchers suspect that the actual composition of these probiotics must be known first before they can understand what is happening in the ponds and ad-vise farmers.

BIOPOND SYSTEMS FIELD TEST. Dr. DJW Moriarty, an honorary associate professor of the University of Queensland (Australia) discussed the value of adding selected strains of *Bacillus* as probiotic bacteria to control luminescent vibriosis in ponds. He compared farms in Indonesia that use the same water source which contained luminous vibrio strains.

The farm that did not use the *Bacillus* cultures experienced almost complete failure in all ponds, with luminescent vibriosis killing shrimp before 80 days of culture was reached. In contrast, a farm using the probiotics was able to grow shrimp for over 160 days without problems.



COMPETITION In ecology, the use of the same resource by two or more species, when the resource is present in insufficient supply for the combined needs of the species



COMPETITIVE EXCLUSION The result of competition between species for a limiting resource in which one species completely eliminates the other

Around 1×10^4 to 1×10^5 cells per ml of *Bacillus* was used.

The bacterial species composition was different in the pond water on the two farms, demonstrating that it is possible to change bacterial species composition and improve shrimp production in large water bodies. The number of vibrios, especially *Vibrio harveyi,* was low in ponds where a large number of specially selected *Bacillus* species was maintained in the water column. Vibrio count was also low in sediment and no luminous vibriosis outbreak occurred in sediments where the probiotic *Bacillus* was used.

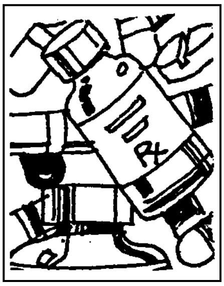
What are *Bacillus?*

Knowing more about *Bacillus,* possibly the main component of effective probiotics, might be helpful in understanding probiotics. There are many *Bacillus,* around 15 species have been identified. Microbiologists have long catalogued their general characteristics:

- *Bacillus* can easily move around (motile) because they have a whip-like "tail" (flagella)
- *Bacillus* form endospores which are useful

☞ *page 17, 2nd column*

The trouble with antibiotics and pesticides is...



"...that their indiscriminate use can cause mortalities of cultured stock, morphological deformities, and development of antibiotic-resistant bacterial strains," say fish health experts at AQD.

In the Philippines alone, more than **100** chemical products are used by fish farmers for prophylaxis and treatment. "These include disinfectants, soil and water conditioners, pesticides, antimicrobials, plankton growth promoters, organic matter decomposers, and feed supplements," notes Dr. Erlinda Lacierda, a fish disease expert at AQD who conducted a nationwide survey on chemical use in aquaculture.

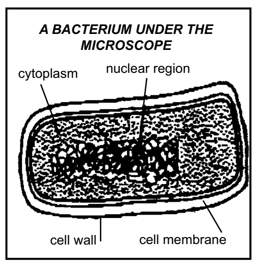
Although chemicals pose potential hazards to humans like other chemical residues in the food industry, aquaculture experts who gathered for the [1]*Meeting on the Use of Chemicals in Aquaculture in Asia* last summer at AQD have agreed that the risks are not excessive. Many chemicals are essentially harmless when applied properly but indiscriminate use can give huge problems.

The meeting also highlighted the effects of chemical use on other cultured stocks in the farm, the immediate environment through discharges and effluents, surrounding areas (especially where other farms operate), farm staff (like toxicity, allergy), consumers (through residues in harvested shrimp and fish) and drug resistance of microorganisms.

Representatives of the public sector (governments, R&D centers including AQD) and the private sector (farmers and suppliers-traders of chemicals) who attended the meeting have also identified, and agreed to, solutions they can adopt to mitigate the adverse effects of chemical use. The public sector will create a research and information network and test alternatives to chemicals with potentially harmful effects on health, the environment and workers. Industry representatives agreed to self-regulation and cooperation with the private sector in seeking more environment-friendly culture methods.

These are solutions for the aquaculture industry not only in the Philippines but also for countries represented in the meeting such as Bangladesh, Cambodia, China, India, Indonesia, Japan, Laos, Malaysia, Pakistan, Singapore, Taiwan, Thailand, and Viet Nam.

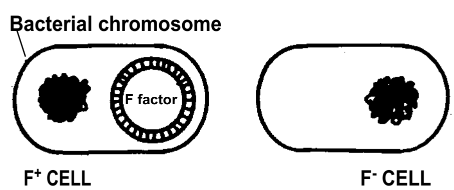
[1]The meeting on chemical use was organized by AQD and the FAO Fisheries Resource Division in cooperation with the Network of Aquaculture Centres in Asia and the Pacific, the Japan International Research Center tor Agricultural Sciences, and the Taiwan Fisheries Research Institute. SEAFDEC, FAO and CIDA funded the meeting.



A closer look at the bacterial world...

The development of antibiotic-resistant bacterial strains is just one of the results of indiscriminate use of antibiotics. Farmers have asked: how will this happen? by what process?

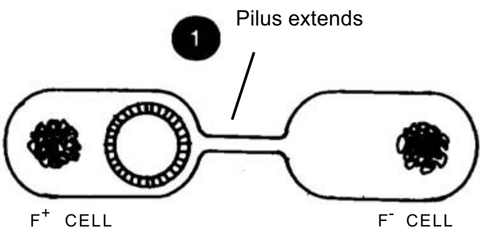
This will happen when bacteria reproduce by conjugation. Microbiologists define bacterial conjugation or mating as the process of genetic transfer that involves cell-to-cell contact. Let's take a look at bacterial conjugation.



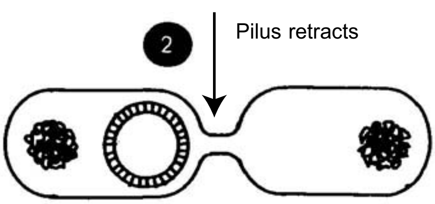
We may think of the F^+ cell (on the left) as the first bacterium that has developed antibiotic resistance on its own by surviving, say, a farm that has indiscriminately used antibiotic products. F^+ encodes antibiotic resistance onto its genes, and pass this on to a non-resistant F^- bacterium (on the right) during conjugation.

Microbiologists note that the pairing of F$^+$ and F$^-$ is specific. Donor cells (like F$^+$) must have conjugative plasmids (the circular *F factor* above) which possess the genetic information to code for sex pili (see below) and for some proteins needed for DNA transfer. Although recipient cells (like F$^-$) lack sex pili, they have receptors on their surface, as pair formation for conjugation generally occurs only between strains of bacteria that are closely related.

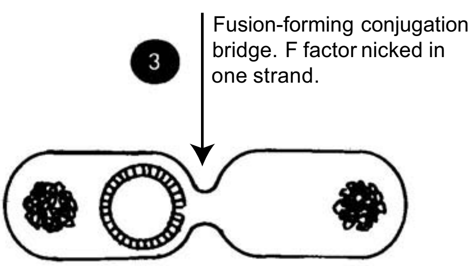
Conjugation is quite rapid. [Bacteria, in general, can reproduce in 30 minutes.] During conjugation, F$^+$ first extends a "bridge" (sex pilus):

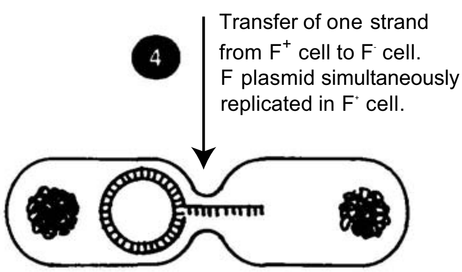


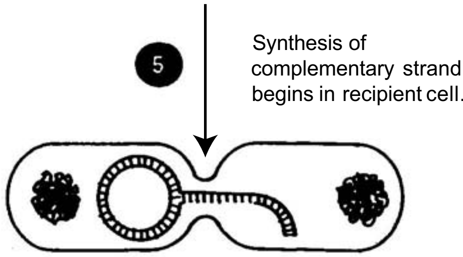
Then this "bridge" or pilus retracts:

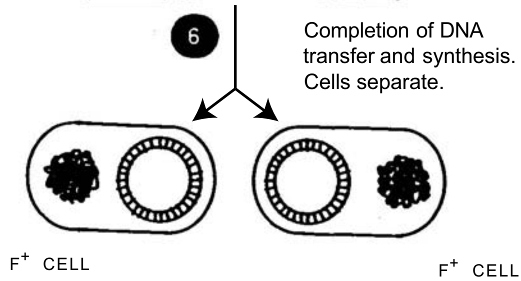


After which, microbiologists think, the cell membranes of F$^+$ and F$^-$ fuse in some way, triggering DNA transfer.









When DNA transfer and synthesis is complete, F$^+$ and the previously F$^-$ separate. F$^-$ is now an antibiotic-resistant P.

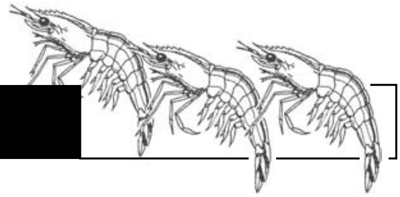
Microbiologists note that this process is highly efficient because under appropriate conditions, virtually every recipient cell which pairs can acquire a plasmid. If the plasmid genes can be expressed in the recipient, the recipient itself then soon becomes a donor and can then transfer the plasmid to other recipients. In this fashion, conjugative plasmids can spread rapidly between populations, behaving like infectious agents. It may therefore take only one F$^+$ bacterium to create a whole colony of antibiotic resistant bacteria.

Microbiologists warn that the infectious nature of bacterial conjugation is of major ecological significance. Bacterial genes that confer selective advantage (or an "ace" up a bacterial "sleeve") can easily allow a whole population to survive and reproduce.

Microbiologists also note that widespread occurrence of infectious drug resistance in clinical medicine has already led to some serious problems in the chemotherapy of infectious diseases.

REFERENCE

TD Brock and MT Madigan. 1991. **Biology of Microorganisms**. Prentice-Hall International Edition. p. 261-262.



Glucans and disease resistance

Crustaceans have both cellular and humoral defense systems. Hemocytes, phagocytes, nodulation and encapsulation are part of the former. Phenoloxidase, pro-phenoloxidase activating system, bactericidin, and lectins are part of the latter.

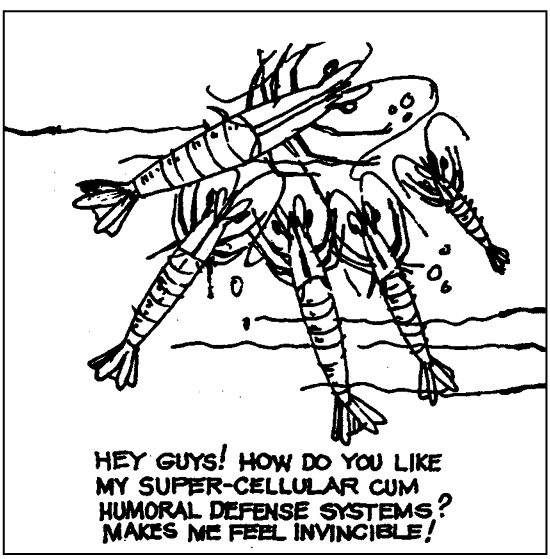
These defense factors "cooperate" together to provide a defense barrier against invading pathogens. They normally construct an elaborate network, and can be damaged when the organism is stressed under culture conditions (high stocking density, environmental pollution).

Beta-glucans (like insoluble beta-1,3 and 1,6-linkage polyglucose) have been successfully used as immunostimulants for strengthening non-specific defense systems of a wide range of animals. Beta-glucans are the most important structural elements of cell walls of fungi.

