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The Aquaculture Department in 6 Years

The sixth year of operation of the Aquaculture Department of SEAFDEC was marked by a turnover of stewardship. Dean R. O. Juliano of the University of the Philippines College of Fisheries took over on July 9 from Dean D. K. Villaluz who has retired. This coincided with the sixth anniversary of the Department's founding.

The new chief announced among other things the need to put more emphasis on applied and practical research as "applicable technologies are what the aquaculture industry of the region needs most." Research, after all, provides the content for training, extension, and other outreach programs, he said.

The Philippines private aquaculture industry sector is now represented in the Department's research council, an advisory body to the chief, with the membership of two of the country's bigger fishfarmers' associations.

Progress Report 78-79

It was in 1978, the fifth year of the establishment of the SEAFDEC Aquaculture Department, that the move was made to refine and standardise results from the Department's research activities, develop practicable packages of aquaculture technologies, and hasten and systematise their transfer to the fish farms. A general effort was made to accelerate studies on milkfish. While the intensity of research on prawn has been sustained, focus is shifting toward making more popular hatchery technology and prawn culture for adoption at the village level and by small fishfarmers. The small fishfarmer began to receive more attention in the research program planning.

Outgoing AQD Chief D.K. Villaluz and new Chief R.O. Juliano exchange pleasantries during the latest meeting of the AQD research council. The meeting was one of the preparations for the turnover of responsibilities.

Serious consideration was paid to increasing and improving the technical and scientific manpower base for aquaculture. And plans began to be crystallized that consider the development needs of the aquaculture industry of the whole of the Asian Region.

There are now five broad research areas; milkfish, prawn, seafarming which is currently focused on molluscs and crabs, freshwater aquaculture, and the newly organized aquaculture engineering program.

Over the past year, promising results have been obtained in the design and construction of ponds, impoundments and other enclosures; management and maintenance of ponds and other water bodies as required by species being grown; improvement in the production of natural fishfood organisms and the formulation of suitable and inexpensive feeds; biological manipulation of stock that should open up new and more productive farming system ideas; control of diseases, parasites and predators; and control of pollution affecting aquaculture operations.

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The AQD in 6 Years...

Milkfish

With the successful capture and taming of the adult milkfish or sabalo, the research door became wide open for work on hormone-induced spawning, artificial fertilization and larval rearing. Successful spawning in captivity was achieved. Dosage and frequency of hormone injection has been standardised, and larvae have been reared beyond the critical period of 56 hours, a decisive break that has paved the way for mass production of fry.

Studies on feeds and feeding have shed more light on the kind, amount and frequency of feeding the larvae. Results also show that animal protein sources are better utilized by milkfish fingerlings than plant protein sources.

Meanwhile, an ongoing project on feeds and feeding supported by the International Foundation for Science seeks to develop practical diets to shorten the rearing period of milkfish which would enable farmers to have more crops a year. The study in modular and multi-sized stocking systems indicates the superiority of this cropping procedure over one which employs mono-sized stocking.

Prawn

The Department has been engaged in research and development on prawn, particularly the large *Penaeus monodon,* not only for its export value but for its high returns for local producers and its potential for generating rural employment.

The work on broodstock development, spawning, maturation and rematuration of spawners, rearing of larvae, and improvement of nursery techniques has considerably moved the prawn industry closer to the goal of having a stable supply of fry. The development of a village-level low-investment hatchery system has made the popularization of prawn culture a near reality among the smaller operators. Feeds and nutrition and disease and predator control studies have lessened risks, especially at the hatchery and nursery stages of operations. Improvement in pond design and the development of better culture techniques in nursery and grow out ponds have increased yield potentials.

The increasing popularity of this species as an aquaculture crop could eventually make it a rich protein source for the people. The culture system being promoted by the Department which pivots around the village-level hatchery lends itself well to a community-operated enterprise such as by cooperatives or associations of fish-farmers.

