Asian Aquaculture

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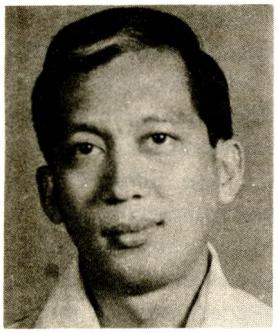
Aquaculture scientist is one of RP's outstanding young men in '78



Dr. Rafael D. Guerrero III

Dr. Rafael D. Guerrero III, 34, a Filipino aquaculture scientist, was chosen as one of the outstanding young men of the Philippines for 1978. He was especially cited for his pioneering research work on the sex reversal of tilapia which has made possible the production of high yields of harvestable-size fish.

The outstanding young men of the Philippines (TOYM) award is bestowed yearly after an extensive search and selection to not more than ten Filipinos working in diverse fields whose achievements are worthy of emulation and have contributed significantly to the welfare of the people as well as the progress of the country.

Guerrero's work on the commercial application of the sex reversal techniques for controlling tilapia reproduction is a well-recognized milestone in aquaculture. His technique is now being tried, or further improved, in the U.S. and Israel. His studies on the hatchery and culture of

(Continued on p. 2)

Int'l cage & pen culture & nat'l aquaculture technology consultation held

An 11-day workshop on cage and pen fish culture attended by scientists and experts from 12 countries and a 4-day technical consultation on available aquaculture technology in the Philippines are to be held this month at the SEAFDEC Aquaculture Department main station in Tigbauan, Iloilo, Philippines.

The cage and pen fish culture workshop, scheduled for Feb. 12 to 22, covers engineering and design concepts and techniques of culture in brackish and freshwater and marine environments, while the technical consultation (Feb. 8-11) seeks to identify and collate current available technology on milkfish, prawns, molluscs, and tilapia; determine production potential of available technology; and crystallize technology gaps in selected aquaculture systems and determine suitable linkage mechanisms for the transfer of appropriate technology. To come out of the consultation are updated technology packages for milkfish farming, prawn culture, mollusc farming and tilapia culture

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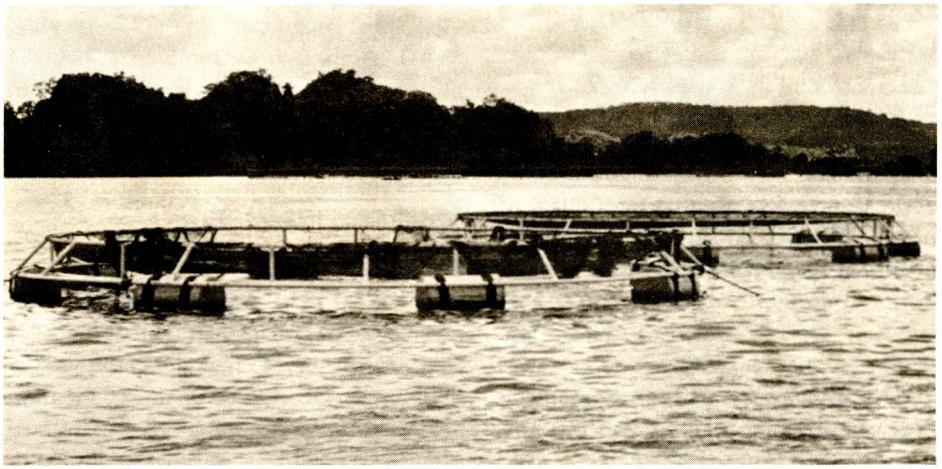
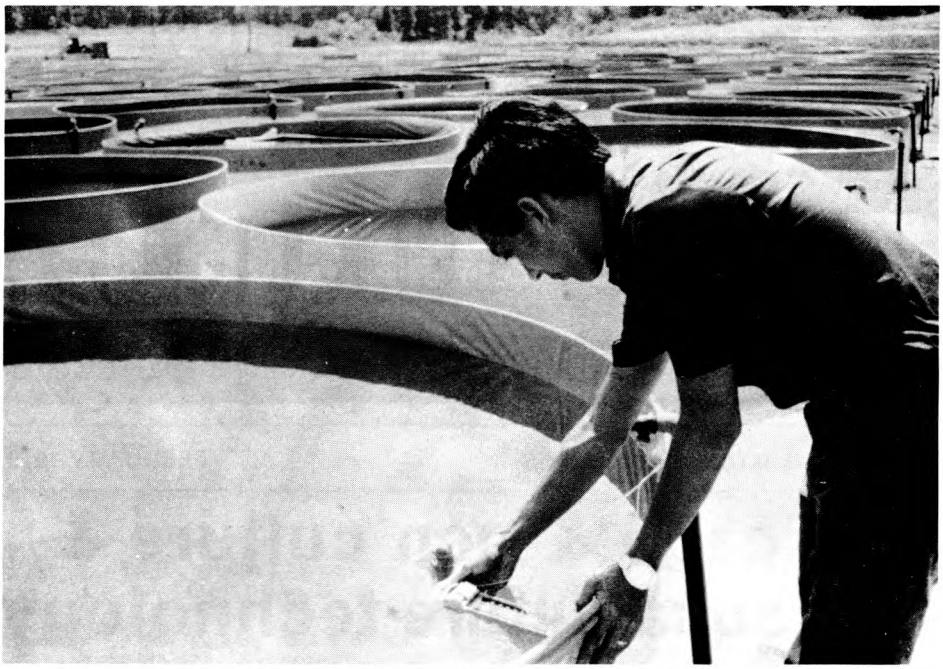


