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Biotech laboratory: gift from Japan

DA Usec Drilon, DA Secretary Lorenzo, AQD Chief Dr. Platon, Embassy of Japan First Secretary Ueno, and JICA Resident Rep Nagaki

The much anticipated turn-over ceremonies for the Laboratory for Advanced Aquaculture Technologies (biotech laboratory for short) finally happened on February 27 at the headquarters of SEAFDEC/AQD.

The ceremonial turn-over was presided by Mr. Eigi Ueno, First Secretary, Embassy of Japan to the Philippines and Honorable Osamu Nagaki, JICA Resident Representative in the Philippines and representatives from CRC Overseas Cooperative, Inc. Taisei Corporation, Marubeni Corporation, Department of Agriculture (DA) Secretary, Luis Lorenzo Jr, ably assisted by DA Undersecretary Cesar Drilon Jr, and AQD Chief Dr. Rolando Platon.

In his message, Mr. Ueno hopes that the biotech laboratory would stand as a mark of cooperation between the governments of Japan and the Philippines in addressing the challenges of the aquaculture industry. In his acceptance speech, DA Secretary Lorenzo mentioned that SEAFDEC/AQD is still in the forefront of aquaculture despite budgetary constraints. He added that research output should result to increased productivity, lower production cost, and increased employment in order to benefit the people, particularly small-scale fishfarmers. He further added that since AQD is here in the Philippines, Filipinos should first benefit from its technologies. He encouraged AQD to continue extending technology to fishfarmers to increase production.

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FAO search for exemplary forest management

Kalibo mangroves make it to top 30

Of the 170 mangrove forest sites nominated for the Food and Agriculture Organization's "In Search of Excellence: Exemplary Forest Management in the Asia Pacific" initiative, the Buswang Mangrove Plantation made it to the top 30 sites.

This is happy news for SEAFDEC/AQD which was instrumental in helping the local community put up aquasilviculture projects, notably mudcrab pens. This site in Buswang, Kalibo, west central Philippines, is also a project area of the European Union's *Culture and Management of* Scylla *Species* (EC-CAMS) implemented by AQD in the country.

In the congratulatory letter sent February 17 to AQD Senior Scientist Dr. Jurgenne Primavera who nominated the Buswang site, FAO's Senior Forestry Officer Patrick Durst mentioned that the final selection of the top 30 sites was made by a 10-person panel with diverse forestry backgrounds from throughout the region, and that the group placed a premium on "instructive and innovative management experiences."

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FAO award-winning Buswang, Kalibo mangroves that have been cited for exemplary forest management

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BIOTECH LABORATORIES ... from page 1

The establishment of the biotechnology laboratory at AQD, a fisheries grant aid to the Government of the Philippines from the Government of Japan, was signed between the two governments on December 12, 2001. Construction work immediately followed the groundbreaking and cornerstone laying rites for the Enclosed Wet Laboratory on February 23, 2002. Simultaneously, improvement of the second floor of the existing Nutrition Building was undertaken to accommodate the other components of the biotechnology laboratory. A year later, the laboratory has been completed. The components of the biotech lab are: Endocrinology and Genetic laboratory, Feed Technology laboratory, Algal Production Technology laboratory, Microbiology laboratory, and the Enclosed Wet laboratory.

The Taisei Corporation of Japan did the construction work under Project Manager Yukiyasu Nishimaki while First Class Architect Fumio Matsumoto was Resident Consultant of the Fisheries Development Department, CRC Overseas Cooperation Inc.

Pioneering research on biotechnology done by SEAFDEC/AQD include, among others, the cloning of DNA for rabbitfish (*Siganus guttatus*) and milkfish (*Chanos chanos*). By harnessing the recombinant DNA technology, it is possible to grow bigger and disease-resistant fish. It could also shorten the growing period of milkfish and rabbitfish to marketable size and make them cheaper and competitive in domestic and international markets. AQD is also developing improved strains of seaweeds thru biotechnology.

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Inside and outside the Enclosed Wet Laborator the tall towers are rapid sand filter for seawater

AT A GLANCE

Components of the Biotechnology Laboratory
Endocrinology and Genetics Laboratory
Feed Technology Laboratory
Algal Production Technology Laboratory
Microbiology Laboratory
Enclosed Wet Laboratory

[Second Floor of AQD's Nutrition Building]
Endocrinology and Genetics Laboratory
Large-scale production of hormones and other substances
Development of novel hormone delivery system and genetically-improved stocks
Controlled breeding techniques
Determination of degree genetic diversity

Feed Technology Laboratory
Development of cheap alternative protein sources
Improvement of feed efficiency
Improved feeds for genetically superior breeds

Algal Production Technology Laboratory
Development of genetically improved seaweeds stocks, techniques for gamete manipulation, and waste management schemes using algae

Microbiology Laboratory
Development of techniques for rapid detection and identification of pathogens and vaccine against pathogens
Determination of antibiotic residues in cultured animals
Development of alternatives to antibiotics

[New buildings]
Enclosed Wet Laboratory Complex
Marine Plants (Seaweed) Cultivation Building
Crustacean Building
Finfish Building
Infection Laboratory Building
Seawater Reservoir, Pump House, Settlement Tank
Filtration/Precipitation Tank, Clearwater Tank
Comfort Room, Storage Building

Primavera appointed to Royal Swedish Academy of Agriculture, IUCN and ASEM Platform committees

SEAFDEC/AQD Senior Scientist Jurgenne Primavera was elected Foreign Member of the Royal Swedish Academy of Agriculture and Forestry (General Section) on 12 December 2002, as relayed officially by B. Nilsson, Secretary General of the Academy.

Also last December, Dr. Primavera was named to the Steering Committee of the Commission on Environmental, Economic, and Social Policy of the International Union for the Conservation of Nature and Natural Resources (IUCN). The CEESP is an interdisciplinary network of professionals whose mission is to act as a source of advice on the environmental, economic, social, and cultural factors that affect natural resources and biological diversity, and to provide guidance and support towards effective policies and practices in environmental conservation and sustainable development. IUCN-CEESP Chair T. Farvar informed Primavera of her approved commission appointment which runs until the fourth quarter of 2004.

More recently, she was invited to join the Steering Committee of the Aquaculture Platform of ASEM (the Asia-Europe Meeting), a partnership set up by Heads of State and Governments of 15 countries in Europe and Asia in 1996. This Platform provides open and permanent space for multistakeholder dialogue, networking and coordination concerning sustainable aquaculture in Asia and Europe, and was developed during the first Aquachallenge Workshop organized in Beijing in April 2002 which was attended by AQD Chief Dr. Rolando Platon and Dr. Primavera. The Beijing Workshop was organized under the auspices of EU INCO (European Union program for International Cooperation), which also funds the present EC-CAMS (Culture and Management of Mud Crab *Scylla* Species) Project implemented by the AQD.

AQD wins research awards

Eleven papers from SEAFDEC/AQD were cited for excellence during the *14th National Research Symposium* held recently in Quezon City. The 2002 symposium and the awards were sponsored by the Bureau of Agricultural Research (BAR) of the Department of Agriculture (DA).