The latest studies under the prawn program have succeeded in producing in indoor tanks enough spawners to supply hatchery needs; developed a prototype for a steamlined pond system; decapsulated eggs of brine shrimp, an important larval feed; established the small-scale hatchery system which increased five-fold production of postlarvae; developed promising control and treatment measures for larval diseases; and formulated economical and more effective pellet feeds from locally available ingredients.

Seafarming

Much of the work in seafarming research deals with mussels and oysters. The biology of the green mussel and oysters and their ecological distribution have been fairly well investigated. Culture systems using improved techniques and materials have been developed and are being promoted. Production trials using ropes shows a potential production of 24 tons of mussel per three ropes of one meter length each. Partial harvests of 2,100 kilos have been obtained from six rafts supporting 400 ropes. The 180-square meter pilot farm of SEAFDEC produced about 2-1/2 metric tons of oysters during 1978.

Other species of molluscs are being bio-screened for the feasibility of their being cultured.

Crab, particularly *Scylla serrata* or *alimango,* is also a seafarming commodity. Preliminary studies have been made on gonadal maturation, molting, breeding, and growth. With technical help from the New Zealand government, broodstock development, hatchery and larval rearing studies are ongoing while pond culture was recently started with the primary aim of establishing parameters for stocking density and other culture requirements.

Freshwater

One research achievement that has considerably cut down the cost of farming milkfish in freshwater pens is an acclimation process for fry that gives a high survival rate. This has done away with growing the fry to fingerling size for freshwater stocking. Stocking density of 2 per square meter resulted in a faster growth rate for milkfish fingerling in cages than densities of 6 and 10 per square meter.

(Continued on page 3)

Breeding work on tilapia has produced superior and bigger strains. Mono-sexed male *Tilapia nilotica* in cages were also found to grow faster than females. All male tilapia can be stocked at 150 per cubic meter, the results suggest.

Carp production studies, adapted from Indian research on this fish, have been producing encouraging results that could warrant the culture or seeding of carps in different freshwater bodies.

Lake farming of the *Penaeus monodon* has been made possible with the development of sound transport and acclimation procedures and fry rearing techniques. Prawns can be stocked in the lake at a density of 20 per square meter compared to only three per square meter in ponds. Key to the encouraging results in prawn farming trials was the discovery and formulation of suitable pellet feeds to supplement the natural lake-growing fishfood.

Larval culture of *Macrobrachium* has been successfully done in the laboratory. Transport of spawners has been studied with a high survival rate obtained with the use of anaesthetics and at a temperature level lower then 20°C. The aim of freshwater shrimp research is to replenish the dwinding stock of this popular delicacy in most freshwater bodies.

Aquaculture Engineering

Lack of consideration for the biological needs of cultured species in applying engineering designs and in building enclosures is probably one of the main reasons for inefficiency in production. This prompted the Department to set up an aquaculture engineering program to conduct studies on this aspect of aquaculture which has been taken for granted. Its function is to work out a program to develop appropriate technology or improve on existing ones for the smaller operators. Cage designs, pond construction, and fishpen establishment depend much on the proper application of engineering concepts for more effective management of a fish farming enterprise.

Technology Verification

Under the technology verification and packaging scheme, 14 studies have been identified that shall be implemented in selected areas and in fishfarmers' ponds. Evolved and crystallized during the February 1978 aquaculture technology consultation, work on these 14 technology verification projects will start this second half of 1979.

Training

Since 1974 the Department has trained more than 1,600 individuals in various short-term non-degree courses. Some 52 graduate students are enrolled this school year in the collaborative graduate aquaculture program of SEAFDEC and the University of the Philippines. Thirteen have finished the M.S. aquaculture program including three Indonesians while three Nigerian government fellows are currently enrolled.

Since 1976, when the international non-formal training programs were started, 157 participants, mostly from Southeast Asian countries, have undergone training in seven aquaculture management and skills courses. From April to July this year, the prawn hatchery operations course and the milkfish culture management program were offered to 41 technologists from five Southeast Asian countries. A 3-month aquaculture research methodology course is now being attended by 18 trainees from Brunei, Philippines, Malaysia, Indonesia and Thailand.