These floating cages contain milkfish broodstock. Six of these have been floated at Igang within the Department's seafarming station territory. Framing is GI pipe, net is nylon, floats are styrofoam. The cages were designed by Aquaculture Department engineer Orlando K. Yu.

Aquaculture scientist... *(from p. 1)*



Dr. Guerrero checks temperature of a plastic pool used for rearing sex-reversed tilapia.

Tilapia nilotica in ponds, paddies and cages have been packaged and extensively disseminated. Some of these technologies are currently being field-tested. With their application, production of *T. nilotica* will be significantly increased.

The TOYM citation noted that Guerrero's research work is geared towards increasing fish production in the rural areas with the capability and resources of the small fish grower. His choice of tilapia is doubly significant for this fish is considered the poor man's fish in the Philippines, the citation added. His development of the cage culture technology for Nile tilapia provides efficient method for utilizing the vast inland water resources of the country and generates income-earning opportunities for the rural poor, the award stated.

Dr. Guerrero is dean of the College of Inland Fisheries of the Central Luzon State University (CLSU) and the assistant project coordinator and research coordinator of the Freshwater Aquaculture Center of the same university. He was one of the designers of the CLSU inland fisheries curriculum, considered the only one of its kind in the country.

His contributions to aquaculture research and development include technical consultancies to the national agricultural research system. He is the Team Leader of the aquaculture research commodity team of the Philippine Council for Agriculture and Resources Research and consultant in aquaculture of the National Science Development Board, the Pampanga Agricultural College, and the SEAFDEC Aquaculture Department. He also headed the PCARR committee that put together the Philippines Recommends for Tilapia, 1976.

Guerrero has represented the Philippines in several international conferences, the most significant of which was the FAO Aquaculture Conference held in Kyoto, Japan in 1976. He has presented or published some 21 technical papers. He also writes a column in the widely-circulated popular magazine, Modern Agriculture and Industry-Asia.

The International Foundation for Science in 1976 awarded Guerrero a research grant to do studies on the cage culture of tilapia, making him the first Filipino to be awarded by the Foundation which recognizes young scientists of outstanding qualities. Another grant from the Asia Foundation enabled him to extend the *T. nilotica* hatchery and culture technologies he has developed with his associates in CLSU to fish farmers and extension workers.

Guerrero holds a Ph.D. in fisheries management from Auburn University, an M.S. in applied zoology from the University of the Philippines, and a B.S. in Zoology, also from the U.P. ●

Int'l cage & pen culture...

(from p. 1)

in the Philippines, clearly identified technology gaps in the farming of these three commodities, and aquaculture technology transfer schemes.

Hosts to the cage and pen culture workshop are the International Development Research Center (IDRC) based in Canada and the SEAFDEC Aquaculture Department.

Among the topics to be taken up are location, flotation systems, rigging, size and shape of and materials for net pens; ways of dealing with fouling and protection of net pens; feed, disease control, protection against predators; and economics and legal considerations of pen and cage culture systems.