In mice, glucans enhance non-specific antimicrobial activity as well as anti-cancer mechanisms. In fish, beta-glucans activate cytotoxic macrophages, lymphocytes, natural killer cells, complement-mediated hemolytic activity, and the complement system through the alternative pathway. In addition, beta-glucans strengthen the non-specific disease resistance of salmon. Long-term administration of peptiglycan may enhance the disease resistance and growth of juvenile rainbow trout.

In crustaceans, glucans activate hemolymph clotting in the horseshoe crab and activate the prophenoloxidase system, causing increases in such activations as phagocytosis and encapsulation, both of which are associated and protective reactions in crayfish.

Based on previous studies involving crustaceans, the protection provided by glucans is possibly due, in part, to its activation of the prophenoloxidase (proPO) system. The proPO system represents the terminal component of a complex cascade of enzymes which function in non-self recognition and host defense; these mechanisms include bactericidal activity and phagocytosis. The proPO system is present in the blood of a wide range of marine invertebrates, especially crustaceans.



Testing a beta-glucan

Researchers from the National Taiwan University tested the effects of beta-glucans on the vibriosis resistance of tiger shrimp *Penaeus monodon.* They immersed 30-day old hatchery-produced shrimp postlarvae (at 100 shrimp per liter) in aerated beta-glucan suspensions for 3 hours. The beta-glucan used was insoluble beta-1,3 and 1,6-linkage polysaccharide that was extracted from the cell walls of the fungus *Saccharomyces cerevisiae.* The glucan concentrations tested were 0.25, 0.5, 1.0 and 2.0 mg per ml of pond water. Control shrimp were immersed in glucan-free pond water.

Following immersion, shrimp were kept in aerated pond water and fed commercial feed three times per day. Around 15-20 shrimp samples were collected and challenged with viable *Vibrio vulnificus* via water-borne infection at 10, 18, and 43 days following beta-glucan treatment. The shrimp were immersed for 12 hours in either 600 or 800 ml of bacterial suspension at a concentration of 5×10^7 colony-forming units per ml.

The researchers noted that shrimp immersed in 0.5, 1.0 and 2 mg per ml beta-glucan suspension grew faster than the 0.25 mg per ml suspension or the control. But gill tissue became noticeably shrunken immediately following immersion in 2 mg per ml; this concentration is hyperosmotic to shrimp.

The researchers also noted these results:

percent mortality of tiger shrimp exposed to *Vibrio* after immersion in beta-glucan

Beta-glucan	Days of challenge following treatment		
	10 (n=15)	18 (n=20)	43 (n=15)
2.0 mg/ml	55.6%	50	86.7
1.0	0*	30	80
0.5	0*	20*	93.3
0.25	41.7	50	86.7
control	54.5	60	73.3

n is number of shrimp used in each experiment.
*significantly different from the control group (α=0.05).

Glucan concentrations ranging 0.5-1.0 mg/ml were able to protect shrimp from *Vibrio* up to 18 days following immersion.

Better growth may have been the result of disease resistance of shrimp. This situation, the researchers noted, is in some degree similar to antibiotic-enhanced poultry feed. But higher levels of peptiglycans (one type of beta-glucans) are not feasible because of adverse effects.

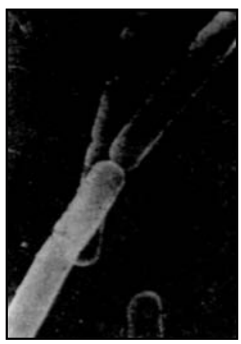
After considering cost and labor, the researchers suggest that supplementation of beta-glucan at 0.5 mg per ml is sufficient in strengthening the non-specific defense mechanism of postlarval shrimp. Beta-glucan may have to be administered continuously. Hatchery-reared juvenile shrimp are particularly susceptible to microbial infections and consequently, high mortality rates. Thus, the addition of a single immunostimulant may provide added insurance against disease outbreaks by strengthening non-specific immunity.

Other than the challenge test, the researchers also examined *in vitro* the phenoloxidase (PO) activity of shrimp hemocytes to clarify the mechanism of the defense system enhanced by the beta-glucan. Their results indicated that the beta-glucan enhances pro-PO system in shrimp hemocytes.

Other researchers noted that beta-glucans can enhance bactericidal activity, oxygen production of macrophages, and serum lysozyme activity. Beta-glucans can also increase phagocytic activity of hemocytes. In general, beta-glucans may act as fundamental elicitor of host defense mechanisms in shrimp.

REFERENCES

Y Takahashi, T Itami and *M* Kondo. 1995. *Immunodefense system of Crustacea.* **Fish Pathology** 30 (2): 141-150.
HH Sung, GH Kou and YL Song. 1994. *Vibriosis resistance induced by glucan treatment in tiger shrimp (Penaeus monodon).* **Fish Pathology** 29 (1): 11-17.



PROBIOTICS/*Bacillus* - FROM PAGE 13

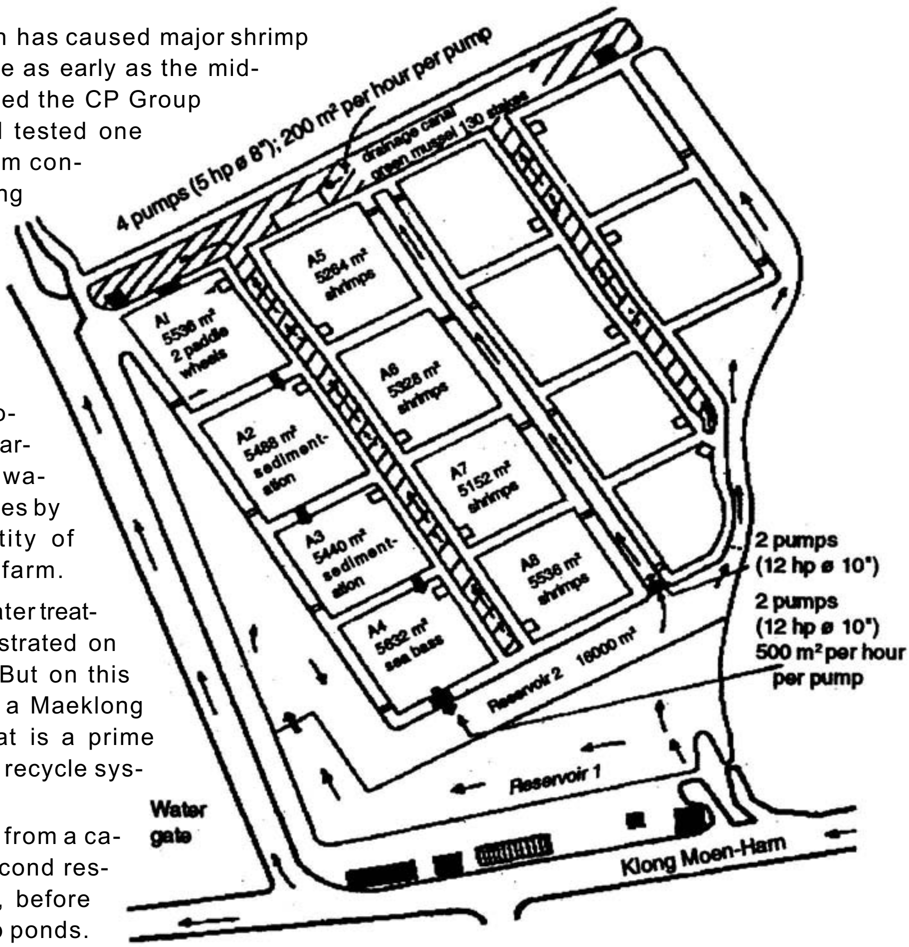
under stressful conditions (or when nutrients are limited). Endospores allow *Bacillus* to reproduce when conditions are favorable.

- *Bacillus* produce antibiotics, of which bacitracin, polymyxin, tyrocodin, gramicidin, and circulin are examples
- *Bacillus* produce special compounds (enzymes) that can break down polysaccharides (sugars), nucleic acids, and lipids
- *Bacillus* cells measure around 0.8 μm in diameter
- *Bacillus* are easily transformable (free DNA is easily incorporated to change its genetic

☞ page 27

Integrating effluent management

In Thailand, pollution has caused major shrimp culture areas to close as early as the mid-'80s. A company called the CP Group has put forward and tested one solution in actual farm conditions - recirculating systems -- that integrates effluent management. The closed recycle system can reduce risks from heavy metals, pesticides, ammonia, and other toxic particles coming in with water from natural sources by reducing the quantity of water brought to the farm.



A generalized water treatment scheme is illustrated on page 4, this issue. But on this page is the layout of a Maeklong farm in Thailand that is a prime example of a closed recycle system.

Water is pumped from a canal to the first and second reservoirs, respectively, before entering the 4 shrimp ponds. After that, water is drained out through an outlet where small green mussels are reared to the first water treatment pond (A1) where a paddle wheel is running continuously. The second and third treatment ponds (A2 and A3) are sedimentation ponds. The sea bass pond (A4) is last, and water is treated before being pumped to the sec ond reservoir for reuse.

Water first pumped from the canal should be aerated and freshwater added everyday until its salinity is lowered from 28 ppt to 20 ppt and the water color is stable. Shrimp larvae may be stocked at 30 per m^2. Superphosphate fertilizer may be applied at 1 ppm (1 gram per ton of water) every three days until the phosphate value is higher than 0.1 ppm. It is better to use pelleted feed, not fresh feed.

Sea bass can be stocked at 2.6 per m^2, and fed twice daily with pelleted feed. Green mussel are cultured in water outlets to reduce suspended solids. For a farm area of 1,500 m^2, about 150 stakes may be used, each stake contains 4.2 kg of green mussel.

The tables on page 19 note the production data and water quality parameters of the ponds illustrated above.

Water quality in the closed recycle system, Maeklong farm

Pond:	Shrimp	Green mussel	Aeration (A1)	Sedimentation (A2)	Sedimentation (A3)	Fish	Reservoir (R2)
pH	8.37	8.49	8.58	8.66	8.69	8.56	8.36
Sal.	20	21	21	21	21	21	20
Tnsp.	28	28	32	34	35	32	34
Temp.	28.5	30.2	29.7	29.9	29.8	28.8	28.8
DO	5.7	8.7	8.9	9.8	9.8	7.5	6.4
NH_3-N	0.11	0.07	0.03	0.04	0.03	0.4	0.2
NO_3-N	0.08	0.01	0.06	0.07	0.06	0.07	0.07
PO_4	0.14	0.14	0.11	0.12	0.12	0.14	59.2
TSS	87.5	66.1	65.2	52.3	60.3	61.5	26.3
COD	24.3	23.6	24.0	23.7	23.6	23.9	4.0
BOD	-	4.1	4.9	4.5	4.5	5.3	4.4
SiO_2	3.11	3.15	2.79	2.8	2.67	2.76	64.44
Chl-A	137.07	110.69	103.72	88.33	70.95	100.23	-

Sal., salinity in ppt; Tnsp., transparency in cm; Temp., temperature in °C; DO, dissolved oxygen in ppm; NH_3-N, ammonia-nitrogen in ppm; NO_3-N, nitrite-nitrogen in ppm; PO_4, ortho-phosphate in ppm; TSS, total suspended solids in ppm; COD, chemical oxygen demand in ppm; BOD, biological oxygen demand in ppm; SiO_2, silica in ppm; Chl-A, chlorophyll-A or amount of plankton in ppm.