Congratulations to the following winners (category, winning author/s, title of paper):

DA Secretary's Award

- **Borlongan IG**, Satoh S. Dietary phosphorus requirement of juvenile milkfish, *Chanos chanos* (Forsskal)
- **Catacutan MR**. Growth and body composition of juvenile mud crab, *Scylla serrata*, fed different dietary protein and lipid levels and protein to energy ratios
- **Catacutan MR, Pagador GE**, Teshima S. Effect of dietary protein and lipid levels and protein to energy ratios on growth, survival and body composition of the mangrove red snapper, *Lutjanus argentimaculatus* (Forsskal 1775)
- **Madrones-Ladja JA, de la Peña MR**, Parami NP. The effect of micro algal diet and rearing condition on gonad maturity, fecundity, and embryonic development of the window-pane shell, *Placuna placenta* Linnaeus
- **Millamena OM**. Replacement of fish meal by animal by-product meals in a practical diet for grow-out culture of grouper *Epinephelus coioides*
- **Millamena OM, Golez NV**. Evaluation of processed meat solubles as replacement for fish meal in diet for juvenile grouper *Epinephelus coioides* (Hamilton)
- **Millamena OM, Golez NV**. Processed meat solubles, Protamino Aqua, used as an ingredient in juvenile shrimp feeds
- **Olaguer I, Bagarinao TU**. Gonadal maturation, fecundity, spawning and timing of reproduction in the mud snail, *Cerithidea cingulata*, a pest in milkfish ponds in the Philippines
- **Santiago CB, Laron MA**. Growth and fry production of Nile tilapia, *Oreochromis niloticus* (L.), on different feeding schedules
- **Teruel MN, Millamena OM, Fermin AC**. Reproductive performance of hatchery-bred donkey's ear abalone, *Haliotis asinina* Linné, fed natural and artificial diets
- **Toledo JD, Caberoy NB, Quinitio GF**, **Choresca CH Jr**, Nakagawa H. Effects of salinity, aeration and light intensity on oil globule absorption, feeding incidence, growth and survival of early-stage grouper *Epinephelus coioides* larvae

BAR Director's Award

- **Millamena OM, Bangcaya JP**. Reproductive performance and larval quality of pond-raised *Scylla serrata* females fed various broodstock diet
- **Madrones-Ladja JA, Polohan BB**. The effect of stocking density, temperature and light on the early larval survival of the abalone *Haliotis asinina* Linné

Agriculture and Fisheries Modernization Act (AFMA) Best R&D Paper Award

- **Emata AC**. Reproductive performance in induced and natural spawning of the mangrove red snapper, *Lutjanus argentimaculatus:* a potential candidate species for sustainable aquaculture

AFMA Outstanding R&D Paper Award

- **Basiao ZU**. Farm-based approach to tilapia broodstock improvement in the Philippines
- **Basiao ZU, Eguia, RV**. Genetic variation in the response of Nile tilapia fry to salinity stress in the presence of an "internal reference" fish

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AFMA R&D Paper Award

- **Emata AC, Borlongan IG**. Reproductive performance of mangrove red snapper, *Lutjanus argentimaculatus*, fed a practical broodstock diet
- **Reyes OS, Duray MN, Santiago CB**, Ricci M. Free-living nematode *Panagrellus redivivus* as alternative live feed

AQD researchers attend mudcrab project coordination meeting in Belgium

Dr. Jurgenne Primavera and Dr. Emilia Quinitio attended the recent annual meeting of the *European Commission-Culture and Management of* Scylla *Species* (EC-CAMS) project held late last year at Ghent University in Belgium. They reported on the progress and activities of AQD in the various Project Work Packages in Year 1 (2002).

The general objective of the EC-CAMS Project is to improve the reliability and economic viability of mudcrab hatchery and nursery production to support development of mangrove aquasilviculture systems and stock enhancement.

The various Project Work Packages are: (1) Hatchery I: bacterial/fungal disease control, (2) Hatchery II: broodstock and larval quality, (3) Nursery and aquasilviculture, (4) Technical identification keys, (5) Fisheries and population dynamics, and (6) Stock enhancement vs. habitat rehabilitation. Other AQD Project members of CAMS are Dr. Celia Torres, Dr. Veronica Alava, Dr. Nerissa Salayo, Dr. Fe Estepa, Mr. Eduard Rodriguez, and Ms. Isidra Tuburan.

These work packages are collaborative efforts between any or all of the EC-CAMS Project partners – SEAFDEC/AQD (Philippines), University of Wales at Bangor (UK), Ghent University (Belgium), and Can Tho University (Vietnam) – whose researchers also participated in the Ghent meeting. The three-year project has a total budget of euro 848,300 of which euro 197,700 (more or less P9 million) is allocated for AQD.

AQD hosted the Project Organizational Meeting at Tigbauan Main Station earlier in January 2002, and will again organize the Year 2 Annual meeting in early 2004 (or late 2003).

While in Ghent, Drs. Quinitio and Primavera also had the chance to discuss future AQD plans in training and stock enhancement with Dr. Cornelia Nauen, Senior Fisheries Cooperation Officer of the European Commission and Dr. Patrick Sorgeloos, Director of the *Artemia* Reference Center, Ghent University and past President of the World Aquaculture Society.

Coordination meeting of the EC-CAMS Project in Ghent (top, L-R): M. Walton, M. Wille, T.T. Nghia, J.H. Primavera, L. LeVay, and V.N. Ut pose with Dr. Cornelia Nauen (4th from right), Senior Fisheries Officer of the European Commission

Dr. E.T. Quinitio (rightmost) and Dr. C Nauen (3rd from right) share a spirited discussion with Dr. P. Sorgeloos (2nd from left) of Ghent University and other CAMS project partners

First online aquaculture courses produced graduates

Forty-seven virtual students from 11 countries learned aquaculture technology without leaving their respective places of work from the first Internet-based courses on aquaculture. AquaHealth and AquaNutrition Online launched by SEAFDEC/AQD produced 24 pioneer graduates in February.

Enrollees were from Brunei Darussalam (2), Cambodia (4), Egypt (1), India (1), Indonesia (4), Malaysia (2), Myanmar (4), Singapore (4), Thailand (4), Vietnam (5) and the Philippines (16).

Knowledge and skills were actually transferred to learners via information technology. They proceeded with the course as if they were in a classroom but with this important difference - they faced computer screens instead of instructors.

Guided by resource persons, enrollees performed learning-exercises or "homeworks" on their own and submitted reports of their work through the Internet. To this, Vietnamese participant Dr. Bui Thi Lang of AquaHealth said, *"Very interesting homework that update my learning on the development of aquaculture in my country."*

Proctors administered examinations near the places of their work.

Unlimited interaction among learners and their resource persons in the Discussion Boards made the course exciting and enjoyable. Sharing insights and experiences further enhanced the learning process. *"The Course being so informative, is likewise*

entertaining and with so much fun." said Filipino participant Mr. Aredel Bonagua of AquaNutrition. Another local participant Dr. Jocelyn Gorospe of AquaHealth said, *"I never expected that virtual learning could indeed be possible, entertaining and highly informative."*

Participants who achieved high in formal examinations, submitted satisfactory learning activities, and participated actively in the discussion boards were granted Certificates of Training. Eleven and 13 participants of AquaHealth and AquaNutrition, respectively, were in this category. Others who had lesser achievements received Certificates of Participation as Observer.