Some 17 experts on this area of aquaculture, excluding Filipino participants, from 11 developing countries (West and East Malaysia, Singapore, Indonesia, Thailand, Hongkong, India, Bangladesh, Turkey, Egypt, Sudan and Colombia) are participating. Demonstrations of some aspects of pen and cage culture follow the usual presentation and discussion of papers.

The technical consultation is sponsored by SEAFDEC in cooperation with the Philippine Council for Agriculture and Resources Research (PCARR) and will be attended by around 75 researchers, technologists, production specialists, and research managers from the two institutions, the University of the Philippines, Central Luzon State University, the Bureau of Fisheries and Aquatic Resources, Fisheries Industry Development Council, South China Sea Programme, and the private fishery industry sector. ●

Advances in prawn research & development in SEAFDEC

The dollar-earning potential of prawn is a well-accepted fact in the Asian region. In the Philippines, for instance, while it has traditionally been raised as a secondary crop, prawn has overshadowed milkfish as an export commodity. The farm gate price now stands at ₱58 a kilo; in the Metromanila market it is some ₱70 per kilo while exporters or their agents offer as high as ₱72 or even more for one kilo. Fry, on the other hand, is bought by pond owners from fry gatherers at about ₱0.20 to ₱0.41 apiece. Live adults caught in the wild and intended for broodstock are being bought by the SEAFDEC Aquaculture Department at ₱6.50 apiece for females and ₱4.00 for males.

As in milkfish, the main constraints to the prawn culture industry have been the unavailability of a constant and reliable supply of fry and the inadequate technology related to the domestication, hatching, rearing and growing of the species.

Work at the SEAFDEC Aquaculture Department began with prawns.

Previous Studies

Before the Department was established, pioneering studies at the Mindanao State University (MSU) Institute of Fisheries Research and Development had shown that *Peneaus monodon* can be cultivated successfully in controlled enclosures. As early as 1969, the MSU researchers, led by then MSU College of Fisheries dean, D.K. Villaluz, who would eventually become the chief of the Aquaculture Department, conducted a series of successful trials on the spawning and larval development of *P. monodon* under laboratory conditions.

The Department, upon its organization, carried on researches on cultivation at the Leganes station experimental ponds and on seed production at the hatcheries in the main station in Tigbauan, both located in Iloilo province.

Initially, prawn fry from the Mindanao State University hatcheries were stocked in the Department's ponds in Leganes. The stocking enabled a series of experiments to determine factors affecting survival of fry during their transfer from hatchery to pond.

To hasten the development of efficient techniques in prawn cultivation, SEAFDEC in 1974 came up with the Fishpond Cooperators Training Program, a research-production scheme. Under this program, the Department formulated the designs for research and production, and provided the research workers and research materials. The cooperators, in turn, made their ponds available for research and provided fertilizers, chemicals and the technicians to take care of the prawn stocks and the ponds.

Some cooperators were allowed to culture their prawns in accordance with their traditional practices while the Department researchers recorded these practices and their results as benchmark information to become bases for further research and improvement of culture techniques.

In December 1975, researchers of the Department succeeded in inducing sugpo to mature, at the same time producing the first generation of postlarval fry following standard hatchery procedures.

This achievement is the first recorded completion of the life cycle of *Peneaus monodon* in captivity.

Shortly thereafter, the Department succeeded in inducing ovarian maturation of spent spawners from the hatchery.

This success in inducing gonadal maturation should lead to the solution of two major problems in prawn culture: the high cost of obtaining gravid females in natural fishing grounds and dependence on seasonal periodicity of gonadal maturation of wild female stock.

Employing the unilateral eyestalk ablation technique first attempted by the Department in 1975, 3,600 prawn spawners were produced in 1977 compared to only 1,360 in the previous year. This gave a 300 percent increase in spawner supply and demonstrated the feasibility of mass producing sugpo spawners under laboratory conditions.

Findings at the wet laboratories indicate that sugpo spawners collected from the wild spawn between 350,000 to 1 million eggs while ablated spawners spawn between 150,000 to 500,000 eggs. Hatching rate of eggs range from 50 to 95 percent. There is no significant difference in the hatching rates of wild and ablated spawners.