Shrimp production in a closed recycle system

Pond	Production kg/rai	Ave. body weight (per pc)	Growth per day	Survival
A5-shrimp	1,265	39.5 g	0.30 g	66%
A6	1,353	32.8	0.26	85
A7	1,434	32.1	0.25	93
A8	1,239	32.0	0.26	80
A4-bass	1,006	408.7	4.08	57

Shrimp was harvested after 125-130 days.

SOURCE

The Recycle System for Shrimp Culture, **Asian Shrimp News**, 4th quarter, 1991.

Further readings

Recirculation-Aeration: Bibliography for Aquaculture *by PW Perschbacher, RV Powell, DW Freeman, WJ Lorio and DT Hanfman. 1993. Published by the National Agricultural Library of the United States Department of Agriculture. 78 pages.*

The book contains literature citations through 1992, and focuses on filtration, aeration, and circulation techniques in various aquaculture systems. It includes water quality, organics removal, invertebrate and algal culture systems, diseases and sterilization, and economics. References on partial recycled systems utilizing wastewater treatment processes, and relevant sanitary engineering are also included.

Contact:

Aquaculture Information Center
National Agricultural Library
10301 Baltimore Boulevard
Beltsville, MD 20705-2351 USA

The Center requests a self-addressed gummed label with the request.

Another source farmers can tap for pond dynamics studies or literature is:

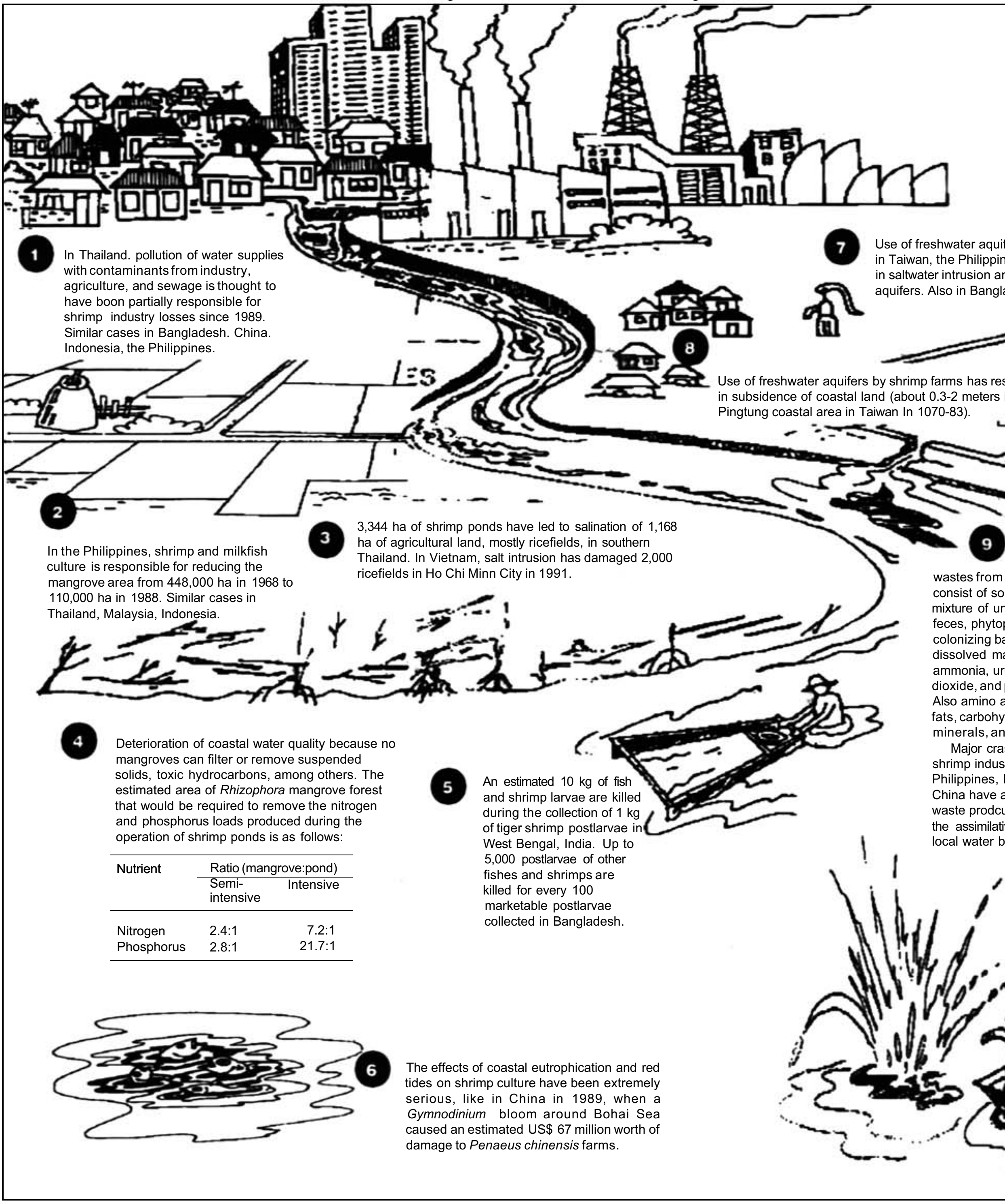
Pond Dynamics/Aquaculture Collaborative Research Support Program
Oregon State University
400 Snell Hall
Corvallis, OR 97331-1641 USA

CRSP is one of the family of international agricultural research programs headquartered at US land grant universities. Their research help farmers improve incomes and alleviate hunger without depleting the natural resource base on which people depend on for food, fuel, fiber and shelter.

CRSP published reports on acid sulfate soil in fishponds, water quality dynamics, among others. They also publish a newsletter available in paper and electronic formats. Interested readers can view the CRSP home page at <http://www.orst.edu/Dept/crsp/edops/edop.html>

Shrimps are part of a larger ec

natural resources -- land, water, and biological resources including seed and feed.   Below are t



1 In Thailand. pollution of water supplies with contaminants from industry, agriculture, and sewage is thought to have boon partially responsible for shrimp industry losses since 1989. Similar cases in Bangladesh. China. Indonesia, the Philippines.

2 In the Philippines, shrimp and milkfish culture is responsible for reducing the mangrove area from 448,000 ha in 1968 to 110,000 ha in 1988. Similar cases in Thailand, Malaysia, Indonesia.

3 3,344 ha of shrimp ponds have led to salination of 1,168 ha of agricultural land, mostly ricefields, in southern Thailand. In Vietnam, salt intrusion has damaged 2,000 ricefields in Ho Chi Minn City in 1991.

4 Deterioration of coastal water quality because no mangroves can filter or remove suspended solids, toxic hydrocarbons, among others. The estimated area of *Rhizophora* mangrove forest that would be required to remove the nitrogen and phosphorus loads produced during the operation of shrimp ponds is as follows:

Nutrient	Ratio (mangrove:pond)	
	Semi-intensive	Intensive
Nitrogen	2.4:1	7.2:1
Phosphorus	2.8:1	21.7:1

5 An estimated 10 kg of fish and shrimp larvae are killed during the collection of 1 kg of tiger shrimp postlarvae in West Bengal, India. Up to 5,000 postlarvae of other fishes and shrimps are killed for every 100 marketable postlarvae collected in Bangladesh.

6 The effects of coastal eutrophication and red tides on shrimp culture have been extremely serious, like in China in 1989, when a *Gymnodinium* bloom around Bohai Sea caused an estimated US$ 67 million worth of damage to *Penaeus chinensis* farms.

7 Use of freshwater aquif
in Taiwan, the Philippin
in saltwater intrusion ar
aquifers. Also in Bangla

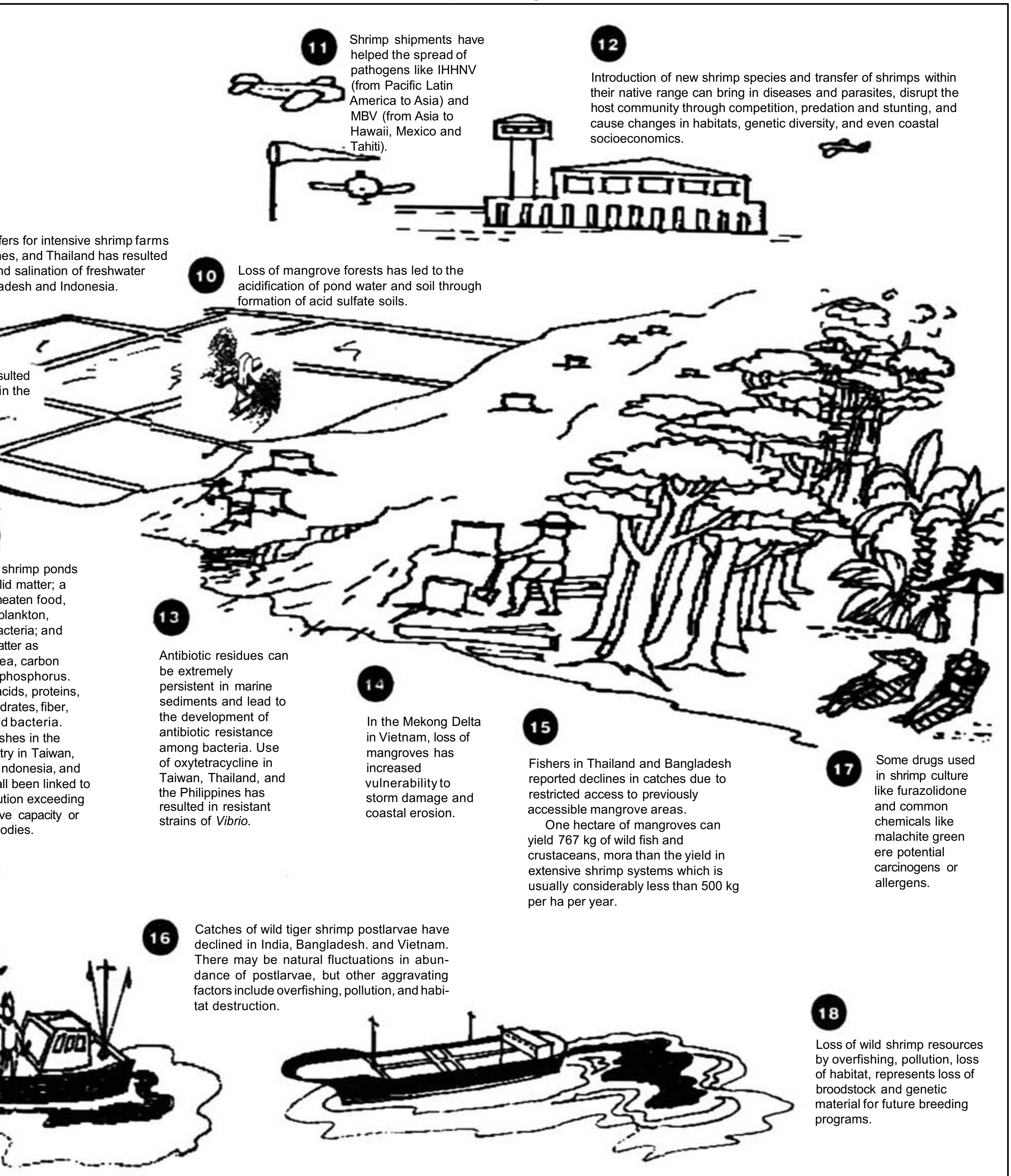
8 Use of freshwater aquifers by shrimp farms has res
in subsidence of coastal land (about 0.3-2 meters i
Pingtung coastal area in Taiwan In 1070-83).