Eighteen specialists prepared the course materials. These scientists and researchers have several decades of combined experience in various fields of aquaculture health management (virology, bacteriology, mycology, parasitology, serology, immunology and molecular biology) and aquaculture nutrition (feed development and aquaculture economics).

They were the ones who also painstakingly presided in the delivery of course modules. "It must be a tremendous work to compile the teaching materials and to spend time with us in the last few months. Thanks for making the course possible!" said Singaporean participant Dr. Tony Zilong Tan, AquaHealth Online topnotcher.

Principles of Health Management in Aquaculture (AquaHealth Online) conducted from 29 April to 16 August 2002 was designed by AQD for learners who wished to start a career in this field. Twenty-five participants enrolled in the course. On the other hand, *Basic Principles of Aquaculture Nutrition* (AquaNutrition Online) with 22 enrollees, ran from 9 August to 19 December 2002. It aimed to teach the essentials of aquaculture nutrition, feed formulation, and feeding management.

Distance learning in aquaculture delivered through the Internet is a new and exciting training method pioneered by AQD. Technical assistance was provided by the UP Open University, the country's premier institution in distance education and Internet based learning systems..

Encouraged by the positive response of learners, SEAFDEC AQD will continue to offer these two Online Courses this year. AquaHealth will be conducted from 5 May to 15 August and AquaNutrition is tentatively scheduled from May to September. For more details please inquire from training@aqd.seafdec.org.ph.

New internship course

SEAFDEC/AQD is offering a short internship course on the detection of White Spot Syndrome Virus (WSSV) using polymerase chain reaction (PCR) for individuals or groups upon request. The course duration is four days.

The course recently graduated one trainee, Jeofrey Silorio, a prawn hatchery technician from Somaqua, Madagascar. Silorio was provided with brief lectures and given laboratory/hands-on work at AQD's Fish Health Laboratory. He finished the course on January 30.

Milkfish harvest from cages managed by Guimaras fisherfolk undergoing training on fish cage culture at AQD

Milkfish harvest from the Mariculture Park Demo and Training Facility in Guimaras

A unit of fish cage can generate a net income of P7,290 after three months, as fisherfolk-trainees from Guimaras found out when they harvested milkfish in mid-December last year. The fish cage is part of a module of 13 units in the Mariculture Park Demonstration and Training Facility that is within SEAFDEC/AQD's marine substation in Igang, Guimaras.

The remaining 12 cages with milkfish, snapper, and grouper stock will be harvested in succession when the fishes reach marketable sizes. The net income from these cages being attended by fisherfolk-trainees will go to their respective municipal fishermen associations.

In a related development, the 29 units of Department of Agriculture-funded livelihood fish cages project stocked with grouper in Sibunag, also in Guimaras, are doing well. This is a spin-off project for fishers who previously trained at the Mariculture Park Demonstration and Training Facility at Igang, and which is technically assisted by SEAFDEC/AQD. The groupers are now at 60 to 80 days of culture and have an average body weight of 40 to 90 grams. Excellent survival rate was observed.

A second spin-off cage livelihood project is ongoing in Lapaz, Nueva Valencia, and has AQD's technical assistance as well.

The objective of AQD's technical assistance is to demonstrate, train, and transfer a sustainable coastal mariculture technology that can give additional or alternative productive employment that are well-suited to the limited resources of the poor.

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AQD sponsors seaweed project for Parara fisherfolk

SEAFDEC/AQD sponsored a training and demonstration project on seaweed culture in Parara Norte, Tigbauan, the town where AQD's main station is located in Iloilo.

The project has five beneficiaries, all members of the Parara Norte Small Fishermen Association. Each beneficiary was given a 500 m^2 area to grow *Kappaphycus alvarezi* using the raft long line (multiple) or 'alul' method.

The participants of the *2002 Third Country Training Program on Responsible Aquaculture Development* first proposed the project under AQD's Aquaculture for Rural Development thrust. It was presented in a community meeting of the Parara Norte fisherfolk on November 22 last year.

AQD specialists involved in this training-demo project are: Dr. Anicia Hurtado (technical), Ms. Didi Baticados (socio-economics), Dr. Nerissa Salayo (economics), and Mr. Abdul Unggui (training). The project started December 2002 and will end in May 2003.

Seaweed culture by a fisher association in the town of Tigbauan

Top shells released in the wild

The release of 3,100 top shell juveniles in Binduyan, Palawan was the highlight of a training on *Marine sanctuaries and top shell resource management* held February 18-20 at Puerto Princesa, Palawan. The juvenile *Trochus niloticus* came from spawners obtained off Palawan and were provided by SEAFDEC/AQD who was a co-sponsor of the training. AQD researchers Dr. Wenresti Gallardo and Mr. Rolando Gapasin also gave lectures on resource enhancement strategies and principles of stock enhancement, and top shell seed production, respectively.

Conducted by the Department of Agriculture's Fisheries Resource Management Program (FRMP), the training was participated in by representatives of four coastal barangays at Honda Bay, Puerto Princesa namely San Rafael, Babuyan, Tanabag, and Binduyan.

The course focused on the community's crucial involvement in fish sanctuaries' establishment and management. In addition, the participants learned to formulate management plans as well as to utilize designed protocols on monitoring and evaluating released stocks.

The training was made possible thru the efforts of FRMP in cooperation with the Regional Fisheries Training Center (RFTC) of DA-BFAR, the Provincial and City Agriculture Offices of Puerto Princesa City, State Polytechnic College of Palawan, and the Iris Marine Development Corporation which has a top shell hatchery in Puerto Princesa. ###

AQD holds commodity and program review meetings

SEAFDEC/AQD's senior staff held a series of commodity and program review meetings, January 20-24, February 4-6, February 10 at the Tigbauan Main Station in Iloilo to discuss the status of various activities of the Department based on the program approved in 1998.

The research staff, led by Research Head Dr. Clarissa Marte, reported the results of completed research studies, status of ongoing research studies, information gaps (topics that needed more studies), research strategies, and priority of their study (relevance to the aquaculture industry). They also suggested priority activities (projects and plans) to hasten attainment of AQD objectives.

Some of the important aspects of aquaculture presented that needed more research are nutrition, feeding, water management, health management, and culture condition (stocking density, substrate, culture period, seed quality) for broodstock, hatchery (larval rearing), nursery, and grow-out culture systems.

The priority commodities included: catfish, milkfish, rabbitfish, shrimp, mudcrab, seaweeds, larval food; a few new species like *Macrobrachium rosenbergii* ("ulang"*), Arius* sp., "ayungin", and snakehead; marine ornamental species (blue tang, *Charybdis*, seahorse); grouper, snapper, and molluscs (abalone, *kapis* shell, short-necked clam, top shell).