In the wild however, only one-tenth of one percent of the eggs — or five to ten thousand — would probably survive. Present technology has made possible a 60 percent hatching rate and a 30 percent survival chance — or an available stock of from 30 to 90 thousand prawns from a single spawner.

The SEAFDEC Aquaculture Department organized in November 1976 the prawn program generally aimed at modernizing the technology of prawn culture through complete domestication of all stages and development of intensive rearing techniques. The major emphasis was on sugpo but studies are now conducted on other commercial penaeids as well.

(Continued on p. 6)

Research on *Artemia salina* in the Philippines

Very good progress is being made in optimizing the use of the brine shrimp, *Artemia salina,* as larval food for various aquatic species under study at the SEAFDEC Aquaculture Department.

Its main station at Tigbauan, Iloilo, Philippines is the first hatchery in the world to apply the *Artemia* cyst-decapsulation method on a routine basis. It has put under control the culturing of the nauplii to the adult stage on cheap inert diets, such as rice bran, and demonstrated the pilot-scale production of cysts under controlled hatchery conditions.

The Department, in collaboration with a Pond Cooperator in Barotac Nuevo, Iloilo, has been the first in Southeast Asia to demonstrate the feasibility of *Artemia* cyst production in man-made salt ponds (see AA Vol I, No. 2).

Taking off from the initial SEAFDEC laboratory trials and with technical expertise provided by SEAFDEC researchers, Mr. Ceferino de los Santos, Jr. showed the feasibility of commercial production of *Artemia* and is now growing brine shrimp successfully and producing highly viable eggs (90 percent hatching rate) which he cans and sells at 30 percent less than the prevailing price. He also produces *Artemia* flakes for aquaria fish food.

The importance of *Artemia* in aquaculture is widely recognized. It is the source of the best food actually available for the larval stages of fish and crustaceans. However, there is a critical shortage of *Artemia* cysts and the need has been felt for aquaculture hatcheries to spend more efforts to improve and, as a consequence, economize the utilization of the brine shrimp. *Artemia,* which thrives well in high salinity waters, are not found in nature in the Philippines and all of Southeast Asia because of heavy rainfall.

Department scientists attempted to culture *Artemia* in the laboratory in an effort to find how local environmental conditions affect it growth.

Initial experiments conducted from 1975 to 1976 included studies on feeds and feeding, salinity, culture in basins, preliminary mass production in marine tanks, collection and processing of eggs, and hatchability.

In the first half of 1977, the Department began collaboration with Dr. Patrick Sorgeloos of the *Artemia* Reference Center, State University of Ghent in Belgium for studies at its main station in Iloilo in hatching *Artemia* nauplii, high density culturing of larvae to adult, and outdoor production in salt ponds. Techniques in decapsulating *Artemia* cysts were improved and indoor culture of larvae and adults was started. Results were very encouraging with particular success in growing *Artemia* in salt ponds, a success only previously achieved in other countries without heavy rainfall.

In 1978, studies on *Artemia* were narrowed down to three: cyst and nauplii production in indoor tanks, mass rearing from nauplii to adult, and screening of various strains for local culture in indoor tanks.

The study on mass rearing indicates that high density culture is possible in a flow through system with short detention time; and that very fine rice bran less than 60 microns in diameter is a suitable feed for *Artemia* provided that feed concentration is maintained at a turbidity level of 25 to 35 centimeters.

The study on cysts and nauplii will eventually lead to the adoption of a system for economical production in indoor tanks.

Preliminary studies conducted on various *Artemia* strains available in the market compared the following characteristics: sex ratio, average length of newly-hatched nauplii, avarage length of sexually mature male and female, and growth rates. Information gained from this study will help in selecting useful strains for further breeding experiments.

Artemia has now been found to be an excellent feed for prawn larvae beginning with the mysis 3 stage. Because providing suitable feed in sufficient quantities for larval crustaceans is a critical component of the hatchery, the studies conducted by the SEAFDEC Aquaculture Department on *Artemia* augurs well for aquaculture in this part of the world. ●

New Developments in Feed Technology

A new technique in capsulating feed for larvae of fish and crustacea under intensive culture systems has been developed by a Welsh marine biologist working at Bangor University Marine Biology Department. This was announced recently in the *Fish Farmer,* a U.K. – based publication.