This year, a special course covering milkfish culture, pen and cage culture, aquaculture engineering, hatchery management, prawn culture and other topics has been arranged for fishery workers from a Central American country. Fourteen Cubans have either finished or are finishing their programs.

Already, 10 scientists of the Indian Council for Agricultural Research have successfully finished special studies in three aquaculture areas. Three technologists, one each from Egypt, Sierra Leone, and Malaysia completed a 3-month course on cage and pen culture with an IDRC grant. Likewise, 2 Indonesians undertook a short-term training under a grant from the German Foundation for International Development.

To date, more than 350 small fishfarmers have benefited from the mobile training course of the Department and the Philippines' Bureau of Fisheries and Aquatic Resources.

Since 1976, some 265 BFAR technologists have trained in the Department.

Outreach

The regular components of the Department's information service come in the form of the monthly worldwide circulation newsletter, the *Asian Aquaculture* which goes to some 84 countries, more than 500 libraries and about 3,000 individuals; and the nationally distributed forthnightly *Fish Farm News* containing 10 stories per issue which now reach some 1,100 receivers every other week.

(Continued on page 6)

Raising Quality Fish Seed in Floating Nurseries in India*

In 1976, the Allahabad Substation of the Central Inland Fisheries Research Institute (CIFRI) launched a program of cage culture in lentic waters to open new vistas for enhanced fish production by utilizing the already existing culturable waters. The program aimed to evaluate the feasibility of rearing carp spawn in floating nurseries (cages) in lentic waters to fry stages and evaluate the feasibility of rearing carp-fry in floating nurseries (cages) in lentic waters to fingerling stage.

A village tank of about 2.5 acres at Jari, 35 km away from Allahabad was selected for the experiments. The tank was 2.4 to 3 m deep. Water for the tank was drawn from a nearby canal when needed besides getting rain water from the catchment area. The cages were floated in the deepest area of the tank.

For rearing of hatchlings, fry and early fingerlings, frames of thick and sturdy bamboos of about 70-100 mm in diameter were made which proved ideal as they were light, durable and could float easily at the required depth. The bamboos, making the frame, were fixed with iron nuts and bolts, enabling easy assembly, dismantling and transport. The dimension of the frames is such that nylon hapas of size 2.20 x 1.60 x 1.45 m could easily be fixed inside. Polyethylene floats of about 100 mm in diameter were fixed in bunches of 10-12 on each vertical bamboo of the cage frame. The location of floats on bamboo frame was so adjusted as to keep the cages submerged in water to a depth of about 1.10 m to 1.20 m. As required, the number of cages were increased by tying long ropes in between and the extreme two cages were tied to sinkers at the two ends with long thick ropes. This allowed scope for movement of cages.

Advance fingerlings were reared in cages made of wood and tubular iron pipes with galvanized iron mesh of 1/5" around. Cages made from tubular iron pipes proved more handy but required regular enamel painting. The size of these cages was also standardized to 2 x 1.5 x 1.5 m to have a surface area of 3 sq. m. Each frame of these cages can be separated before transport by removing the nuts and bolts.

Riverine spawn, having a good percentage of major carp was collected from the river Yamuna. The spawn was acclimatized in plastic pools for about a week on artificial feed.

The acclimatized spawn was transported to the site and released in floating nurseries prepared with 1/40" mesh nylon hapas. Two such nurseries were stocked each with about 30,000 hatchlings. Close observations on the behaviour of spawn in these prepared nurseries was kept and dead hatchlings were removed. Regular feeding with artificial feed was continued the day after the release of spawn. The nylon hapa cages were changed every fortnight.

Observations

The hatchlings started moving in shoals immediately after their release in cages. The behaviour of hatchlings in these floating nurseries was almost normal and within two to three days they were conditioned to take feed. The hatchlings of one nursery attained an average length of 45.6 mm within a period of 28 days from an average size of 7.8 mm. The other nursery was stocked later and over 21 days of rearing, the fry attained an average length of 30.2 mm from an average size of 6.5 mm at stocking.