The following program-in-charge made the reports: (1) Dr. Clarissa Marte, *Broodstock management and seed quality improvement of cultured species*; (2) Dr. Felix Ayson, *Development of improved technologies in fish and crustacean hatchery/nursery production*; (3) Dr. Aurelio de los Reyes, *Development of appropriate aquaculture technologies and practices*; (4) Ms. Ilda Borlongan, *Development of nutritionally efficient and environment-friendly*

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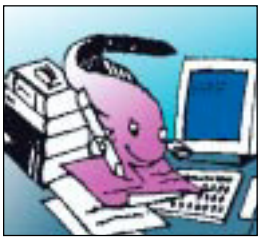

AQD Research Publications

Reprints of papers listed here may be requested directly from SEAFDEC/AQD authors
[names of AQD researchers in boldface] **or from the AQD Library**

Compiled by the AQD LIBRARY <library@aqd.seafdec.org.ph>

Bombeo RF, Fermin AC, Tan-Fermin JD. 2002. Nursery rearing of the Asian catfish, *Clarias macrocephalus* (Gunther), at different stocking densities in cages suspended in tanks and ponds. Aquaculture Research 33 (13): 1031-1036

Abstract. Growth and survival of hatchery-bred Asian catfish, *Clarias macrocephalus* (Gunther), fry reared at different stocking densities in net cages suspended in tanks and ponds were measured. The stocking densities used were 285, 571 and 1143 fry m^{-3} in tanks and 114, 228 and 457 fry m^{-3} in ponds. Fish were fed a formulated diet throughout the 28-day rearing period. Generally, fish reared in cages in ponds grew faster, with a specific growth rate (SGR) range of 10.3-14.6% day^{-1}, than those in cages suspended in tanks (SGR range 9-11.3% day^{-1}). This could be attributed to the presence of natural zooplankton (copepods and cladocerans) in the pond throughout the culture period, which served as additional food sources for catfish juveniles. In both scenarios, the fish reared at lower densities had significantly higher SGR than fish reared at higher densities. In the pond, the SGR of fish held at 228 and 457 m^{-3} were similar to each other but were significantly lower than those of fish held at 114 m^{-3}. The zooplankton in ponds consisted mostly of copepods and cladocerans, in contrast to tanks, in which rotifers were more predominant. Per cent survival ranged from 85% to 89% in tanks and from 78% to 87% in ponds and did not differ significantly among stocking densities and between rearing systems. In conclusion, catfish nursery in cages suspended in tanks and ponds is density dependent. Catfish fry reared at 285 m^{-3} in tanks and at 114 m^{-3} in ponds had significantly faster growth rates than fish reared at higher densities. However, the desired fingerling size of 3-4 cm total length for stocking in grow-out culture can still be attained at stocking densities of 457 m^{-3} in nursery pond and 571 m^{-3} in tanks.

Cruz-Lacierda ER. Undated. Establishment of methods in managing aquaculture environments to allow sustainable production. In: Studies on sustainable production systems of aquatic animals in brackish mangrove areas. Japan International Research Center for Agricultural Sciences

Cuvin-Aralar ML, Fastner J, Focken U, Becker K, **Aralar EV**. 2002. Microcystins in natural blooms and laboratory cultured *Microcystis aeruginosa* from Laguna de Bay, Philippines. Systematic & Applied Microbiology 25 (2): 179-182

Abstract. Laguna de Bay, the largest freshwater lake in the Philippines, experiences periodic blooms of the cyanobacteria *Microcystis aeruginosa*. Blooms of these cyanobacteria in 1996, 1998 and 1999 were sampled. HPLC and MALDI-TOF mass spectrometry were used to analyze for microcystins. A total of 16 structural variants of the toxin were isolated from the samples with microcystin LR (MC-LR) as the most abundant variant in the samples from 1996 and 1999 making up 77 to 85% of the total, respectively. MC-RR was the dominant variant in the 1998 bloom making up 38%. The samples from 1996 had the highest total toxin concentration (4049 mug g^{-1}) followed by those from 1998 (1577 mug g^{-1}) and 1999 (649 mug g^{-1}). A strain of *M. aeruginosa* previously isolated from the lake was also cultured in the laboratory under different nitrogen concentrations (1, 3 and 6 mg L^{-}) and elevated phosphorus concentration (0.5 mg L^{-1}) to determine the influence of these factors on toxin production. A total of 9 different structural variants of microcystin were isolated from the laboratory cultures with MC-LR consisting more than 75% of the total in all treatments. No significant differences in the total toxin concentration as well as the % distribution of the different variants among treatments were observed. However, the strain of *M. aeruginosa* cultured in the laboratory had from 3 to 20 times higher total microcystin than those harvested from the lake.

Fermin AC, Buen SM. 2001. Grow-out culture of tropical abalone, *Haliotis asinina* (Linnaeus) in suspended mesh cages with different shelter surface areas. Aquaculture International 9 (6): 499-508

Abstract. This study investigated the effects of shelter surface area (SSA) on the feeding, growth and survival of the donkey-ear abalone, *Haliotis asinina* reared in mesh cages (0.38 x 0.38 x 0.28 m) suspended in flow-through tanks (water volume =6 m^3). Cages had sections of polyvinylchloride (PVC) that provided shelters with surface area of 0.22 m^2, 0.44 m^2 and 0.66 m^2. Hatchery-produced abalone with initial shell length of 32±1 mm and wet weight of 7.5 g were stocked at 50 individuals $cage^{-1}$ that corresponded to stocking densities of ca. 227, 113 and 75 abalone m^{-2} of SSA. The ratios of shelter surface area to cage volume (SSA: CV) were 5.5, 11 and 16.5. Abalones were provided an excess red seaweed *Gracilariopsis bailinae* (= *Gracilaria heteroclada*) at weekly intervals over a 270-day culture period. Feeding rates (18-20% of wet weight), food conversion ratio (26-27) and percent survival (88-92%) did not differ significantly among treatments ($p > 0.05$). Body size at harvest ranged from 56 to 59 mm SL and 52 to 57 g wet body weight with significant differences between abalone reared at SSA 0.22 m^2 and 0.66 m^2 ($p < 0.05$). Abalone reared in cages with 0.66 m^2 SSA grew significantly faster at average daily growth rates of 132 and 188 mg day^{-1}. Stocking densities of 75-113 m^{-2} SSA in mesh cages suspended in flow-through tanks resulted in better growth of abalone fed red seaweed.

Hurtado AQ, Agbayani RF. 2002. Deep-sea farming of *Kappaphycus* using the multiple raft, long-line method. Botanica Marina 45(5):438-444

Abstract. Farming practices of *Kappaphycus* seaweed planters using

the multiple raft, long-line method were assessed in three major cultivation areas of Zamboanga del Sur, Mindanao. Results show that this cultivation method is appropriate in deeper waters (> 10 m deep). Family labor (6-70 years old) is usually used in the selection and preparation of 'cuttings', unloading of newly harvested crops and drying of seaweeds, while preparation and installation of the raft, tying of 'cuttings' and harvesting, hired labor is needed. Though the multiple raft, long-line method of cultivating *Kappaphycus* is expensive (PhP 45,742 to PhP 49,785) based on a 500 m^2 raft, return on investment (ROI) is high and the payback period is short. Of the three areas assessed, Maasin had the highest ROI (218%), followed by Tictauan Island (212%), and finally Taluksangay (79%). Consequently, the payback period followed the same order. Seaweed farming in these areas showed a tremendous impact on the quality life of the fisher folk and contributed a high revenue to the national economy.