9 wastes from
consist of so
mixture of ur
feces, phyto
colonizing ba
dissolved ma
ammonia, ur
dioxide, and
Also amino a
fats, carbohy
minerals, an
Major cra
shrimp indus
Philippines, I
China have a
waste prodcu
the assimilati
local water b

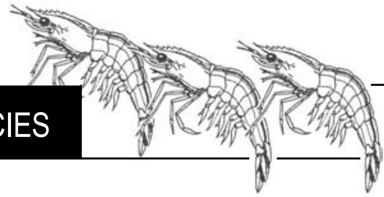
CONCEPT M. Castaños SKETCH A Surtida / E Ledesma REFERENCE MJ Philipps. 1994. *Shrimp culture and the environment.* In: TU Bagarinao and EEC Flores (eds). Towards sustainable aquacult

cosystem. Shrimp farming, like all other agriculture enterprises, requires

the documented interactions between shrimp farming and the natural environment.

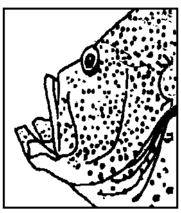


ure in southeast Asia and Japan. SEAFDEC Aquaculture Department, Iloilo, Philippines.



Grouper, mudcrab and company

Shrimp farmers can opt to culture other high-value commodities while R&D institutions struggle to develop sustainable methods. Three such commodities include grouper, mudcrab, and sea bass. Shrimp farmers can even explore milkfish culture or perhaps shrimp-seaweed and shrimp-mollusc polyculture but the latter two are still ongoing studies at AQD. Five aquaculturists share their experiences in raising what are now called shrimp alternatives.



Grouper culture

Elmer Blasurca[1] of Roxas City (west central Philippines) is a successful grouper farmer. "Grouper species popular and farmed in the Philippines include brown-spotted grouper, black-spotted grouper, red grouper and the *señorita* or panther fish," Elmer reported. "Although grouper can be cultured in cages and in ponds, we Capiz farmers like cage culture better." Capiz grouper cage farms are mostly centered in Brgy. Basiao (Ivisan) and Brgy. Cagay (Roxas City). Grouper ponds are not many. "Pond culture is still in its infancy," noted Elmer.

The major constraint grouper farmers identified is shortage and uncertain supply of fingerlings from the wild. Capiz farmers, Elmer noted, have searched for fingerlings even up to Cagayan in the north to Dadiangas in the south. The provinces that are major fingerling sources include Cavite, Mindoro, Quezon, Masbate, Bulacan, Cagayan and Dadiangas.

AQD has undertaken studies in breeding captive grouper, and so does BFAR, the Bureau of Fisheries and Aquatic Resources of the Department of Agriculture. "But sad to say," Elmer assessed, "hatchery techniques are still very experimental. But I'm thankful that AQD, the pioneer research center in Asia, is now on-the-go, (having instituted a technology verification program), and can now answer the major constraints in aquaculture." Elmer listed these constraints as follows:

- inadequate knowledge of biology and ecology
- lack of appropriate techniques for culture
- lack of trained personnel
- inadequate support from financing institutions

"Grouper culture in ponds is considered 'piggy bank' savings because farmers can get a minimum of 90% return-on-investment," Elmer noted, "It is capital-intensive considering the high price of seed. Extra large sizes cost P60 a piece but culture period is shorter. If farmers are renting the pond, it is better to stock bigger than 1-inch fingerlings." (See table next page.)

In general, the technology developed for tiger shrimp can be applied to grouper pond culture. So, abandoned shrimp ponds can be used. These ponds must have at least one meter in depth, good water quality (including salinity of 15-32 ppt), and can admit or drain water easily. Unlike shrimp and milkfish, grouper do not appear to go with the current when the ponds are drained.

To grow grouper, ponds are prepared using traditional methods (repair of dikes, canal and gates; levelling pond bottom; eradication of predators and competitors using tea seed powder applied at 100-125 kg per ha). Tilapia, the essential natural live food for grouper, is grown two months in advance in a separate pond.

Fry are first acclimated before stocking. This is better done early morning or late afternoon when it is cool," Elmer reported, "and avoid stocking when it is raining." Stocking density is 2,000 fingerling per ha. The target average body weight upon harvest is 450-700 grams which can be attained after 10-12 months. There can only

[1] Contact address: Doña Elena St., San Joss Village, Tisa, Roxas City.

be one run a year.

Grouper are fed live tilapia fingerlings; trash fish is a good supplemental feed. "It is better to give trash fish during high tide so that water change could be made easily," Elmer advised, "in case pollution occurs due to excess feeds. Also, remove and take out excess or unconsumed feeds." Feeding is at least 10% of fish body weight. Trash fish are usually placed in feeding trays near sheltered areas. "If feed is consumed within an hour, adjust feeding rate," Elmer advised.

To maintain good water quality, water change should be frequently made. Dissolved oxygen should be kept at no less than 3 ppm; water should be relatively clear and free from pollutants. Grouper stocks are graded monthly to prevent cannibalism. "Enough and regular supply of tilapia and trash fish can also minimize cannibalism," Elmer reported.

Grouper are harvested live to attain maximum profit. Survival is pegged at 85%. Farmers may opt to harvest earlier if majority of the stock weigh 500-700 grams. Buyers sometimes advise farmers not to feed two days prior to harvest for easier transport (fish excreta wont pollute transport water). Crushed ice may be placed inside the transport bags to keep the temperature down. Survival rate in transport tanks should be 95-100%.

Mudcrab culture (with milkfish)

The feasibility of raising mudcrab in ponds in combination with milkfish has been demonstrated by AQD way back in the 1980s, noted Dan Baliao the Special Assistant to the AQD Chief for Technology Verification. Mudcrab-milkfish polyculture has also been successful in Dumangas (Iloilo) and Buenavista (Guimaras).

Mudcrab is probably one of the most edible and widely sought crustaceans that inhabit tidal rivers and creeks in Asia and the Indo-Pacific. This "food of the Gods" used to be a nuisance species in ponds, but there is a strong indication that mudcrab culture in ponds along with milkfish is a lucrative industry.

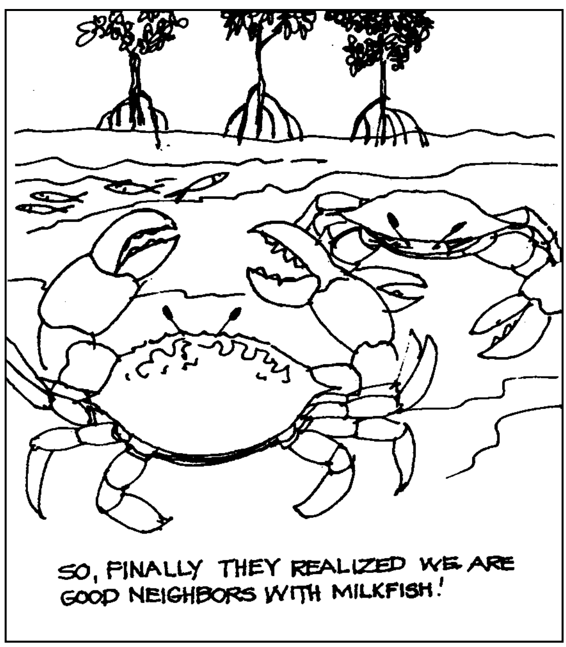
Mudcrab eat trash fish, small crabs, animal entrails, filamentous algae, and detritus. Milkfish subsist on natural food (*lab-lab,* plankton, *lumut*). They do not strictly occupy the same niche, and are thus good partners in polyculture.

Dan reported that a typical brackishwater pond designed for milkfish or shrimp can be used for farming mudcrab. Sites should have good water quality year-round, and seawater can advance and fill ponds to 60 cm during high tide.

Dan noted that mudcrab juveniles measuring 10-40 grams or 5-20 cm carapace breadth

Cost-and-returns of grouper culture in a 1-hectare pond (estimated by E. Blascura)

Expenses	
1 -inch fingerings at P10 (2,000 pieces)	P20,000
trash fish [about P30 worth of trash fish are eaten by each grouper × 1,800 grouper (90% survival)]	54,000
labor (1 feeder at P1,500 a month × 12 mos.)	18,000
contingencies (P500 per mo. × 12 mos.)	6,000
Total investment	**P98,000**
Gross revenue (1,800 pcs × 500 g = 900 kg at P260/kg)	234,000
Net profit before tax	136,000
Less: income tax	46,700
Net profit after tax	**P88,400**
Return-on-investment	90%
Payback period	1.11 years



are available throughout the year, more during the months of May to September. Mudcrab can be collected from some areas in Iloilo, Capiz, Aldan, Negros, Camarines Norte, Bicol, Bataan, Lanao, Zamboanga and Misamis. Mudcrab for fattening (5-10 pieces to a kilo) can be bought from local markets. AQD is also conducting studies on producing mudcrab in the hatchery.

Milkfish fingerlings or juveniles on the other hand may be bought from other farmers. There is no useful distinction between wild-caught and hatchery-produced fingerlings.

"Mudcrab compartments should range in size from 0.25 to 1 hectare with independent supply-drain canals," Dan advised. "Provide earthen mounds that crab can use as breathing spots in times of low oxygen. About 12 mounds per ha measuring 5 m^3 will suffice. Align these in series at the middle of the compartment." However, farmers using concrete shrimp ponds can use wooden or bamboo platforms.

"Also provide shelter or refuge areas," Dan added, "like sawed-off bamboos (50cm long with 15 cm diameter opening at both ends) or hollow blocks (3 pieces of 10.2 x 20 x 41 cm). Place these strategically; around 100-200 shelters per ha will do."

To prevent the crabs from escaping, farmers can use a *banata* screen (bamboo slats woven 1-cm apart with monofilament). The *banata* is driven 50-70 cm into the base of the dike. It also extends about 30 cm from the waterline, with bamboo overhang or plastic sheets (70-cm wide) on top. *Banata* screens are not needed in concrete ponds.

"The plankton or deep water method of growing natural food can ensure more croppings in mudcrab-milkfish polyculture," Dan reported. "It also shortens the time for pond preparation and increase the carrying capacity because of greater water volume." Plankton can support 500-600 kg per ha incremental weight gain of milkfish for a 90-day culture.

Mudcrab juveniles may be stocked at 5,000 juveniles per ha; 10-15 g milkfish juveniles at 2,000-2,500 per ha.

"It is essential to maintain good water quality favorable to both mudcrab and milkfish," Dan noted. "They grow faster at 23-32°C and <40 ppt. Maintain water visibility between 15 to 40 cm. Change 1/3 of the pond water during spring tides. An irrigation pump may become necessary. Inspect your ponds for leaks."

Mudcrab are fed finely chopped trash fish, animal entrails or hides twice a day every other day at 10% of initial body weight. Feeds are adjusted as the culture progresses. For milkfish, fertilizer dressing (1 bag of 16-20-0 or 1/2 bag of 18-46-0) can be applied every 15 days or when water becomes clear.

To harvest, partially drain ponds during low tide and admit water at high tide. Mudcrab and milkfish swim against the current and they can be caught by scoop net as they congregate in a catching gadget installed near the pond gate. The remaining crab and fish are handpicked after totally draining the pond. If farmers wish to harvest mudcrab alone, they can use baited hand lines.

The yield is about 600 kg per ha per crop mudcrab of sizes 150-200 grams and 600 kg per ha per crop of milkfish. Three crops are possible in a year. Below is the cost-and-return analysis.