The survival at this stage was estimated at 25%. The hatchlings during transfer of cages were given 3% sodium chloride and 0.1 ppm Acriflavin solution. Aquatic plants such as Hydrilla and Vallisneria were submerged inside the cages in bunches with the help of nylon twine. This provided nibbling material to the growing fry and a distraction to the shoaling movement. This method found successful in earlier trials at Getalsud Reservoir by Natarajan (1976) proved effective in controlling the mortality noticed at this stage of fry in cages.

The young fry were transferred after one month to cages having 1/8" mesh nylon mosquito netting hapa cages. The number of fry of each of the two nurseries was distributed equally into two cages each having about 2,500 fry. Within a period of about 3 months from the young hatchling stage the fry grew to fingerling size attaining an average length of 121.8 mm in one cage and 103.6 mm in the other cage, the actual period of rearing being 89 days and 82 days, respectively.

Conclusion

The experiments conducted by setting up floating nurseries, proved successful in terms of (a) rearing carp spawn in floating nurseries (cages) in lentic

From the paper, "Experiments on raising quality fish seed in floating nurseries and its role in aquaculture in India" by A. V. Natarajan, R. K. Saxena and N. K. Srivastava, CIFRI Research Substation, Allahabad.

waters to fry stage and (b) rearing carp fry in floating nurseries (cages) in lentic waters to fingerling stage.

In the experiments, 30,000 hatchlings were stocked for every cage of 35 sq m area which is equivalent to 8,500 hatchlings/sq m or 85,000/ha. Even after allowing for escape and mortality, this is about three times more, in terms of stocking rate, than has been reached in pond nursery management. The growth is also comparable to any pond rearing stock as within 28 days fry measuring about 46 mm were available.

For fry, a maximum density of 2,550/cage or 700/sq m area (7,000,000/ha) was tried. This is about 35 times more than the stocking density achieved for fry rearing in ground nurseries. The fingerlings in our experiments attained stocking size of over 100 mm by the middle of November.

It is significant to note that the diverse and scattered character of ponds, tanks and reservoirs in India reinforces the need for floating nursery as this not only dispenses with elaborate nursery management but renders each pond, tank, etc. a production unit without having to set up a nursery or rearing pond.

Summary

One of the important constraints encountered in the development of fisheries in ponds, tanks, reservoirs and lakes in India is limited availability of nurseries for raising major carp stocking material. The floating nurseries composed of units of floating cages (made of wooden framework and internal lining of nylon cloth of 1/40 mesh/inch appear to hold great promise as reflected by studies carried in a large tank at Allahabad and Getalsud reservoirs. The nylon mesh of 1/40 mesh/inch was used for rearing hatchlings to fry, 1/8 mesh/inch from fry to finger-

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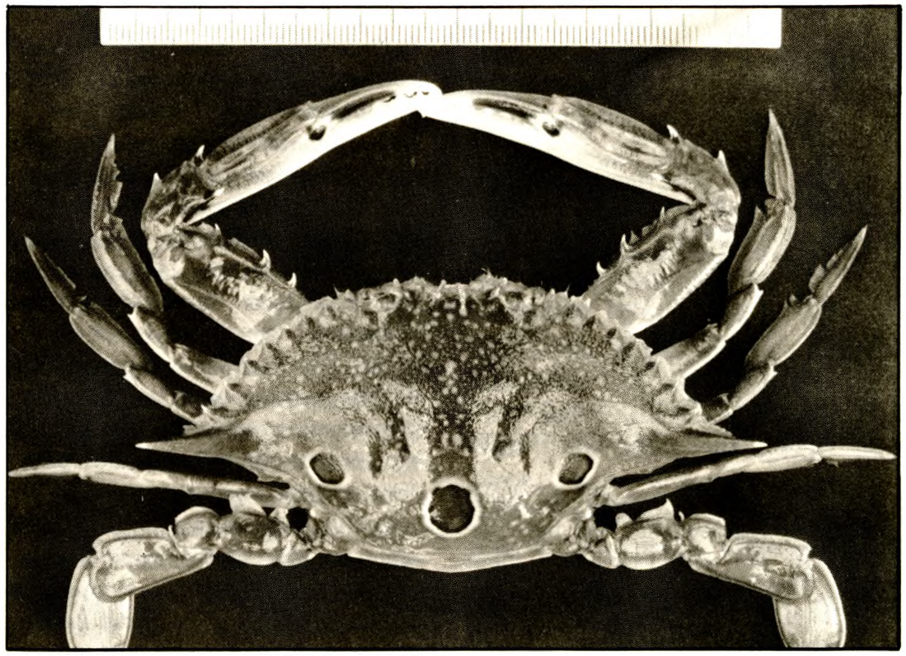
Edible Crustaceans in the Philippines*