Dr. David Jones has succeeded in wrapping microscopic food particles in a synthetic membrane which eliminates bacterial attack and halts the dissolving of nutrients into the water.

After six months of collaboration with a Japanese nutritionist, he has announced the first successful prawn rearing system from egg to marketable adult based entirely on artificial diets.

The new technique involves encapsulation inside a membrane which is made of nylon cross-linked with protein. While the technology involved is not new and has been used very successfully in human medicine, the refinements of the membrane used are a secret. Using it, capsules measuring only 5 microns can be made allowing artificial feeding during the critical post-hatching phase of crustaceans and small-mouthed fish.

The significance of the encapsulation technique is that commercial fish and crustacea production could be streamlined by the elimination of the phytoplankton production on site.

On a laboratory scale the capsules are stored under brine. Commercial production might involve deep freezing or freeze drying.

Costings done by a commercial firm interested in producing the encapsulated feeds suggest that the cost compares favorably with that of producing live feeds.

Edible Crustaceans in the Philippines

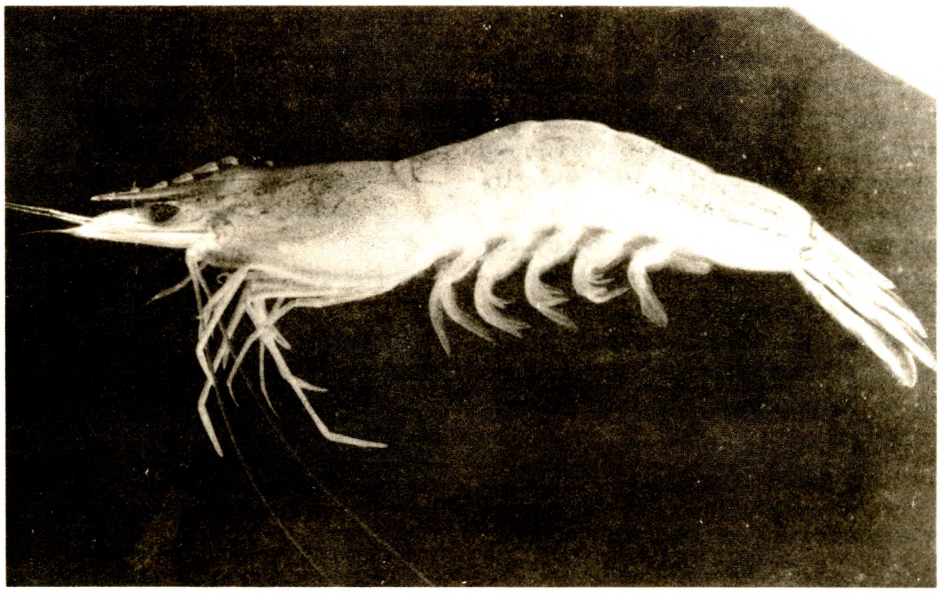
Penaeus merguiensis DE MAN
English name: Banana prawn, White prawn
Philippine name: Puti (Tagalog), Hipon Puti (Tagalog), Lunhan (Cebuano), Putian (Cebuano), Pasayan (Ilongo)

P. mergguiensis reaches adult size of 6 to 10 cm, and may exceed 17 cm in body length. Unlike the tiger prawn, the banana prawn has no dark brown transverse bands on the carapace and abdomen. Carapace and abdomen are uniformly glabrous. The proximal part of the rostrum is considerably high, triangular in shape, particularly more so on fully grown females. Rostrum is usually armed with 7 or 8 teeth dorsally and 5 or 6 ventrally. Telson has no lateral spine.

The color in life is cream to yellow, sometimes minutely speckled with brown, olive green or light green pigment spots. Antennules are banded with brown; brown antennae are not banded; legs and pleopods are yellowish, sometimes tinged with brown or pink; uropods are colored in combinations of yellow, green and brownish shades. The upper margin of the rostrum is fringed with brown in a fully grown material.

This species mostly dwells in shallow open sea, and at the mouth of the river and bay areas where water is more or less turbid, and is commonly caught by commercial trawlers and trapped in fish corrals. Found in the Indo-Pacific region from the Philippines, Malaysia, Indonesia, Mergui Archipelago, India to New Guinea and Australia, this species has a market value of about half the price of *P. monodon.*

*Contributed by H. Motoh; third in a series.