Cost-and-returns of mudcrab-milkfish polyculture in a 1-ha pond; 3 crops a year
(estimated by D. Baliao)

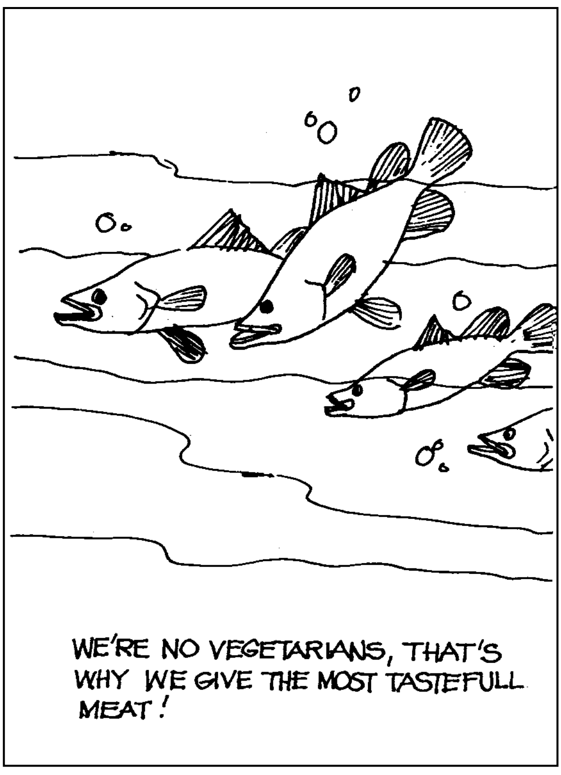
Expenses	
crab juveniles (P6 each × 15,000 pcs)	P 90,000
milkfish fingerlings (P1.50 × 7,500 pcs)	11,250
trash fish (P5 × 3,780 kg)	18,900
fertilizer (P200 × 18 bags)	3,600
caretaker's salary	36,000
laborer (to install fence, 15 days)	1,650
repair and maintenance	3,000
transport, freight	5,000
tools	2,000
bamboo poles (P50 × 50 pcs)	2,500
banata (P60 × 150 pcs)	9,000
Total investment	**P 182,900**
Gross revenue	
mudcrab (1,800 kg × P180)	324,000
milkfish (1,800 kg × P50)	90,000
Total revenue	414,000
Net profit before tax	231,100
Less: income tax (35%)	80,885
Net profit after tax	**P 150,215**
Return-on-investment	82%
Payback period	1.22 years

Sea bass farming

Sea bass *(bulgan* or *apahap)* are highly valued for its tasty, white, and consistent flesh especially in restaurants. Because of this economic potential, AQD conducted research on breeding captive sea bass and produced seeds from the hatchery as early as the 1980s. However, grow-out culture was not actively pursued.

"But the fundamentals of sea bass farming is closely similar to other fishfarming practices," reported Joebert Toledo, an Associate Scientist from AQD. "Sea bass can be grown in netcages and in ponds in two phases, the nursery and the grow-out."

The nursery phase grows the fry (~1 cm) to fingerling stage (5-10 cm) for grow-out culture. "Nursery ponds are usually small, not more than 2,000 m^2, with 1-m water depth," Joebert explained. "Fertilizers are added to maintain good phytoplankton growth and to allow copepods, which feed on plankton, to grow and multiply." Copepods are part of the sea bass diet in nurseries; if the ponds do not hold enough of these, additional copepods and other zooplanktons are collected from fish or shrimp ponds. Farmers can use a lamp to attract copepods at night which can be scooped out by a net. Farmers can also place netbags facing the current generated by paddlewheels to collect copepods in shrimp ponds.



Sea bass are stocked in nurseries at 30-50 fry per m^2 in unaerated ponds or 100-200 per m^2 in aerated ponds. After 2-3 weeks, fry may grow to 4-6 cm. To prevent cannibalism, farmers may harvest the fry as soon as the copepod becomes depleted. With enough food, survival may exceed 70%.

From nurseries, sea bass fingerlings can be moved to grow-out ponds. "These ponds usually have a soft substrate, vary in size from 0.2 ha to several hectares, and with 1-m water depth," Joebert noted. "Abandoned shrimp farms are ideal. Pond preparation follows the traditional method; to enrich substrate, chicken manure is broadcast at 500 kg per ha."

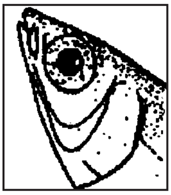
Sea bass may be grown alone or in combination with tilapia to save on feeds. For monoculture, stocking density is as low as 5,000 to as high as 40,000 fingerlings per ha. Feeding with trash fish or pellets is initially done to satiation at least once in the morning and once in the afternoon. As sea bass reach 100 grams, feeding can be reduced once daily. "Sea bass come to the surface to feed," Joebert noted, "and feeds that sink to the bottom are usually not eaten. Farmers, however, should take care to maintain water transparency of not less than 30 cm."

After 4-6 months, sea bass may be harvested. Survival can be >80%, and total yield as much as 2.5 tons for properly managed ponds.

"For polyculture with tilapia, tilapia are stocked at 5,000-10,000 fry per ha 2-3 months before stocking sea bass fingerlings," Joebert explained. "Tilapia are allowed to reproduce in the pond so that sea bass can have more live food. Farmers can stock 1 male tilapia for every 3 females."

Farmers must take care not to stress their stock too much. White spot, fin or tail rot, and other ulcers can develop from injuries during handling and stress.

"Prevalence of diseases increases as the culture system increases in intensity," Joebert noted. "Fishfarmers should manage fish health and water quality as an integral part of their overall production strategy." ☞



Milkfish farming*

AQD scientist Renato Agbayani noted that productivity of milkfish ponds has increased from 500 kg per ha in the 70s to about 2,000 kg per ha today through the adoption of better farm technology. He estimated the cost of producing milkfish using semi-intensive methods in converted shrimp ponds and in new ponds. He also looked at the economics of the extensive and modular milkfish farming systems.

We featured **milkfish culture in our November-December 1995 issue. -Ed.*

"Shrimp farmers can get the highest revenue in a year if they use the semi-intensive system," Rene reported. This is because of good production (1,159 kg of milkfish per run times 2.5 runs a year). However, farmers should note that the variable cost is also the highest because of the need for commercial feeds and the additional labor to do the feeding. And for new ponds, fixed cost is the highest because of the capital outlay for deepening the pond and the purchase of new water pumps for efficient water management. Of course, this is not a problem for converted shrimp ponds."

Comparative costs-and-returns of extensive, modular and semi-intensive milkfish production systems; 1-ha farm (estimated by R. Agbayani)

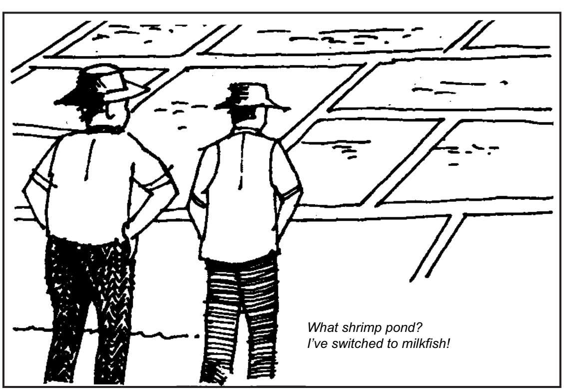
	Extensive	Modular	Semi-intensive[1]	
			New ponds	Converted shrimp
Revenue[2]	**P 68,125**	**94,200**	**144,875**	**144,875**
Less: variable costs[3]	23,790	39,328	99,091	99,091
fixed costs[4]	17,724	19,632	32,560	13,260
Total cost	**P 41,514**	**58,960**	**131,651**	**112,351**
Operating income	30,211	39,740	45,784	45,784
Net income before tax	26,611	35,240	13,224	32,524
Return on investment	71.5%	83.3%	13%	75.2%
Return on working capital	154.4%	203.5%	25.6%	75.2%
Payback period (years)	1.23	1.06	4.57	1.25

[1]Stocking rate at 7,000 fingerlings per ha; production at 1,150 kg per ha per run; 2.5 runs per year

[2] Prices in early 1996 in Iloilo

[3]Includes cost of pond preparation, seedstock, feeds, labor, among others

[4]Includes depreciation, repairs and maintenance, among others



Rene also projected a five-year cash flow for shrimp farmers using semi-intensive methods (table next page). He uses a discount rate of 15% which represents the weighted average inflation (7-10%) and interest rates (20%). "More than a decade ago, feasibility studies on intensive shrimp farming used low discount rates of about 10% which led to very attractive or very profitable levels for tiger shrimp," Rene noted.

Discounted 5-year cash flow of semi-intensive milkfish production in newly renovated ponds at 15% discount rate; per hectare (estimated by R. Agbayani)

Year	Revenue	Cost	Net cash flow	Discount factor	Discounted revenue	Discounted cost	Discounted net cash flow
0	0	50,000	(50,000)	1.00	0	50,000	(50,000)
1	144,875	122,651	22,224	0.87	125,983	106,657	19,326
2	156,465	132,463	24,002	0.76	118,303	100,155	18,148
3	168,982	143,060	25,922	0.66	111,106	94,062	17,044
4	182,501	154,505	27,996	0.57	104,354	88,346	16,008
5	197,101	166,865	30.236	0.50	97,999	82,965	15,033
Net present value							**P 35,560**
Benefit-cost ratio							**1.07**
Internal rate of return							**40.53%**

"But the profit taking was short-lived because of risks associated with environmental deterioration. This was not considered in the computations then." The high discount rate used in Rene's analysis is intended as fair warning for investors to look into the associated risks in high-density aquaculture systems to avoid similar losses and to prevent environmental deterioration which caused many intensive shrimp farms to go under.

REFERENCE

R. Agbayani. 1996. *Economic analysis of various milkfish culture systems.* Paper presented at the **National Conference-Exhibit on Technical Considerations for the Management and Operation of High-Density Milkfish Culture Systems**; 24-25 October 1996; Quezon City; U.P. Aquaculture Society, Inc. Miag-ao, Iloilo.

PROBIOTICS/*BACILLUS* - **FROM PAGE 17**

make-up). This is very useful in making "designer" bacteria.

- *Bacillus* are thermophilic, growing at high temperatures (50-70°C) in areas like hot springs and heated industrial wastes
- *Bacillus are* easy to isolate from soil or air. They grow well on synthetic media containing sugars, organic acids, alcohols, among others, as sole carbon sources. Ammonium can be its sole nitrogen source. Few isolates have vitamin requirements.

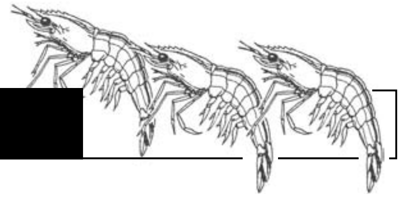
REFERENCES

DJW Moriarty. ***Asian Shrimp News,*** 2nd Quarter 1996. p. 3.

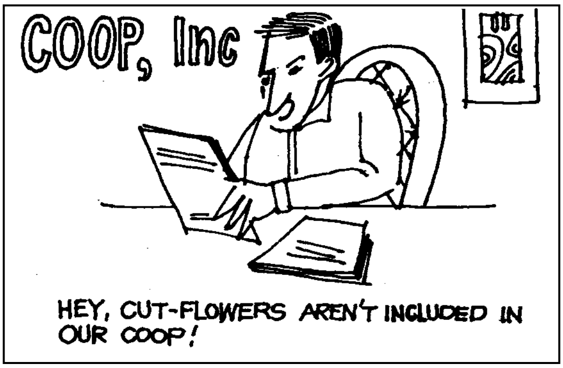
DJW Moriarty. Control of luminous *Vibrio* species in aquaculture ponds. Abstract of seminar given at SEAFDEC/AQD. Undated.