Portunus sanguinolentus **(HERBST)**

English name: Blood-spotted swimming crab, Blue swimming crab, Sand crab or Blue swimmer.

Philippine name: Alimasag (Tagalog), Suga-suga (Cebuano), Bansaway (Ilocano) or Kagang (by Muslims).

The carapace attaining some 6 cm in length is smooth, slightly convex and covered with small granules, and marked on its lateral border by a pair of very sharp spines. Antero-lateral border is armed with nine teeth, which are not sharply pointed. The posterior half of the carapace is marked by three large conspicuous red spots fringed with white circles.

This species lives on sandy and sandy mud bottoms mostly along the shoreline.

The crab which has lesser commercial value due to poor population and its smaller size than *P. pelagicus* is mainly caught with beach seines.

They range from Hawaii southward Polynesia, westward, through Micronesia, to Japan, China and the Philippines and East Indies and further to the Indian Ocean, the Red Sea, and the coast of Africa.

This edible crab is locally offered for sale in the market at P25/kg.

(Scale represents 10 cm)

*** by H. Motoh, 9th in a series**

The AQD in 6 Years...

Extension-type materials are published in an aquaculture extension manual series and in an aqua-guide series. Quarterly research reports containing extended abstracts of completed studies have so far been published in two volumes.

Last year, SEAFDEC in collaboration with other agencies held in the Philippines two workshops on aquaculture strategy planning and formulation — one for the Philippines and one for the Asian Region.

Early this year, the technical consultation on available aquaculture technology in the Philippines was convened. Attended by 79 of the Philippines' outstanding fishery and aquaculture workers, the consultation evaluated the currently available technology on 4 of the Philippines' more important aquaculture commodities, (milkfish, prawn, molluscs, tilapia) established the production potentials of these technologies, pinpointed the technological gaps, and worked out a scheme for transferring appropriate technology. This was followed immediately by the international cage and pen culture workshop co-sponsored with the IDRC.

The Department, through its Asian Institute of Aquaculture, has been designated as the Southeast Asian input center for the FAO-coordinated Aquatic Sciences and Fisheries Information System, a global documentation and information service. Launched last June 1979 is the aquaculture scientific literature service for Asian institutions as well as scientific and technological workers engaged in aquaculture research and development.

Linkages

Among the significant research and development projects which the Department has entered into cooperation with other institutions are: the socio-economic survey of the aquaculture industry of the Philippines with the Philippine Council for Agriculture and Resources Research; the Aquaculture Graduate Study Program with the University of the Philippines. Plans are being drafted to expand the graduate program to focus in reproductive physiology, fish nutrition, aquaculture systems, and aquabusiness; the Freshwater Aquaculture Research Project with the University of the Philippines. The Freshwater program includes a joint venture with the Laguna Lake Development Authority and the University of the Philippines at Los Baños on lake farming and development of the country's freshwater resources. The freshwater station is also working with the Philippines Ministry of Human Settlements in setting up a model fisherman's village along Laguna Lake; the training and extension project with the fisheries bureau; and the Mindanao Aquaculture Resources Development Program with the Mindanao State University.

