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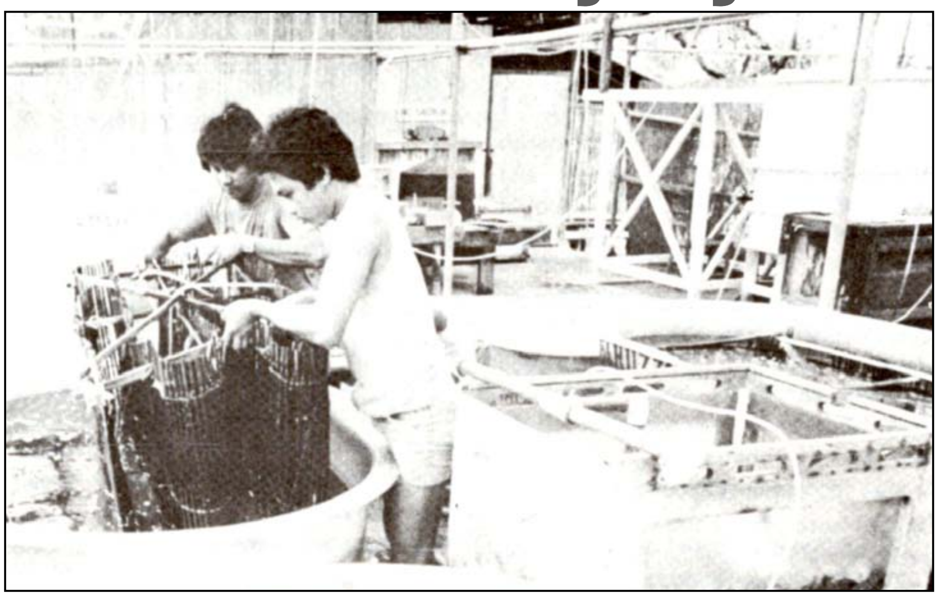
Bare Improvements in Batan Sub-station

Small Scale Prawn Hatchery System



Using bamboo substrates such as shown above, a nursery tank could be stocked with 3,000 to 5,000 fry/sq m.

The giant tiger prawn (*Penaeus monodon* Fabricius), locally known as sugpo, has long been recognized as the most commercially important crustacean in the Philippines and many countries in Asia. Even at the high price of P75 to P95 a kilo in Metro Manila, the demand for sugpo continues to increase, locally and internationally, but production has never come near to satisfying the markets, especially Japan, the biggest importer of sugpo.

The low supply of sugpo is attributed to the fact that sugpo is hardly caught in large numbers at one time in open waters, says Dr. Hiroshi Motoh, a Japanese prawn expert who worked with the SEAFDEC Aquaculture Department for 7 years. Because of the severe conditions in the open sea, fisheries experts estimate that the survival rate from egg to fry of sugpo is only a fraction of 1 %.

Pond culture of sugpo is constrained by the unreliable and inadequate supply of fry. The solution to this problem is to produce fry in hatcheries.

Experts reckon that if only 10%of the estimated 176,000 hectares of operational fishponds in the Philippines are converted to sugpo culture and stocked at a total of 10,000 fry/hectare/year, the yearly fry requirement would reach 176 million. Based on the current price of sugpo fry which is in the vicinity of P0.25 apiece or P250 per one thousand, the potential demand of 176 million fry would bring P44 million yearly to prawn hatchery producers. However, the normally cited estimate of sugpo fry production in the country, which includes the wild catch, is only 20 million yearly, leaving a gap of 156 million fry.

Clearly, fry production in hatcheries will have to be increased. Prawn hatcheries in the Philippines, however, have been saddled with heavy mortalities. As a result of continued failures and losses, 13 out of 41 prawn hatcheries have closed down. The 28 operating hatcheries, unfortunately, are running at 25-50% capacity only, according to estimates of aquaculture experts.

Recent Advances

Research efforts at the SEAFDEC Aquaculture Department in Tigbauan, Iloilo have yielded encouraging results which could greatly bolster the sugpo in-

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Bare Improvements i n . . .

(From page 1)

dustry.

Recently, Mr. Porfirio Gabasa, Jr., head of the SEAFDEC-AQD Tigbauan Research Station's substation at Batan, Aklan, uncovered some reasons for the erratic results in the previous small-scale hatchery system which was basically an adaptation of the Galveston method developed at the National Marine Fisheries Service Laboratory in Texas, U.S.A. for the larval rearing of *P. setiferus* in the late sixties. He came up with a much-improved small-scale hatchery system, characterized by greatly simplified procedures and a corresponding reduction in investment, which could easily be adopted by the private sector.

This was revealed in a paper entitled "Recent Developments in Small-Scale Hatchery Technology for *Penaeus monodon* in the Philippines" which will be presented at the Expert Consultation on Small-Scale Shrimp/Prawn Hatchery sponsored by the UNDP/FAO South China Sea Fisheries Development and Coordinating Programme to be held in November in Semarang, Central Java, Indonesia.