RQ Gacutan, MY Tabbu and RT Dal. 1996. The beneficial effects of probiotics on selected chemical and growth parameters in *Penaeus monodon* pond waters. Abstract of seminar given at SEAFDEC / AQD. Undated.

TD Brock and MT Madigan. 1991. **Biology of Microorganisms**. Prentice-Hall Intematl Ed. p. 44, 249, 327, 693, 775-777.



A shrimp cooperative in action



The Negros Prawn Producers' Marketing Cooperative, Inc. (NPPMCI or the Coop) based in Bacolod City (west central Philippines) is the most active among shrimp cooperatives in the country. It was organized by 15 shrimp farmers in 1984; and membership has since grown to 245 with a total equity amounting to over P9 million. Coop members operate a total of 3,000 ha of shrimp farms in Negros island where 60% of Philippine shrimp exports originate. The Cooperative Development Authority under the Office of the Philippine President has direct jurisdiction over cooperatives, NPPMCI included. The Coop is also registered with the Board of Investments as an indirect prawn exporter in 1987.

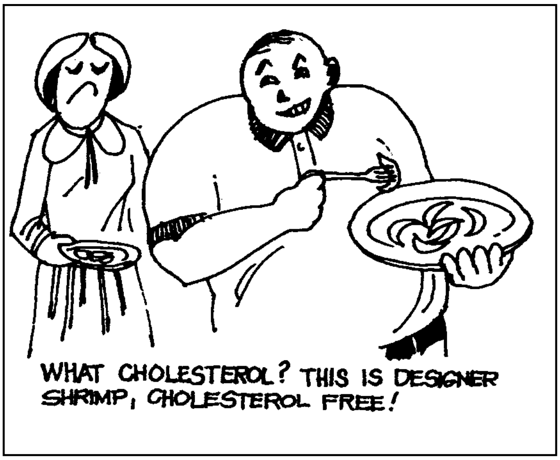
"We have successfully achieved our objectives of integrating prawn production and marketing, and of providing members important services," reported Coop chair Roberto 'Bob' Gatuslao (see also pages 10-11). "We are able to link all the industry sectors and open a steady partnership with government and private institutions. We have processed and transferred tax credit certificates worth over P100 million, an incentive enjoyed by our grower-members."

The Coop is very active in:

- documenting industry practices and validating R&D results in its 1.1 ha demonstration farm. The Coop cooperates with AQD on five projects on shrimp, mudcrab, grouper, seabass and milkfish (see also pages 7-11).
- monitoring feed samples (aflatoxin levels and other quality tests) from dealers' warehouses which is done monthly. The results are disseminated to growers. The Coop also meets with feedmillers periodically.
- assessing fry quality before fry are stocked in members' ponds. This can aid farmers decide whether a fry batch can be stocked or in identifying possible causes in cases of stock mortality.
- monitoring disease occurrences in Negros island to guide farmers on stocking schedules and preventive measures. Their histopathology unit is now operational, boosting diagnostic capabilities.
- monitoring water quality in coastal areas and rivers. The Coop noted that disease problems seem to recur in a seasonal pattern. The Coop conducts dialogue with water resource users, especially industries.
- organizing technical workshops and meetings. Farm-site seminars are often conducted on environment-related concerns and disease occurrences. The Coop also co-convenes national shrimp workshops.
- providing cheaper and quality farm supplies. The Coop sells Vitamin C, cast nets, lime, squid oil, weighing scales, among others. It also services broken farm machineries and equipment.

"A few years ago, we had relatively stable high prices, but with the luminous bacterial disease, most growers stopped their operations or delayed their stocking schedules," Bob reported. The significant drop in production was notable and alarming. We need to prioritize our grow-out concerns, refocus our R&D thrusts with AQD's and BFAR's support. As we survived the 1989 crisis, I am confident we can again overcome these trying times."

Key issues in marketing shrimp



John Filose of Ocean Garden Products in San Diego, California thinks[1] of the shrimp as a unique food product. It is a luxury seafood, traded on a worldwide basis, subject not only to macroeconomic factors of supply and demand but also to various political and social issues that can often surprise even the most experienced producer, importer or distributor. The companies that survived the difficult and volatile period - from 1989 through 1992 -- should now be well-positioned to benefit from a more favorable worldwide supply-demand relationship in the years ahead. This suggests that shrimp farmers who can sustain production of quality shrimp, at reasonable costs, will profit in the years ahead.

Filose noted key issues facing the industry:

(1) **Increasing concern about shrimp quality.** Importing countries, the US especially, considers importing seafood a privilege, not a right. The current focus is antibiotic residues and chemical additives in shrimp. It is no longer enough to ensure that shrimp are free from filth, *Escherichia coli,* salmonella, decomposition, and listeria. The shrimp will have to be totally free of non-approved antibiotics. Japan and western Europe has joined the US in regulating imported shrimp.

The US and the European Union are also designing mandatory seafood inspection, and Japan may follow suit. It may well be imperative for shrimp exporting countries to establish Memoranda of Understanding with the major consuming markets. If these agreements are not reached, it will become virtually impossible for producers to export shrimp without costly and time consuming 100% inspection of each inbound cargo.

(2) **The industry relationship with the world environment community**. Radical environmental groups and their counterparts in shrimp producing nations are switching their concern from at-sea bycatch issues to what they term excessive development of coastal areas for shrimp farms. Producers must deal with these groups.

(3) **Value-added products**. Shrimp processors in major consuming markets have more advantages over the overseas producers because of logistics. They can prepare small quantities of value-added products based on specific orders from either supermarkets or restaurant customers.

It is important to note that chefs, the prime users of quality high-priced aquaculture shrimp products, prefer to buy shrimp in the shell-on presentation. Chefs believe that the shell protects meat quality, plus adds flavor to their dishes. In addition, value-added products that are designed to be sold directly to consumers often fall victim to pricing problems in supermarkets. If these are not displayed correctly in retail, they won't be sold. It is important for a professional import company to test new presentation ideas in the marketplace before committing major capital funds. Find out whether the added cost can be returned by higher pricing.

Shrimp producers must have two grades of shrimp: premium and standard. If both are produced under one brand, the producer will never develop a quality reputation. Consumers know the difference, and so should producers.

[1] J. Filose. *Factors affecting the processing and marketing of farm-raised shrimp.* IN: CL Browdy and JS Hopkins, editors. Swimming through troubled water; Proceedings of the special session on shrimp farming; **Aquaculture '95**. World Aquaculture Society, Baton Rouge, Louisiana, USA.

Working together to save shrimp

THE NETWORK OF AQUATIC ANIMAL HEALTH or NAAH was formed to take up arms against the nemesis of the shrimp industry: the luminous bacteria. It is national in scope, with three participating agencies: AQD, the Philippine Council for Aquatic and Marine Research and Development (PCAMRD), and the Bureau of Fisheries and Aquatic Resources (BFAR).

A spin-off of NAAH is the Task Force *Oplan-Sagip-sugpo* (transl. Save-the-Shrimp) (see next page). This group aims to come up with solutions to rehabilitate the shrimp industry and map out strategies for its sustainability.

"We need appropriate technologies for each culture system," stressed AQD Chief Dr. Rolando Platon, "including extensive (stocking density: 1-3 shrimp per m^2), semi-intensive (3-10 per m^2), and intensive (higher than 10 per m^2)."

"There is always a tendency for the industry to go intensive which becomes dangerous when the organic matter exceeds the capacity of the receiving water to break it down. The pollution expelled by the overcrowded animals themselves, the excess feeds and other organic wastes wreak havoc on our rivers and other waterways."

I have no other choice but adopt environment-friendly methods. It is the only way to profit in the long run.

Thus for environmental reasons, AQD does not and will not recommend the intensive system which many pond operators practice for profit's sake. But Dr. Platon believes that the present intensive fishfarmers should not be left alone with their problems. "We should deal with these intensive farms and the wastes they produce. We should come up with technology appropriate for their use."

Meanwhile, AQD has advised shrimp farmers to try polyculture with commodities such as seaweeds and molluscs. The "cleansing" effect of seaweeds and molluscs in shrimp ponds is an ongoing study at AQD.

An industry practitioner and consultant before he became AQD Chief, Dr. Platon said NAAH will put in place a strong monitoring system. "When something is wrong, everybody must know about it. AQD is going to be the center or headquarters of the network."

Dr. Platon showed the gravity of the shrimp problem by citing the decline in production caused largely by the luminous bacteria: 30,000 tons in 1991, down to 22,000 tons in 1992, to 20,000 tons in 1996. All these on a culture area of 47,000 hectares. He said other countries, Indonesia and India for instance, have more areas to develop into shrimp ponds. In the Philippines, because of limited land space, most farmers went intensive, stocking as high as 300,000-500,000 fry per hectare, resulting in pollution, fish diseases and mortalities.

NAAH will have to strike a happy medium between profitability and the sustainability of the ecosystem. The industry practitioners are crying out to aquaculture scientists for help. AQD which is at the heart of NAAH must answer the call for technology. *By* ***J. Carreon-Lagoc***

The Oplan Sagip-Sugpo

I hope the government suceeds in this, otherwise I'll lose my shirt!

By **J. Carreon-Lagoc**

OPLAN SAGIP-SUGPO TASK FORCE was the subject of a Special Order issued September 16, 1996 by Philippine Agriculture Secretary Salvador Escudero. The objectives: to hasten the rehabilitation of the shrimp culture industry, and to set the R&D direction of shrimp health management and production aspects. Shrimp, *sugpo* or *lucon,* if you will, is the common name for *Penaeus monodon.*

The task force has a wide representation of agencies involved in the development of the shrimp industry. Fittingly, it is chaired by Dr. Rolando Platon, Chief of AQD, the institution that pioneered in shrimp culture research.

In the '70s and '80s, the tiger shrimp industry was deemed a sunshine industry. Production increased a hundred-fold and thousands got employed in allied industries such as feed milling and processing. AQD was hailed for the technologies that boosted the industry.

Why the SOS call? Because at present, the Philippine *sugpo* industry is in the doldrums. From a peak 30,462 tons with a value of P7.46 billion in 1991, *sugpo* export has dipped to about 20,000 tons in 1995. Entrepreneurs were dismayed by the decline in production, and the opportunity lost. In Negros Occidental, for instance, a number of *sugpo* farms have ceased operation due to the prevalence of the dreaded luminous bacteria. The disease results in almost total mortalities in shrimp ponds throughout the country.

The present problems in the *sugpo* culture industry have been blamed on overintensification of culture operations (see preceding articles). Shrimp farms which stocked 300,000-500,000 fry per ha produced effluents that exceeded the capacity of the natural environment to degrade and render harmless. The result: deterioration of the soil and water quality within the sugpo farm and its vicinity. Fish diseases and mortalities eventually ensued.

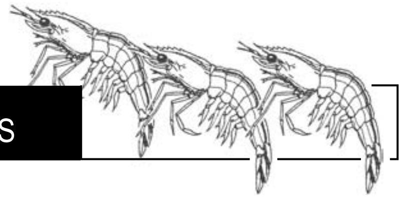
Oplan Sagip-sugpo consists of technical people from various agencies working on shrimp diseases and production problems. BFAR Director Dennis Araullo believes this would lead to unified and concerted efforts at rehabilitating the country's *sugpo* farms.

The task force's immediate strategy is to conduct "fire-fighting" operation "to greatly minimize the risk involved in *sugpo* farming and make it profitable and financially attractive once again." Practices reported to have been successful will be documented, evaluated and verified such as the use of probiotics, greenwater, reservoir, biofiltration, and other methods.