R & D Notes

Some Laboratory Indications for Crab Fattening*

A very important side information has been gathered from a 10-month (February to November 1978) study on the gonadal maturation of *Scylla serrata* at different salinity levels. Test salinity levels were: 30 ppt, 20 ppt, 22 ppt, 26 ppt and 28 ppt.

It was observed that at 26 ppt, lesser molts per crab per broodstock occured but with very high body weight increment. Meanwhile, more molts were observed at 30 ppt but with lesser overall weight increments. At the same time, survival of the captive crabs in the lower salinities was higher due to the lesser frequency of exposure of molted ("soft") crabs to the "hard" unmolted ones. Cannibalism was therefore minimized.

These observations suggest the possible practical application of water quality management in crab fattening systems whether in land-based tanks or in ponds. Such manipulation can lead to the maintenance of conditions suitable for growth of crabs. The market quality of these crabs would foreseeably be high and turnover would be faster. In addition to water quality management, a strategically arranged refuge system should offer the crabs more surface area for shelter and movement.

The main objective of this study on gonadal maturation was to find out at what salinity levels germ cells of male and female crabs would attain maturation. It was observed that at 26 ppt mating occurrence was highest from February to June, and highest at 20 ppt followed by 26 ppt from July to November. Gonadal condition indices were recorded highest at 28 ppt from February to June and at 20 to 22 ppt from July to November 1978.

*Contributed by Alice Fe Laviña of the SEAFDEC Aquaculture Department crab research project.

Advances in prawn research...

(from p. 3)

Pre-Program Status

At the time the SEAFDEC prawn program was being organized, the following situations were observed to be prevailing in terms of prawn research and development.

a) Basic techniques for prawn larval rearing had been worked out but refinement was needed to stabilize survival rates in hatchery. The feeds, consisting mainly of diatoms, were propagated in the larval rearing rank itself;

b) Mass mortalities in the hatchery were often unexplainable. If the mortalities were at all explained, these were made in purely physical terms such as nitrite/nitrate and ammonia levels in the water. Biological parameters like diseases and natural feed densities were not given as much attention and consequently remained unidentified. Prophylactic measures were non-existent.

c) Natural feeds production research was geared towards screening species from local waters as possible larval feed;

d) Nutritional requirement studies were non-existent; while feed development research was oriented towards artificial larval feed production for hatchery, pond feed development was neglected;

e) Hatchery was totally dependent on wild spawner supply. However, maturation inducement through eyestalk ablation in captive adult prawn has already been demonstrated at the experimental level;

f) Ecological research was geared towards spawner distribution and collection;

g) Research in the grow-out aspects was conducted in large ponds, often unreplicated;

h) Mortality of hatchery-reared fry during pond rearing was heavy. Techniques used were not much different from those used for milkfish;

i) Pond researchers wanted older post-larvae for stocking while hatchery workers wanted to harvest as early as possible.

Further Work

To increase growth and survival rates of larvae, nutrition and disease control studies were intensified. There are two distinct areas involved in the feed studies: feed for larvae and feed for juveniles and adults. Simultaneous with studies on the culture of such natural feeds as diatoms, brine shrimp and water flea, studies on unconventional sources of protein are also conducted. Attempts are being made to look for locally available materials which may be suitable for feed, such as defatted coconut meat, rice bran, shrimp heads, *Leucaena* seeds, *Atys* or tiny shrimps locally known as *alamang,* and soybeans.

Another research area is disease control. In an artificial ecosystem where density of the cultured organism is high, diseases can take a great toll. Identification, prevention and control of disease-causing organisms is essential in order to find the causes of and prevent mass mortalities and make larval rearing evolve from art to technology.

A technique which would enable Department researchers to predict the onset of diseases in hatchery tanks will have to be perfected. This makes use of a daily examination of 50 individuals in a population from the zoea stage to post-larvae 6, or six days past the larval stage. The patterns observed may give leads in the prediction of mass mortality. From these observations, researchers are now able to foresee the development of a nematode-caused and fungus-triggered mortality.