Lavilla-Pitogo CR, Paner MG, Traviña RD. 2002. Swollen hindgut syndrome (SHG) in hatchery-reared *Penaeus monodon* postlarvae, p 151-158. In: Lavilla-Pitogo CR, Cruz-Lacierda ER (eds). Diseases in Asian Aquaculture. Fish Health Section, Asian Fisheries Society, Manila

Abstract. In the course of routine microscopic analysis of hatchery-reared *Penaues monodon* postlarvae, several batches were found with hindgut abnormalities not previously described in shrimp postalrvae. The abnormality was named swollen hindgut syndrome (SHG) because it affected mainly the hindgut and, to some extent, the posterior midgut. Postlarvae with SHG showed enlargement and distention of the hindgut folds and its junction with the midgut, although in some cases swelling also occurred in the midgut of the sixth abdominal segment. Over a five-year period, incidence of SHG ranged from 6 to 13%. No seasonal pattern was observed as SHG occurred year-round. The abnormality caused cessation of the rhythmic movements of the hindgut-midgut junction resulting to failure of affected postlarvae to excrete fecal pellets. Swollen hindgut syndrome, although reversible to some extent, caused mortality and significant size variation within batches of postlarvae resulting in their unsuitability for stocking in grow-out farms.

Madrones-Ladja JA. 2002. Salinity effect on the embryonic development, larval growth and survival at metamorphosis of *Placuna placenta* Linnaeus (1758). Aquaculture 214 (1-4): 411-418

Abstract. The effects of salinity on the embryonic development, growth, and survival of D-larvae to plantigrade as well as settling in *Placuna placenta* were studied. Embryos were developed to D-larvae of shell length (SL) 86±12 mum (SL±sd) after 20 h at salinities of 22-34 ppt, but not at lower salinity levels. Percentage production of straight-hinged larvae from fertilized eggs at these salinities ranged from 51% to 63% (P greater than or equal to 0.05). *P. placenta* larvae survived and settled in salinities of 16-34 ppt. Settlement occurred first (14 days) in salinities of 22-34 ppt and later (19 days) in 16 ppt when SL greater than or equal to 200 mum. Larval size at metamorphosis was not significantly different among these salinities (P greater than or equal to 0.05). Percentage survival of plantigrades at 34 ppt (13%) was significantly higher (P less than or equal to 0.05) than at 16 ppt (4.5±3%) but not greater than at 22 (6.3±3%) or 28 ppt (7±4%) salinity. The best salinity levels for embryonic development and larval survival at metamorphosis ranged from 22 to 34 ppt and larval growth from 16 to 34 ppt. The tolerance of *P. placenta* to lower and higher salinities progressively increased as larvae develop from embryo to the plantigrade stage.

Marte CL. Undated. Studies on breeding and seed production of the new species of fish with high commercial value. In: Studies on sustainable production systems of aquatic animals in brackish mangrove areas. Japan International Research Center for Agricultural Sciences

Pakingking RV Jr, **Cruz-Lacierda ER**, Torres JL. 2002. Studies on the efficacy of Sarafin ® (sarafloxacin hydrochloride) on vibrios associated with vibriosis in black tiger shrimp (*Penaeus monodon*), p 125-134. In: Lavilla-Pitogo CR, Cruz-Lacierda ER (eds). Diseases in Asian Aquaculture. Fish Health Section, Asian Fisheries Society, Manila

Abstract. *In vitro* activity of Sarafin ® (sarafloxacin hydrochloride) was determined against 7 luminous *Vibrio harveyi* isolates and 3 non-luminous *Vibrio* species (*V. parahaemolyticus, V. alginolyticus* and *V. anguillarum* from diseased marine fish, 1 strain each of *V. alginolyticus, V. vulnificus,* and *V. mimicus* from diseased grouper (*Epinephelus coioides*), and *V.* alginolyticus from diseased seabass (*Lates calcarifer*). Bacterial susceptibility was expressed as minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC). The MIC and MBC values obtained for all *V. harveyi* isolates ranged from <0.3 to 1.25 _g/ml. For the non-luminous *Vibrio* species, MIC and MBC values ranged from <0.08 to 1.25_g/ml. *In vivo* tolerance levels (24 h static bioassay) of larval and postlarval stages of *P. monodon* for Sarafin® were ≤10 _g/ml for nauplii, mysis, and postlarvae and ≤1 _g/ml for zoeae. Morphological deformities in the carapace, rostrum, and setae were noted among larvae exposed to ≥ 50_g/ml Sarafin®. These results indicate that the Sarafin® is a potential candidate as a chemothrapeutic agent against luminous vibriosis in *P. monodon.*

Penaflorida VD. 2002. Evaluation of plant proteins as partial replacement for animal proteins in diets for *Penaeus indicus* and *P. merguiensis* juveniles. Israeli Journal of Aquaculture-Bamidgeh 54(3):116-124

Abstract. The growth rate and survival of two white shrimps, *Penaeus indicus and P. merguiensis*, fed diets in which fishmeal was partially replaced with plant protein sources were investigated in three trials. In trial 1 with *P. indicus*, soybean, yeast and leaf meals of kangkong, papaya and *Cassia tora* L. were screened as partial substitutes for fishmeal. The total biomass of shrimp fed 20% yeast (20 yeast) was highest but not significantly different than that of shrimp fed 10 yeast and 10 papaya. Survival was highest with 20 yeast, 10 papaya and 10 yeast. Shrimp fed *Cassia tora* L. had the highest weight gain and SGR but their survival was similar to those fed poor performing diets. In trial 2 with *P. merguiensis*, the ingredients were modified by decreasing fishmeal and increasing the yeast and soybean substitution. The biomass of the shrimp fed 10 yeast was similar to that of the shrimp fed 20 yeast and 26 soybean, the weight gain and SGR were similar to shrimp fed 20 yeast while survival was highest

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but not different from 20 yeast and 26 soybean. In trial 3 with *P. indicus*, weight gain and SGR were best with 20 yeast and 34 soybean. However, biomass and survival did not differ among replacement levels. The performance of the white shrimp varied with different levels of yeast and soybean meal incorporation. The response of *P. indicus* was best with 20 yeast (15% by weight) or 34 soybean meal (34% by weight) while that of *P. merguiensis* was with 10 yeast (7% by weight), 20 yeast (15% by weight) or 26 soybean meal (26% by weight). Partial replacement of fishmeal with yeast or soybean meal would result in lower feed costs but the use of these feeds needs further refinement since survival was low in all treatments. Rearing techniques, such as increasing the feeding frequency, simulating deep pond conditions or using adequate substrates, should be refined.