Two major features in the Galveston-based hatchery system were considerably changed: feeding scheme and aeration system.

Table 1. Feeding Scheme for *P. monodon* Larvae

Larval Stage	Nauplius	Protozoea			Mysis			Postlarva
		PZ I	PZ II	PZ III	M I	M II	M III	PL 1 to PL 5
A. OLD METHOD								
Chaetoceros cells/ml		30,000	50,000	80,000	80,000	80,000	80,000	
Tetraselmis cells/ml			5,000	10,000	20,000	20.000	20.000	
Rotifer (*Brachionus*) ind/ml					5	8	10	
Artemis								5
B. NEW METHOD								
cells/ml		5,000	5.000	5,000	5,000	5,000	5,000	
Egg yolk particles/ml			15-25	15-25	15-25	15-25	15-25	
Artemia ind/ml					10-15	10-15	10-15	15-20
Bread Yeast* g/ton		0.1-0.3	0.1-0.3	0.1-0.3				

*If *Tetraselmis* is not available.

Feeding Scheme

"It is a common belief among hatchery operators that *P. monodon* larvae (protozoea) are purely filter feeders. Thus only microscopic organisms such as diatoms and phytoflagellates are given as food (Table I). It has been observed, however, that as early as Protozoea I, the mouth parts are already functional. Protozoea I and II larvae have been observed grasping big food particles like *Artemia* and *Brachionus,* and biting them with their mandibles. Microscopic examination of the gut of the larvae revealed the presence of parts of the food they have eaten," says Gabasa.

Based on the above observations, a new feeding scheme was formulated with the use of the boiled egg yolk as the main diet for Protozoea II and III larvae instead of the diatom *Chaetoceros* (Table 1). It should be noted that egg yolk particles are as big as *Brachionus.* Egg yolk is given to protozoea II up to mysis III three to four times daily maintaining a feeding level of about 15-25 particles/ml. *Tetraselmis* is still used as feed for protozoea and mysis larvae but at reduced levels of about 5,000 cells/ml. It is believed that *Tetraselmis* maintains good water quality by utilizing the metabolites present in the water. *Artemia* is given from mysis and early postlarval stage at higher feeding levels. Bread yeast can be given to protozoea as supplementary food at 0.1-0.3 g/ton in case *Tetraselmis* is not available.

The use of egg yolk greatly simplifies hatchery procedures considering that the most difficult and tedious part in larval rearing is the maintenance of algal foods, especially diatoms. Egg yolk is easy to prepare and readily available even in remote areas.

Larvae from wild spawners collected from fish corrals in Batan Bay were reared in two-ton fiberglass tanks with conical bottoms in the experiments. The runs were conducted at a private hatchery in close collaboration with the SEAFDEC AQD.

The first experiments were conducted from June to September 1979. Of a total of 31 runs, only 7 runs or 22.5% were successful using the old method. Average survival rate of the successful runs from nauplius to P5 was only 2.46%. Using the new feeding scheme, a total of 44 runs were conducted at the private hatchery. All the runs were successful with survival rates ranging from 20-75% giving a high average survival rate of 52.9%.

Poor survival rate in the old feeding scheme may be attributed to the following:

(a) Overfeeding of diatoms during the protozoeal stage — reddening of the larvae is a common observation when diatoms are fed at high densities. For diatom feeding, density levels of no more than 3,000-5,000 cells/ml should be maintained in the rearing tank.

(b) Underfeeding of *Artemia* and *Brachionus* during the mysis and postlarval stages.

Aeration System

According to Gabasa, most hatcheries use compressors or roots blowers which are not only expensive but impractical. "This aeration system is centralized to aerate all the tanks, hence the same energy is consumed even if only one tank needs aeration. Moreover, when air lines are contaminated with pathogenic organisms, the whole aeration system has to be cleaned and disinfected, a difficult and time-consuming job," he explains.

He has observed that survival rate as

high as 60% can be attained with minimal aeration. Thus, he suggests the use of electrically operated portable aquarium-type aerator (5-watt) instead of compressors or blowers. Such an aerator is cheap and available locally, can be maintained easily and without much cost, and consumes minimal energy.

Hatchery Model

Based on the recent findings and experiences at the SEAFDEC AQD, a new small-scale hatchery model for *P. monodon* has been drawn up. Tests are being conducted to refine the system at certain points. Figure 1 shows the layout of the model. The specifications for each of the components are as follows:

1. Larval Rearing Tanks. The size and shape of the larval rearing tanks will not significantly affect survival of the prawn larvae. In deciding tank size and shape, due consideration should be given to ease in construction, water management, and harvesting of fry. The proposed larval rearing tank is 2-ton in volume and shaped like a bathtub to prevent accumulation of organic detritus at comers. It is shallow (0.8 m deep) and thus requires minimal aeration. The tanks can be made either of concrete, wood or fiberglass. Concrete tanks, however, are more durable, cheaper and easy to construct. Changing of water can easily be done by using a rubber siphon with strainer to prevent draining the larvae. A 2" PVC pipe is fitted into the tank to control drainage and harvesting. This pipe eliminates the use of PVC gate valves which are not only expensive but also difficult to obtain locally. A tank of this size can be stocked with 100,000 to 200,000 nauplii. The number of tanks needed will depend on the desired production levels of the operator.