Real husbandry of sugpo can come only with the elimination of the hunting phase which shifted from wild fry to wild spawner acquisition. The full domestication of prawn therefore depends upon the development of a captive broodstock. Initial experiments showing the feasibility of inducing maturation of *Penaeus monodon* in captivity made it possible to plan a full-scale development of a captive broodstock to supply the spawner needs of prawn hatcheries. Studies on the domestication effort include feeding, molting, mating and spawning patterns of the animal.

The Department has concrete prawn hatchery tanks of 50-, 120-and 200-ton capacities. Studies are being conducted to

solve hatchery problems such as water quality, parasites, diseases, and spawner quality.

In order to popularize the farming of prawn as a primary crop, a constant supply of fry is essential. Encouraging results from seed production experiments at SEAFDEC indicate that a sugpo life cycle production and management system can be developed for the benefit of end-users in the industry, particularly those at the village level.

Ultimately, it is the private sector itself which should produce the prawn fry to fill the needs of the industry. Towards this end, the Barangay Hatchery Project was organized in order to effect the transfer of hatchery technology to the private sector. The project seeks to scale down the technology to a level which can be adopted by villages with minimum financial and technical input as a means of increasing food production, improving nutrition and raising income.

A barangay hatchery consists of small tanks made of marine plywood, designed in modules, which makes it expandable and transportable. Fully operational, a basic unit is capable of producing 50,000 fry a month.

From the hatchery, the fry must be stocked in nursery ponds to allow them to adjust to the grow-out pond environment. The single problem widely recognized as the serious constraint to prawn production in ponds is low recovery rate. This problem is commonly attributed to many factors like predation and cannibalism, low dissolved oxygen concentration, low pH, high concentration of toxic metabolites, and others. Whether these occur singly or simultaneously, they can bring disaster to the prawn culture business. In a nursery system, where young and fragile fry are released directly from the controlled water of a hatchery, the problem is even more serious.

To solve these problems, and consequently increase the survival of cultured prawns, new designs and construction techniques are needed.

Research at the Department's experimental ponds give primary consideration to the utilization of natural forces, revision in the designs of water facilities, and introduction of new facilities that will, at the least cost, aid in pond management. (See "SEAFDEC nursery pond system solves prawn fry survival problems," AA Vol. 1 No. 5).

Present Picture

Today, after about five and one-half years since the Department was established and work on prawn in SEAFDEC began, and more than two years since the prawn program of the Department was formally organized, the advances in prawn R & D at SEAFDEC can be summarized as follows:

a. Hatchery method has changed to one where the diatoms are reared in a different culture tank/container, concentrated and introduced at controlled densities to the larval rearing tank/container. Small scale "barangay" hatchery systems have been tested and are now being promoted for application.

b. More emphasis has been given to biological parameters, mainly diseases and nutrition, as a factor in hatchery survival. Most of the disease organisms have been identified at the specific level or at least at the family level. Prophylactic measures thus have been devised and applied successfully. As a result, hatchery production has stabilized and fungal diseases can now be prevented.

c. Natural feed production research has shifted to the verification or application of already available technology in mass algal rearing. Phytoplankton species already isolated and used for prawn larval rearing elsewhere are being propagated.

   Technology developed elsewhere for producing *Artemia* or brine shrimp is now being verified at tank and pond scale.

d. Nutrition and feed development research is now concentrated on the production of feed for rearing the fry to marketable size. Most of the problems of producing feed with acceptable physical characteristics (i.e. stability in water for a reasonable length of time) have been solved. Pelletized feeds are already being pond tested. Research on producing feed for broodstock is underway. Nutrient requirement studies are being carried out.

e. Maturation of prawns through eyestalk ablation is now being done on a large scale. Reliance on wild spawners has thus been eliminated. The research is now in the "fine tuning" stage. Emphasis is now on improvement of maturation and spawning rates, fecundity and egg quality.

f. Ecological studies have been broadened to include food and feeding habits. Greater emphasis is now made on prawn fry ecology.

g. A limited number of small ponds capable of various experimental designs are already available and in use.

h. An intensive prawn nursery system capable of accommodating 1.5 and 2 million fry per hectare at P_5 is now operational. Only P_{35} juveniles are now released for use by private ponds. Consequently there are now fewer complaints regarding low survival of hatchery-produced fry in grow out ponds from the private sector. Demand for the P_{35} juveniles has become very high.

i. The conflict between grow out pond needs and hatchery needs has been eliminated since the hatchery can now harvest at P_5 which is perfectly acceptable to the prawn nursery.

j. Significantly, *P. monodon* has been demonstrated at the freshwater fisheries station of SEAFDEC to be capable of being raised in freshwater (in cages) to harvestable size.