The long-term strategy is to develop specific disease resistant strains of sugpo through genetics, selective breeding, or through biotechnology in general. This will entail 6-10 years of research work.

Dr. Platon's team in the task force is composed of Celia Pitogo, AQD fish health expert; Dr. Arnulfo Marasigan, head of University of the Philippines Visayas - Institute of Aquaculture; Director Rolando Edra of PCAMRD; Roselyn Usero of NPPMCI fish health laboratory (see page 28); Dr. Tereso Abella, Dean of the Central Luzon State University-College of Fisheries; Simeona Aypa, BFAR Chief; and Dr. Quintin Bautista, a professor at the Mindanao State Universtiy-Naawan. On-call basis are personnel from the Department of the Agriculture regional offices.

Mr. Entrepreneur must know that the government cares, and cares deeply so that the tiger shrimp, once a huge dollar earner for the country, would again be a major export to rake in the green bucks. The once sunshine industry must shine again. We need pillars to establish Philippines 2000, and the succulent shrimp is one of them.



Shrimp research at AQD

"The tiger shrimp *Penaeus monodon* is the main focus of shrimp research at AQD, with only a few studies on other penaeid species," reported AQD associate scientist Fe Estepa[1]. Research results have been published in scientific journals and conference proceedings. In the last five years, AQD's crustacean team have had 57 published papers. A total of 17 senior research staff comprises the team.

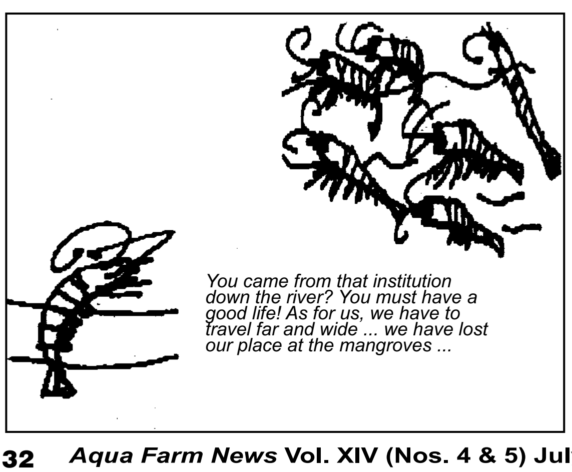
Broodstock research

Fe noted that AQD's research efforts on shrimp maturation were geared towards getting baseline information on reproductive physiology and the improvement of reproductive performance. "Age, size, gonad, and hepatopancreatic weight, oocyte diameter, and hormone-vitellogenin levels of females vary at different stages of maturation," she cited one result.

AQD also evaluated sperm quality of pond-reared and wild males, and, to improve reproductive performance of pond-sourced broodstock, tested diets containing different levels of fatty acids and lipids, and various sources of carotenoids and levels of steroid hormones.

Larval rearing studies

Fe noted that larval rearing studies were directed towards refinement of hatchery techniques. AQD determined physico-chemical levels tolerable to larvae and postlarvae to define optimal rearing conditions. AQD also investigated water treatment and management systems to come up with improved methods to get more consistent survival and more cost-effective hatchery production.



Grow-out culture

Fe reported that research on grow-out was mainly focused on refining extensive and semi-intensive systems. For the extensive systems, AQD compared various fertilization schemes and investigated the role of natural food. For the semi-intensive systems, most of the studies were on testing different supplementary diets.

Nutrition and feed development

Research on nutrition and feed development focused on three major areas, Fe reported. These include nutrient requirements and interrelationships, apparent protein digestibility, and practical diet development.

In feed development, Fe noted, the primary concern is a nutritionally balanced and low-cost feed that uses inexpensive indigenous raw materials. AQD is initiating the development of environment-friendly feeds and the application of nutritional strategies to decrease the impact of fish culture on the environment. Feed refinement is geared towards reducing feed costs and safeguarding the ecological balance.

Diseases

AQD studied disease-related problems with significant economic input. Specific studies, Fe reported, dealt with methods of prevention and control of viral, bacterial, fungal and environment-related diseases using physical, chemical or nutritional approaches.

[1] This paper was also presented at the *Second International Conference on the Culture of Penaeid Prawns and Shrimps;* 14-17 May 1996; Iloilo City; sponsored by SEAFDEC Aquaculture Department

AQD looks forward: 1998 to year 2000

TIGER SHRIMP RESEARCH PRIORITIES OF THE AQD CRUSTACEAN TEAM

SHRIMP *Penaeus monodon*

Development of pond-reared broodstock
- genetic studies
- management protocols
  - health maintenance (specific pathogen-free or specific pathogen-resistant shrimp)
  - source of stocks to ensure genetic diversity
  - feeding program (costs included)
- artificial diet formulation (including vitamins, minerals, immunostimulants)

Larval rearing

water management protocols to enhance microbial balance within the systems
larval quality (nauplii to postlarvae)

AQD may convene a workshop to discuss the basic requirements of a breeding program.

ENVIRONMENT

Impact of pond culture on the environment (=simulated industry practice)
- nutrient load in and out of ponds, of incoming water, of different water exchange protocols
- nutrient budgets and feed efficiency; environment-friendly feeds, feed conversion, cost
- effluent treatment systems and techniques (biological or chemical methods; use of seaweeds; bivalves, among others)

Coastal zone management
- socioeconomic studies
- aquasilviculture
- literature review on deforestation and rehabilitation of mangroves

HEALTH MANAGEMENT

Bacterial profile of healthy shrimp
Epidemiology of viral and bacterial diseases

Impact of chemical usage in aquaculture
- fate and effects of antibiotics in the environment
- residual effects of chemicals

Alternative approaches to shrimp health management
- the use of probiotics
- health enhancement through nutrition

ADAPTATION / VERIFICATION / PILOT STUDIES

(OF TECHNOLOGIES FROM COUNTRIES OTHER THAN THE PHILIPPINES)

The use of probiotics
Management protocols for closed systems
Culture of alternative species like *Penaeus japonicus*

Aquaculture clinic

QUERY Farmers in Negros Island (west central Philippines) are reportedly dumping sugar in their tiger shrimp ponds. Why are they doing this? Is there a scientific basis?

REPLY Some farmers believe sugar can increase the number of bacteria in ponds and hasten the decomposition of excess shrimp feeds. Because bacteria need a certain C:N (or carbon-nitrogen) ratio for rapid decomposition of organic matter, adding more C (from sugar or other forms of carbohydrates) will encourage more decomposition especially when there are plenty of N from organic matter accumulation (excess shrimp feeds) in ponds. [C is first limiting compared to N in ponds with supplemental feeds.] "Cleaner" water can also discourage the growth of harmful bacteria like the luminescent vibrios.

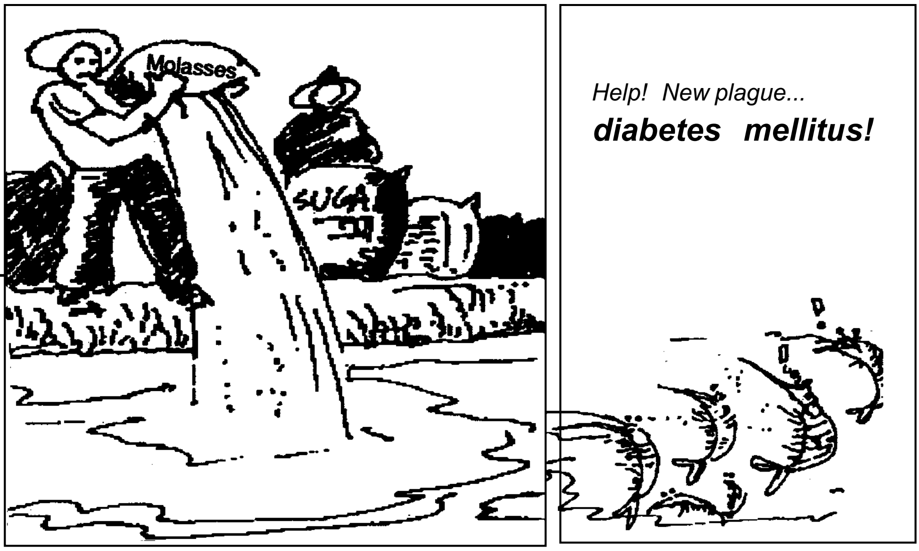
The NPPMCI Lab in Bacolod City (see page 28) tested this hypothesis *in vitro.* They compared the effects of brown and washed sugar in varying concentrations on the *Vibrio* population after 24 hours. The results:

Concentration tasted	Total *Vibrio* count	*Vibrio* colonies		Luminous bacterial count
		% yellow	% green	
Brown sugar				
1.0 ppm	1.5×10^3	82	18	6.0×10^1
1.5 ppm	2.3×10^3	89	11	4.5×10^1
2.0 ppm	5.4×10^3	99.5	0.5	2.0×10^1
2.5 ppm	5.1×10^4	100	0	1.5×10^1
Washed sugar				
1.0 ppm	3.6×10^3	94	5	4.5×10^1
1.5 ppm	6.4×10^3	98	2	5.0×10^1
2.0 ppm	5.8×10^4	97	3	5.0×10^1
2.5 ppm	7.0×10^4	100		not detected
Blank/control	6.2×10^2	50	50	1.1×10^2
Pond water	2.6×10^2	38	62	2.6×10^2

Test procedure: Water sample from a pond was collected and analyzed. Aliquot volumes were plated onto TCBS media to quantify yellow and green vibrios. About 500 ml of water sample were placed in 6 erlenmayer flasks; 0.0115 g per liter ammonium chloride was added as nitrogen source; and the flasks were randomly assigned to the above treatments. Two flasks without sugar served as control. The untreated water was plated and counted after 24 hours; aliquots from treated samples were plated to quantify green and yellow colonies. (The number of replicates was not included in the report. - Ed.)

NPPMCI remarked that total vibrio count of <1.5 × 10^4 is slightly high.

NPPMCI suggested using brown sugar at 2.0 ppm or 20 kg per hectare and washed sugar at 1.5 ppm at 15 kg per ha. They also noted that at these



By AP Surtida

Have molasses, will control pond diseases

concentrations, total *Vibrio* load is <10,000; all concentrations also showed increases in yellow colonies or decreases in luminous vibrios (which are generally green). NPPMCI further urged more studies, especially on frequency of application and ammonia reduction.

But Biomanagement Systems Pty Ltd *(ARDA-Tek Technical Bulletin, June 1996;* e-mail: *djwm@ozemail.com.au* or *abody@ozemail.com.au)* (see also page 12, this issue) says the use of sugar in ponds is not an ecologically sound procedure, and will not work over a period of more than a few days. They noted that increase in bacterial biomass will stimulate bacterial predators (from minute protozoans to the shrimp themselves) to feed on them and grow. These "predators" also excrete ammonia, and the farmer will have a pond full of sugar, bacteria, and protozoans.

What will work long-term, Biomanagement says, is the oxidation of ammonia to nitrate by the combined action of the ammonia-oxidizing autotrophs *(Nitrobacter* and *Nitrosomonas).* (Nitrate can be reduced to nitrogen or nitrous oxide gases and released to the atmosphere). Biomanagement noted, however, that no bacterial product presently marketed actually contain active cells of *Nitrobacter* because it is very sensitive to stress, and active cultures have to be shipped cold (5°C) and used within 2 weeks. (Biomanagement worked with the University of Queensland, Australia, in this test.) Bacterial products that are dried, liquified or stored at room temperature can not contain active nitrifying bacteria. Although *Nitrosomonas* may survive longer, Biomanagement says, it takes many weeks to become resuscitated from a dormant phase. Instead, most bacterial product currently in the market contain heterotrophic bacteria which obtain their food from organic compounds such as excess shrimp feed (and sugar). These bacteria also excrete nitrogen as ammonia, and this is not a useful solution to fishfarmers who wanted to reduce ammonia concentration in their ponds.