Primavera JH, Lebata MJHL, Gustilo LF, Altamirano JP. 2002. Collection of the clam *Anodontia edentula* in mangrove habitats in Panay and Guimaras, central Philippines. Wetlands Ecology and Management 10: 363-370

Abstract. The mangrove clam *Anodontia edentula* is highly prized in the Philippines for its flavor and large size. Because this infaunal species is found down to one meter deep in mangrove areas, harvesting the clam reportedly damages mangrove stands. To evaluate such reports, survey of collection methods was undertaken in Panay and Guimaras, central Philippines in August 1997-December 1999. Host to chemosynthetic bacterial symbionts that utilize sulfide as energy source. *A. edentula* are strategically situated in sulfide-rich anoxic substrates but also gain access to oxygenated seawater through a ventilation burrow or tube. By locating the opening of this burrow, collectors can detect the presence of a buried clam and harvest it nondestructively with a blade or bare hands. In contrast, the indiscriminate tilling of wide mangrove areas can damage mangrove plants. Most collectors were 40-45 years old with 22-30 years collection experience, married with 5-7 children and had low educational attainment. They sold clams directly in the local markets or through middlemen (to restaurants and beach resorts); sales provided from 10% to 100% of daily family income. Collectors complained of decreasing clam sizes and numbers and the physically strenuous work of collecting.

KALIBO ... from page 1

Sampling for mud crab juveniles at Buswang for the EC-CAMS project

FAO expects to document the 30 selected forests as case studies and as technical papers where their commonalities and differences can be analyzed. The forests also exemplify a broad range of eco-types from many countries in the region.

The select 30 are found in Australia, Cambodia, China, Fiji, India, Indonesia, Japan, Republic of Korea, Kyrgyz Republic, Laos PDR, Malaysia, Mongolia, Nepal, New Zealand, Philippines (four sites: Mt Makiling Forest Reserve, Kalahan Reserve, Ifugao Muyong, Buswang Mangrove Plantation), Sri Lanka, Vanuatu, and Viet Nam. ###

Tendencia EA, de la Pena LD. 2002. Level and percentage recovery of resistance to oxytetracycline and oxolinic acid of bacteria from shrimp ponds. Aquaculture 213 (1-4): 1-13

Abstract. The bacterial level of the water, sediment and cultured shrimp (*Penaeus monodon*) from different ponds were determined using a general medium, a presumptive *Vibrio* medium and a presumptive *Pseudomonas-Aeromonas* medium. Samples were taken from ponds that had not used any antimicrobial, ponds that had previously used and also ponds that were currently using oxolinic acid (OXA). The bacterial level in the sediment was higher than in the water using all three media. More bacteria existed in the pond system than in the receiving environment. Shrimp hepatopancreas harbored more bacteria than the lymphoid organ. The *Vibrio* density of the pond and bacterial levels in the shrimp were correlated with the use of the antimicrobial. The *Vibrio* level of the pond samples and microbial density of shrimps were higher from ponds that had not used any antimicrobials. The percentage recoveries of resistance to oxytetracycline (OTC) and OXA in bacteria from shrimp ponds and cultured shrimps were also determined using Zobell's marine agar, *Pseudomonas-Aeromonas* selective agar and thiosulfate citrate bile sucrose agar (TCBS) with the addition of either 25 mug/ml OTC or 25 mug/ml OXA. Presumptive *Vibrio* bacteria and other bacterial taxa recovered from the pond/receiving water/sediment from all three sites showed some degree of resistance to OTC and OXA. However, a higher percentage recovery of strains resistant to OTC than to OXA was observed among the presumptive vibrios and other bacterial taxa. *Pseudomonas* and *Aeromonas* bacteria were more resistant to OXA compared with the vibrios. All bacterial taxa resistant to OTC were more readily recovered from the water samples than from the sediment samples. In general, between the samples from the pond and from the receiving environment, a higher percentage of resistant strains was observed in the latter. Higher percentage recovery of bacteria resistant to OXA was observed in shrimp from ponds currently using OXA than those from ponds that had not used any or those that had previously used them. The results of the present study showed that the percentage recovery of resistance reflected the pattern of antimicrobial use.

FROM AROUND THE WORLD

queensland.australia

Participants to the 2002 Diseases of Asian Aquaculture *symposium in Queensland*

Fish health experts gather for the 5th symposium on diseases in Asian aquaculture

"Bitter experiences and substantial economic losses have demonstrated that good health management is key to success in aquaculture," says Dr. Rohana Subasinghe of the Food and Agriculture Organization in Rome, in effect explaining why experts continue to gather and discuss diseases in Asian aquaculture.

Hosted by the Fish Health Section of the Asian Fisheries Society, the symposium, dubbed DAA, was held in Gold Coast, Australia from November 24 to 28, 2002. It was sponsored and supported by CSIRO; Department of Primary Industries-Queensland; Biosecurity Australia; Department of Agriculture, Fisheries and Forestry-Australia; NSW Fisheries; Intervet; INVE; University of Queensland; WAS-Asia Pacific Chapter; ACIAR; and Australian Prawn Farmers Association.

Trans-boundary pathogens (disease-causing agents) were the foremost concern, especially since many Asian countries share common social, economic, industrial, environmental, biological, and geographical characteristics. Experts emphasized that a country's national quarantine and health certification requirements for imports must be developed within the context of international standards, that is, the World Trade Organization's Sanitary and Phytosanitary Standards Agreement and the Office International des Epizooties' Code and Manual. Even so, notes Dr. Barry Hill of the Centre for Environment, Fisheries and Aquaculture Science in the United Kingdom, it is important to recognize that such legal safeguards alone may not necessarily prevent the sudden appearance of a serious disease in a country from which it was previously believed to be absent. Reasons include failure of an import risk analysis, ineffective surveillance for the disease/pathogen in the exporting country, and illegal imports.

Dr. Hill adds that there is also the possibility of the emergence of a more virulent strain of the pathogen that has existed benignly in a local reservoir without previous detection.

What could this mean for the farm's biosecurity? Farmers are advised to strictly adhere to protocols such as seed and brood screening programs; proper disinfection strategies at defined critical points where pathogens may gain entry to a culture system; isolation/quarantine, access restriction, disinfection when the disease is detected. Basic farm management must also include monitoring of pond soil and water quality, in particular dissolved oxygen, pH, ammonia, and hydrogen sulfide.

"The need of the hour," experts agree, "is to have rapid, on-site immunodiagnostics which do not need sophisticated equipment and trained manpower." There are efforts towards this goal. The state-of-the-art methods of disease detection are by: gross symptoms; post-mortem examination; wet mount; electron microscopy; histopathology; microbiology; immunodiagnostics; and DNA-based diagnostics.

When disease is present in the farm, it might be counterproductive to use pharmaceuticals primarily because of strict international regulations regarding chemical residues. There are already complex regulations on pharmaceutical use to protect the consumer market. And, the European and North American markets may be excluding produce from country sources where veterinary medicines are less regulated.

What does the future hold? Experts foresee that while researchers and scientists must continue to provide the necessary scientific base through targeted research and information dissemination, ensuring institutional, financial and human capital will continue to depend on the political will of governments.

There were lots more technical papers presented in the symposium, covering topics on the white spot syndrome of shrimp, betanoviruses and iridoviruses of fish, advances in molecular genetics, immunology, vaccine development, therapeutics (including herbal preparations), breeding disease-resistant shrimp, to name some.