A pilot aquaculture resource management project, the strategies and implementation procedure of which have been jointly formulated by the Development Academy of the Philippines, SEARCA, the bureau of fisheries and aquatic resources and the SEAFDEC aquaculture department is being held in abeyance pending the release of funds to effect implementation.

IDRC has been supporting the milkfish program now on its second phase, while the Oceanic Institute of Hawaii and the Tungkang Marine Laboratory in Taiwan have been collaborating with SEAFDEC in milkfish research.

The Department and the International Center for Living Aquatic Resources Management have expressed mutual interest in joint ventures which could possibly include the development of an aquaculture recommends series for the fishfarmers of Asia.

With the South China Sea Fisheries program of the United Nations Development Program, an arrangement has been made in which the Department can avail of the short-term services of the Program's experts and the Program can avail of the Department's research and training facilities.

Finally, linkages have been established with the private industry sector for training, extension and applied research purposes. Members of the West Visayas and the Philippine Federation of Fish Farm Producers have been enlisted as cooperators in applied research projects, are served by the Department's training programs, and help in the Department's training and practicum activities. This arrangement helps systematise technology transfer and enhances training and extension work.

In summary, the findings, accomplishments, and directions of the SEAFDEC Aquaculture Department have made it emerge as truly a center of aquaculture research and development in this region of the world.

D.K. Villaluz: Pioneer

The retirement of Dean Domiciano K. Villaluz, 70, from the SEAFDEC Aquaculture Department of which he was chief since it was founded in July 1973 also ends his almost half-a-century active and varied service to the government and the fishery industry.

He began his career in 1931 as a graduate assistant of the zoology department of the University of the Philippines' college of liberal arts. In his 48 years of service, the Dean, with his quiet discoveries made in the solitude of his laboratory, sparked a surge of research activities that would later on lead to the pile up of a mass of literature that propelled the scientific and technological advancement of Philippine aquaculture. But more significantly, he was able, as a teacher, to inspire a number of young workers into pursuing a career in fisheries. This handful of young fishery graduates would become the core of the manpower force for fisheries development in the country. Some would later strike out into the then very new specialization of aquaculture.

Early in his career, even as the aquatic life in Philippine waters was still abundant and unthreatened by over-exploitation, Dean Villaluz already sounded the warning that nature could not go on replenishing resources if man did not help in the process of replenishment. He must have been one of the few scientists, before ecology or environmental concerns became scientific and political issues, who recognized the inter-dependence and the relationships among forestry, agriculture and fishery. He recalled these thoughts in one of his speaking engagements immediately before his retirement. But these viewpoints would become the guiding philosophies for the work at the Aquaculture Department. When he became chief of the Department, he steered the R & D work toward the development of technology that would help nature restore her productive capability. He urged that technology be simple enough for the smaller people to use and small enough so that their application would not require heavy investment of scarce resources. Technology should not outstrip the capability of a small community and of nature to provide the resources, he used to say.

Dean Villaluz became chief of the Department in 1973 while concurrently serving as professor and dean of the Mindanao State University (MSU) until 1974. He had served MSU in that capacity since 1963 while holding other positions such as the directorship of the MSU Institute of Fisheries Research and Development (1971-75), the research directorship of the MSU-National Science Development Board Research Project No. 2.156, a consultancy to an FAO-UNDP project, and as University Research Center director (1970-71).

For his contributions to the development of Philippine fishery, he was awarded the Rizal Pro Patria Award by the President of the Philippines on the diamond anniversary of the Department of Agriculture in October 1976.

He served the RP Government as fishery expert at EEA, Office of the President; as agriculture supervisor in the Development Bank of the Philippines (DBP), fishpond supervisor of the Rehabilitation Finance Corporation (forerunner of the DBP); Bureau of Science zoologist; assistant ichthyopologist, Bureau of Fisheries.