(We encourage readers to send in their **QUERIES**. Please send to **Aqua Farm News**, fax: 63 (33) 336 2891, e-mail: seafdec@mozcom.com. - *Ed.)*

AQD offers option to prawn

AQD and the Negros Prawn Producers Marketing Cooperative Inc. hosted a seminar on *Alternatives to Prawn* on September 20 in Bacolod City. The seminar offered viable options to prawn raising which is still reeling from the outbreak of pathogenic bacteria. It was attended by 42 fishfarmers.

Resource persons from AQD included Dan Baliao and Joebert Toledo who tackled *Milkfish/mudcrab culture in ponds* and *Culture of sea bass in ponds and floating netcages,* respectively. A prominent lapu-lapu grower from Capiz, Elmer Blasurca, lectured on *Cage and pond culture of grouper.* (See excerpts of their papers on pages 22-27, this issue.)

AQD Chief Dr. Rolando Platon and Negros Coop President Roberto Gatuslao led the program activities.

Dr. Rolando Platon also presided over a roundtable discussion on *Oplan Sagip-Sugpo* in Bacolod City last September 19. He pointed out the need for a concerted effort among government fishery agencies, academe, NGOs and fishery associations to rehabilitate the industry and make it sustainable through a focused and sound shrimp health management techniques for short, medium and long-term solutions. (More on *Oplan Sagip-sugpo* on pages 30-31, this issue).

QUOTE, UNQUOTE

AQUACULTURE SYSTEMS SHOULD BE BIOTECHNICALLY FEASIBLE. ENVIRONMENTALLY SOUND, AND SOCIOECONOMICALLY VIABLE.

PS Leung
University of Hawaii at Manoa

Still on Negros, AQD is documenting an existing industry practice on the use of probiotics and greenwater technology to prevent luminous bacteria outbreak in intensive prawn ponds. The study is carried out in the Negros Coop demo farm in Calumanggan, Bago City and in the Samson Farm in Sum-ag, Bacolod City in collaboration with BFAR and the Negros Coop.

Fishfarmer groups may request AQD researchers to lecture on aquaculture topics. For inquiries, tel/fax: 0 (33) 335 1008 or 336 2891.

New Deputy Chief

Mr. Yasuho Tadokoro, 50, from Chiba City, Japan is AQD's new Deputy Chief starting July 8 this year.

He worked as a GATT expert at his country's Ministry of Agriculture, Forestry and Fisheries; as First Secretary (Fishery Attache) at the Japanese Embassy in Moscow from 1980 to 1982; as Director of Fisheries Technical Cooperation at the Japan International Cooperation Agency from 1987 to 1994, and as Section Chief of Environment and Head of Fishing Boat Building at the Fisheries Agency in Japan in 1994.

Mr. Tadokoro obtained his degrees from Kyoto University (Fisheries, 1970) and Meihi University (Law, 1977). He serves AQD until May 31, 1998.

SEAFDEC/AQD News SEAFDEC/AQD News

National Seminar-Workshop on the Conservation and Ecological Management of Philippine Lakes in Relation to Fisheries and Aquaculture

21-23 October 1997 Diliman, Quezon City

Organized by
SEAFDEC Aquaculture Department
Co-sponsors
Philippine Council for Aquatic and Marine Research and Development
and
Bureau of Fisheries and Aquatic Resources

RATIONALE The continued use and exploitation of our lakes primarily through fisheries and aquaculture has resulted in sometimes drastic changes in their ecosystem. Foremost among these problems are the degradation of these bodies of water and the loss of aquatic biodiversity. The long-term sustainability of fisheries and aquaculture depends to a large extent upon conservation of aquatic ecosystems and aquatic biodiversity. Concerns on the social consequences of such changes has also been expressed. These problems resulted in a need to undertake a multidisciplinary and multisectoral research approach that will focus on rapid resource and ecological assessment of our inland waters. This will provide a sound scientific base for policy recommendations on the rational management of inland waters for capture fisheries and aquaculture.

Researchers, administrators, representatives of government and non-government organizations closely interested in the conservation and management of lakes are encouraged to present papers or posters.

CALL FOR PAPERS Send contributions on these topics (tentative). Deadline for full papers: **15 August 1997**. Additional topics may be suggested:

- Current ecological status of Philippine Lakes
- Fishery resources and aquaculture practices
- Conservation and management strategies for Philippine lakes and their socioeconomic implications

Presentors must submit one original printout and one photocopy in A4-sized sheets and a diskette containing the text of submitted paper (ASCII file format). Contributions should be in English. Abstracts should have 250 words maximum. Give about 5 keywords. For charts and figures, these should be made on separate sheets and should be legible enough if reduced to 30% of its original size. Submitted papers will not be returned. The proceedings of the seminar-workshop will be published by SEAFDEC/AQD.

For registration, submission of papers, and further information, contact:

The Secretariat
National Seminar-Workshop on the Conservation and Ecological Management of Philippine Lakes
SEAFDEC Aquaculture Department
17 Times St, West Triangle
Quezon City

Tel. 924-5511 to 13
Fax 924-5553
E-mail: bfs-seafdec@phil.gn.apc.org

SEAFDEC/AQD News SEAFDEC/AQD News SEAFDEC/AQD News

1997 AQD Training Courses

Culture of Natural Food	March 5 to April 3
Aquaculture Management	April 1 to 30
Fish Health Management	April 15 to May 26
Marine Fish Hatchery	June 9 to July 29
Freshwater Aquaculture	September 2 to October 10
Fish Nutrition	October 23 to December 3

For application forms and further information, please contact:

Training and Information Division
SEAFDEC Aquaculture Department
Tigbauan, Iloilo 5021, Philippines

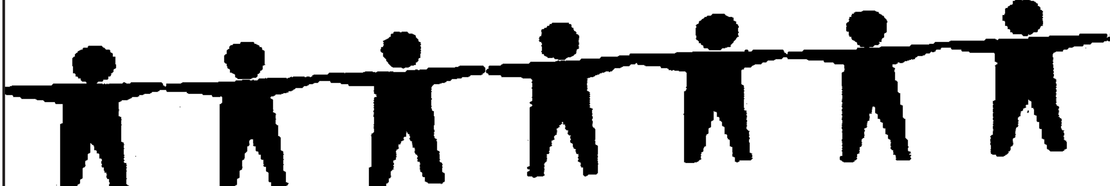
Tel/Tax: **63 (33) 336 2891**
E-mail: **seafdec@mozcom.com**

For local applicants who wish to apply for fellowships, contact:

Mr. Joemari Gerochi
Undersecretary and SEAFDEC Council Director
Department of Agriculture
Elliptical Road, Diliman, Quezon City 1104

FAX: 0 (2) 927 8405

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



Shrimp-related AFN issues

MANGROVES SUPPORT LIFE

Edited by E Aldon

What are mangroves? How important are they to our ecosystem? Just two of the questions this issue answers. This issue also includes the state of mangrove resources in the Indo-Pacific region, valuation of mangroves, their impact on both marine and human life, the impact of mangrove loss, some management recommendations, and some mangrove trivia.

MANGROVES VS PONDS

Edited by E Aldon

This issue focuses on the value and benefits of fishponds and the comparative economic analyses of mangroves and fishponds. **Shrimp farms are used to illustrate the benefits and hazards from aquaculture.** It is evident that leaving the remaining mangrove forests as reserves can provide the human population with tremendously higher returns in terms of wildlife sanctuary, pollution sink, nutrient enrichment, nursery and breeding ground, and maintenance of sustained yield of brackishwater and marine fishes, shoreline protection, and natural land reclamation.

Requests for AFN back issues may be faxed to SEAFDEC/AQD **63 (33) 336 2891** *or sent through e-mail* **tms-seafdec@phil.gn.apc.org** *or* **seafdec@mozcom.com**

New publication

FEEDS FOR SMALL-SCALE AQUACULTURE Edited by CB Santiago, RM Coloso, OM Millamena, IG Borlongan. 1996. 144 pages.

DOCUMENTS the proceedings of the *First National Seminar-Workshop on Fish Nutrition and Feeds* AQD hosted in 1-2 June 1994 in Tigbauan, Iloilo.

INCLUDES four review papers on:

- future considerations in fish nutrition research (by C Lim)
- nutritional requirements of commercially important shrimps in the tropics (by M Boonyaratpalin)
- feed formulation and evaluation for semi-intensive culture of fishes and shrimps in the tropics (by A Tacon)
- preparation, management, problems, and recommendations for farm-made feeds (by F Piedad-Pascual)

ALSO CONTAINS 7 full papers and 19 abstracts.

WRITE TO Sales/Circulation, SEAFDEC/AQD, P.O. Box 256, Iloilo City 5000.

FOOTNOTE

***Aqua Farm News* Editor** Julia Carreon-Lagoc retires from AQD on her 60th birthday, 1 November 1997. Julie is one of the editors instrumental in forging the current AFN content and format. Here, she receives a certificate of appreciation from AQD Chief Dr. Rolando Platon. Julie now freelances for the *Philippine Daily Inquirer - Visayas,* and continues to write a column in a prominent local paper.

Aqua Farm News Vol XIV Nos 4-5 July-Oct 1996

Contents

Aqua Farm News **is published bimonthly by the Aquaculture Department of the Southeast Asian Fisheries Development Center P.O. Box 256 Iloilo City 5000 Philippines**

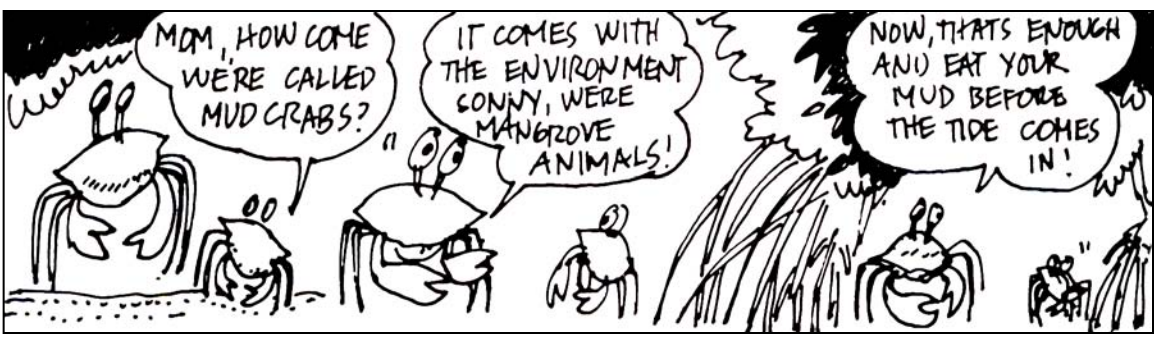
Entered as second class mail matter at PPC Tigbauan, Iloilo 21 July 1995

AFN is a production guide for fishfarmers and extension workers. It discusses the technology for cultured species and other recent information from various sources.

Editors: M. Castaños and E. Aldon

Production: D. Badilles, R. Buendia, E. Ledesma, I. Tendencia, E. Gasataya; *Circulation* R. Tenedero, L. Tabigo-on, Jr.

Subscription rate: P40 per year (local), US$ 15 per year including air mail postage (foreign). Please make remittances in postal money order, bank draft, or demand draft payable to SEAFDEC/AQD.



by A. Surtida