From SEAFDEC/AQD in the Philippines were five poster or oral presentations, as follows:

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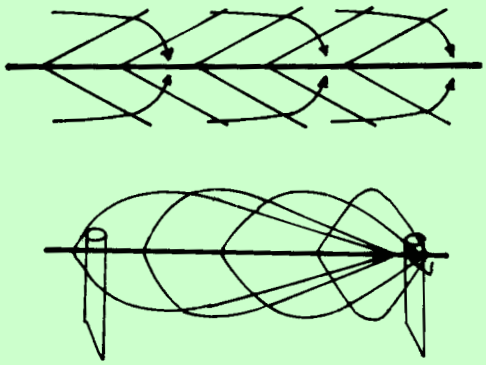
FRESHWATER PRAWN MACROBRACHIUM ROSENBERGII

CONTINUED FROM THE BACKCOVER

sufficient protection during molting when their skins are soft and susceptible to injuries and diseases. The shelter may be made of small bamboo sticks tied together in several ways, some of them designed as follows:



Observe care in stocking the postlarvae into the ponds. PLs should be stocked at 5-30 or 10-40 per m^2. Polyculture with tilapia may also be done. It is advisable that *ulang* is first stocked, followed by tilapia after two weeks. When stocking PLs, it is good to do it during early morning or late afternoon when the weather is cool. Acclimatize first before releasing the PLs into the ponds. On the first day after stocking, do not feed the stock. Feed on the second day following the feeding management:

Size of fry	*Amount of feed (% body weight)*	*Feeding frequency*	*Protein requirement*
Fry (PL)	5-10	2x (am, pm)	35-40
Juvenile	3-5	2x (am, pm)	30-35
Adult	3-5	2x (am, pm)	25-30

With the above scheme, the amount and kind of feed is determined by using Table 1 as feeding guide.

Ulang may also be fed with chopped golden snail, carrots, and kitchen refuse. Make sure that the size of the chopped parts fit the size of the stock to allow ingestion.

Ulang can be harvested after 4-5 months from stocking. Harvest all or a part of the stock. Either way a net may be used for harvesting. It may also be handpicked, depending on the amount of harvest.

Maintenance activities should be undertaken such as: fertilize the ponds weekly, maintain water quality (greenish, dissolved oxygen of 5 ppm; pH 6.5-8.5; 25-30 ^{0}C; water hardness <100 ppm, $CaC0_3$ >40 ppm), keep the ponds clean, supplement feeding, use sinking feeds, and do not use chemical sprays near the ponds.

A simple cost-profit computation shows that with 10,000 PL stock in a 2,000 m^2 pond, a farmer's total sale is P66,000. With P32,300 expenses, he'll make a net profit of P33,700.

Prospects

Through time, Lina predicts that the Thai variety would be cross-bred with the Philippine native. He says that the Philipppine native is more difficult to grow than the Thai but is bigger and faster growing. The cross-bred *ulang* would hopefully be as easy to farm as the Thai and as big and fast growing as the Philippine native. He is also aware that people prefer marine species to freshwater but he has gone into an information campaign for acceptability, whether for farming or for food. For farming, he conducts training for grow-out production six times a year in his office, and for food, he has already started to hold

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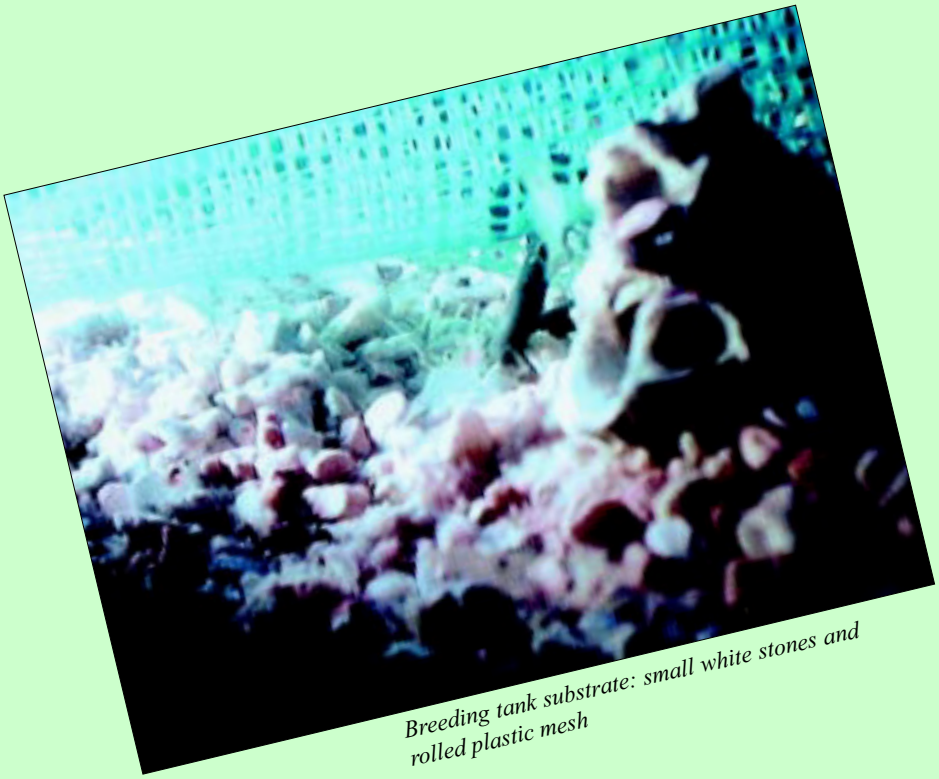
Table 1. Feeding guide for the freshwater prawn based on Lina's experience

Days culture	*Number per kg*	*ABW (g)*	*Feed rate*	*Feed type*	*Feed amount*	*% feed rate*	*Total feed (kg)*
1-30	10 000	0.01	3	Crumbles	0.01	10	3
31-40	625	2.28	3	Crumbles	1.00	10	10
41-50	296	3.37	3	Crumbles	1.48	10	15
51-60	200	4.99	3	Crumbles	2.19	10	22
61-70	135	7.39	2	Grower	3.24	10	32
71-80	91	10.94	2	Grower	1.44	5	14
81-90	62	16.19	2	Grower	2.13	5	21
91-100	42	23.97	2	Grower	5.52	4	25
101-110	28	35.48	2	Grower	3.74	4	37
111-120	43	23.5	2	Finisher	5.53	4	55
121-130	29	34.12	2	Finisher	8.19	4	82
131-140	20	50.50	2	Finisher	9.09	3	91



Breeding tank substrate: small white stones and rolled plastic mesh

Lina (in blue shirt) conducts grow-out training every two months

FRESHWATER PRAWN ... from previous page

ulang cooking contests or foodfests in business schools in Metro Manila to encourage and inform future and present investors and perhaps gourmets. Lastly, to make sure that the producers know exactly where they may sell their *ulang*, he provides market information to his clients. All these he does to ease production problems.