Attesting to his research achievement are 9 research reports and some 23 scientific publications, among which is the definitive book, *Fish Farming in the Philippines,* published in 1953.

Although his research covered most aquaculture commodities, he is especially noted for his pioneering studies on the reproduction, larval development, and cultivation of *Penaeus monodon.*

His colleagues, former students, and assistants in numerous research projects remember him as a pioneer — quiet, unassuming, but a leader in his own way.

How to Test Hatchability of *Artemia* Cysts*

Hatchability of a given sample of cysts has been mostly expressed as hatching percentage – or the number of live nauplii hatching out of 100 cysts. This criterion does not take into account the degree of purity of the product. In other words, it does not consider the quantity of debris included in the batch of cysts. In this regard, the concept of hatching percentage is misleading since a figure of 90% hatching may indeed be correct despite the fact that the product may carry a significant amount of debris.

Since *Artemia* cysts are always sold on a weight basis, the important criterion for the customer is the number of live nauplii which he will get from the total quantity of product purchased.

The following simple procedure can be applied to determine the weight of product which, under standard conditions of incubation, will yield one million nauplii:

a. Three samples of 250 mg are taken at random from the batch of cysts to be analysed.

b. Cysts are hydrated in 100 mL graduated cylinders in 80 mL natural seawater at 30°C and are kept in suspension by a continuous aeration from the bottom of the cylinders.

c. After one hour, the water volumes are increased to 100 mL with seawater and 5 subsamples of 0.250 mL each are taken from each cylinder with a glass pipette or preferably with an automatic micropipette.

d. Each subsample is pipetted into a small plastic tube (5 mL content); the pipette is cleaned with seawater in the same tube and the water level in the tube is finally brought to 4 mL with seawater.

e. Since at the end of the hatching period a total count will be made on each tube, the volume of seawater in the tubes may vary in function of the type of the tube used (minimum 4 mL).

f. The tubes are closed with a cap and clamped into a rotating axle at 5 rpm; the whole set up is incubated at 30°C in continuous light conditions.

g. After 48 hours, the content of each tube is fixed by addition of a few drops of Lugol's solution (the solution stains the nauplii dark) or with another fixative.

To prepare Lugol's solution:

1. Dissolve 10 g neutral KI and 5 g I_2 sublimate in 50 mL boiling water
2. Dissolve 5 g Na-acetate in 50 mL distilled water
3. Mix solutions 1 and 2.

h. The total number of nauplii hatched in each tube is determined by filtering the suspension on a small gauze filter, placing the filter in a petri dish and counting the nauplii under a dissection microscope. The average number of nauplii produced per gram of cyst product is then calculated. This number can also be expressed more practically as the quantity of product that has to be incubated to produce one million nauplii.

i. In summary –
* 250 mg product in 100 mL seawater
* 5 subsamples of 0.250 mL giving mL giving n_1 n_2 n_3 n_4 n_5 nauplii or average $\bar{n}$ nauplii in 0.250 mL
* number of larvae per gram product $= \bar{n} \times 4 \times 100 \times 4$
* weight of product needed for the production of one million nauplii

$$= \frac{1{,}000{,}000}{\bar{n} \times 4 \times 100 \times 4}$$

*From "The culture and use of brine shrimp, Artemia salina, as food for hatchery-raised larval prawns, shrimps and fish in Southeast Asia," by Patrick Sorgeloos. The report was submitted by Dr. Sorgeloos, in his capacity as consultant, to the National Freshwater Prawn Research and Training Center of the Freshwater Fisheries Division, Thailand. The document's series no. is THA: 75/008/78/UP/3.

Raising Quality Fish...

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lings. For further rearing 1/5 mesh/inch was used. The feed was made of soya bean powder, ground nut oil cake and rice polish in 1:1:1 ratio. The stocking rate was 10,000/m² for spawn to fry and 2,800/m² for fry to fingerlings. The material used for the study was *Catla catla, L. rohita, C. mrigala* and *L. bata. C. catala* showed great promise for culture in cages.

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