Industry Outlook

As a result of the completion of the prawn life cycle, first achieved by SEAFDEC scientists in Dec. 1975, and with the development of technology packages that are meant to enhance prawn culture in ponds and in other enclosures, the popularization of an integrated prawn production technology has been made possible. ●

SEAFDEC 1979 TRAINING SCHEDULE

The SEAFDEC Aquaculture Department announces its 1979 schedule of international and national training programs. Conducted yearly, the training programs have two-fold objectives: to alleviate the shortage of technical manpower for the aquaculture industry in Southeast Asia and to hasten the transfer of technology developed at SEAFDEC laboratories to end-users to improve fish production, generate employment, and increase rural income.

The SEAFDEC 1979 Training Program Schedule:

International Training Program (open to foreign and Filipino participants)

1. Aquaculture Research Methodology — June 18-Sept. 8
2. Aquaculture Management
   a) Milkfish — March 19-June 9
   b) Prawn — Sept. 17-Dec. 8
3. Aquaculture Engineering
   a) Fishponds — May 14-June 9
   b) Hatchery, Cages & Pens — Aug. 13-Sept. 8
4. Small-Scale Prawn Hatchery Management
   a) First Session — April 16-May 12
   b) Second Session — Oct. 1-Oct. 27

National Training Program

1. Prawn Culture
   a) First Session — April 2-7
   b) Second Session — July 16-21
   c) Third Session — Nov. 19-24
2. Barangay (Village) Prawn Hatchery
   a) First Session — March 5-31 (for Philippine Bureau of Fisheries and Aquatic Resources (BFAR) personnel)
   b) Second Session — June 4-30
   c) Third Session — July 16-August 11
   d) Fourth Session — Nov. 5-Dec. 1
3. Fishpond Engineering — April 16-May 12
4. Mussel/Oyster Culture
   a) Himamaylan, Negros Occ. — April 2-6
   b) Bohol — May 7-12
   c) Leyte — May 21-26
   d) Zamboanga — June 25-30

Special Skill Training (For Filipinos as well as foreign participants)

1. Feed Development — March 5-16
2. Fishpen Construction and Management — March 19-30
3. Fish Diseases/Parasites — July 2-14
4. Post Harvest — Dec. 3-15
5. Extension Methods — March 5-16

In-Situ Training (conducted in farmers' fields)

1. Pond Culture and Management
   a) Luzon (4 centers at 5 days each) — March 19-31
   b) Mindanao (4 centers at 5 days each) — Sept. 24-Oct. 6.

Send inquiries to: Dr. H. Chaudhuri
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New publication from SEAFDEC

QUARTERLY RESEARCH REPORT VOLUME 2, No. 1 recently came off the press. This 7" x 10" technical bulletin contains extended abstracts of researches done by the staff of the SEAFDEC Aquaculture Department. This issue contains seven reports, namely: 1) Preliminary studies in growth and survival of *Penaeus japonicus* postlarvae fed with *Tapes* and commercial formula feed by C.T. Villegas; 2) Changes in length and weight of milkfish fry preserved in formalin by S. Kumagai and N. Castillo; 3) The food and feeding habit of *Penaeus monodon* Fabricius collected from Makato River, Aklan, Philippines by C.L. Marte; 4) A preliminary study of the protein requirement of *Chanos chanos* (Forskal) fry in a controlled environment by C. Lim, S. Sukhawongs, and F. Piedad-Pascual; 5) Growth and survival of *P. monodon* postlarvae fed shrimp head meal and fish meal as primary animal source of protein by F. Piedad-Pascual and W. Destajo; 6) The effect of the different binders on water stability of feeds for the prawn by F.Piedad–Pascual, L. Bandonil and W. Destajo; and 7) Notes on the construction of 12 cu m ferrocement maturation tank for prawn broodstock by R.T. Tolosa.

The 40-page, offset-printed bulletin is available at the Asian Institute of Aquaculture, SEAFDEC Aquaculture Department, P.O. Box 256, Iloilo City 5901, Philippines. ●

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