No doubt Lina faces a daunting future, but for him, nothing can be too difficult for the progress of *ulang* culture. -- *MBS*

[PHOTOS FOR THIS ARTICLE COURTESY OF L. LINA]

SEAFDEC/AQD NEWS ... from page 6

feeds; (5) Dr. Wenresti Gallardo, *Development of strategies for stock enhancement for priority species like abalone, top shell, giant clam, window-pane shell, and sea horse*; (6) Dr. Jurgenne Primavera**,** *Mangrove-friendly shrimp culture project*; (7) Ms. Ma. Lourdes Aralar, *Development of appropriate technologies for use in lakes*; (8) Dr. Yasuo Inui, *Aquaculture disease management and SEAFDEC-JIRCAS Collaboration*; (9) Dr. Zubaida Basiao, *Plans on freshwater species (tilapia and carps)*; and (10) Dr. Corazon Santiago (in behalf of Josefa Tan-Fermin), *Catfish proposed plans.*

Training and Information Head Mr. Pastor Torres Jr. reported on the status of training courses, fellowships, and information dissemination programs. Last year, AQD was able to offer nine short courses, two online courses and accommodate 130 on the job trainees (OJT) and 27 interns. Due to the shift in priority of the Government of Japan, which funds the fellowship grants, there will be less regular training courses in 2003. Strategies for training include intensification of specialized internships, addition of more online courses, continuation of regular courses that are popular (based on demand), course and material development for self-instruction, and the Rural Aquaculture Development (RAD) Training Demo Project.

For the information program, there will be minimal changes: the aquaculture newsletter will still be published albeit with limited pages, manuals will be printed and sold as materials become available, *Aquafarmers' Corner* in the official website (www.seafdec.org.ph) will be maintained, the in-house newsletter for the AQD family published weekly, two-thirds of the journal subscriptions of the AQD Library will be retained, and the Internet server upgraded.

AQD will likewise continue its current thrusts on technology verification, extension, and commercialization programs. For more information, email: aqdchief@aqd.seafdec.org.ph. ###

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DISEASE EXPERTS ... from page 10

- Ms. Eleonor Tendencia – "Effect of tilapia *Tilapia hornurum* on luminous bacteria *Vibrio harveyi*"
- Dr. Elena Catap – "Experimental transmission of hepatopancreatic parvovirus (HPV) in *Penaeus monodon* postlarvae"
- Ms. Gregoria Pagador – "Biology and pathogenicity of the gill monogenean *Pseudorhabdosynochus* sp."
- Dr. Celia Lavilla Torres - "Evaluation of pathogenicity of bacterial strains by static bath in crustacean larvae: significance of monitoring bacterial counts"
- Dr. Yukio, LD de la Peña, E Cruz-Lacierda - "Susceptibility of marine fish species to piscine nodavirus from orange-spotted grouper, *Epinephelus coioides* in the Philippines"

Dr. Torres, AQD scientist, also attended the symposium as part of the organizing committee.

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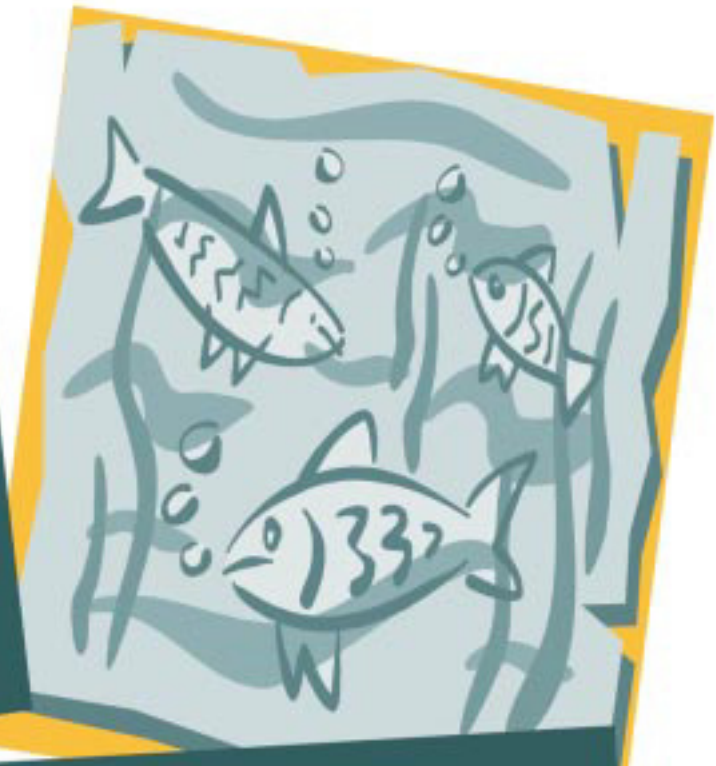

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Filipino Engineer Makes Big Strides in Freshwater Prawn Culture

Luis Lina, owner of the first ulang *hatchery in the country shows adult-sized ulang. He urges tilapia growers to try* ulang *farming which he says sell at P400-P700 per kilogram*

The freshwater shrimp
Macrobrachium rosenbergii

Holding tanks for breeders (big tank) and postlarvae (other smaller tanks)

Engineer Luis Lina says that *ulang* farming is profitable (freshwater prawn, *Macrobrachium rosenbergii*). Who can better assure us than this engineer who owns the first commercial hatchery of *ulang*?

Ulang sells P400-700 per kg. With the inspiring price, he established a hatchery so that he can assure farmers of steady fry supply and eventually encourage grow-out production. His *ulang* hatchery is in MBL Farms, where he raises other aquaculture crops, in the town of Pangatlan, Mexico, Pampanga.

Hatchery

He initially got his breeders from the Central Luzon State University in Nueva Ecija. Now he raises his own breeders from eggs that he allows to hatch and grow for 6-7 months. After this time, *ulang* has reached sexual maturity. He stocks 20 females and 1 male in a 2-m diameter circular tank, 2.5 m deep with freshwater. After spawning is detected, and as soon as the prawn larvae detaches itself, the female is returned to the broodstock tank. Saltwater is slowly added in the larval rearing tank to reach a salinity of 12 ppt. This salinity is maintained during the larval stage only. At PL1 until 20, freshwater is gradually added to decrease the salinity to 6, then to nil. The PL20 is now ready for the freshwater grow-out ponds.

Lina feeds with *Artemia*. It takes about 45 days for *ulang* to develop from eggs to PL 20 when the fry is ready to be stocked in ponds. Lina says that the first 10 days are the most tedious.

With his 1,500 breeders, he continues to produce fry. Lina mentions a few things to remember in *ulang* hatchery. "It is important to provide shelters in the breeding tanks because during the day, they hide in the shelters," Lina says. Further, it must be kept in mind that the *ulang* hatchery technology is not well developed. Survival from hatching to PL20 is at 12.5%, Lina said.

Grow-out

But Lina says that growing the fry in ponds is not as tedious as growing PLs and likens *ulang* to tilapia in ease of culture. In the seminars he conducts on grow-out culture, Lina emphasizes that a farmer should have sufficient knowledge of *ulang* before starting. For site selection, it is good to have an excellent supply of good water and having a kind of soil with strong water retention. He recommends the use of well water in ponds with a minimum depth of 2-3 ft on the shallow end and 3.5-5 ft on the deep end.

Pond preparation is much like that of the brackishwater giant tiger shrimp (*Penaeus monodon*) pond preparation. One has to eradicate predators, screen in the ponds inlets and outlets, sun dry until the land cracks, and maintain a water depth of 0.8 - 1.2 m. Apply lime when needed (1,000 kg per ha), fertilize with 16-20-0 or chicken manure (1,000 - 2,000 kg per ha). After the pond preparation, scatter shelter all over the pond to allow *ulang* to have

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