The larval rearing tanks do not have to be housed in a massively constructed building. However, there should be some provision so that the tanks can be easily covered with plastic walling and roofing to prevent salinity change during rains and to maintain the desired temperature.

2. Algal Culture Tanks. Since the hatchery innovation requires minimal algal feeds, only a few algal culture tanks are needed. A 2:1 ratio of larval rearing tanks to algal tanks is adequate. Approximately one ton in capacity, the algal tank can be

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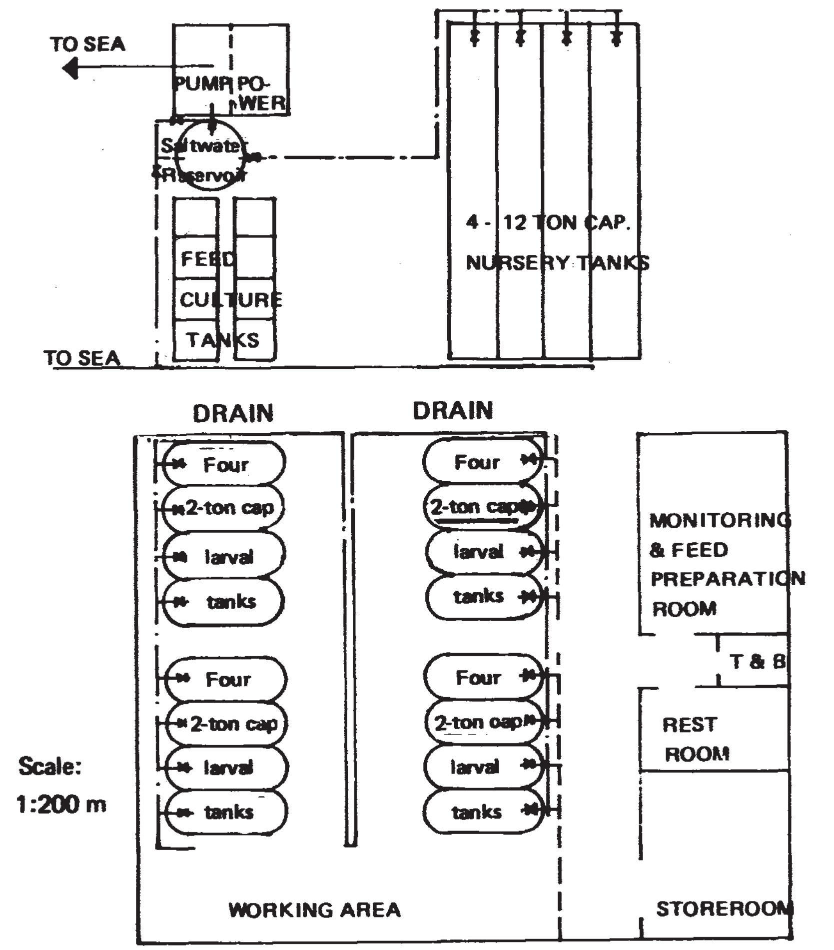

FIG. 1. Proposed layout for a small scale *P. monodon* hatchery.

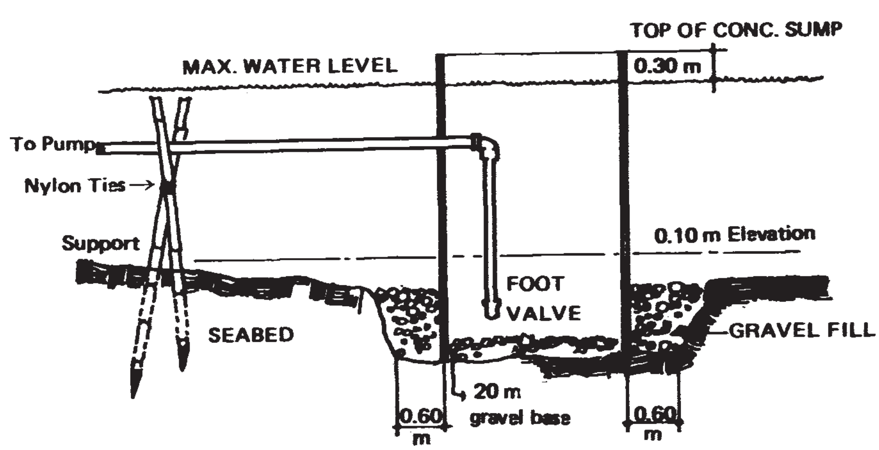

FIG. 2 Proposed detail of saltwater sump pit.

Fisheries and Aquaculture in the People's Republic of China

G.I. Pritchard

Editor's Note

This article (first of two installments) is extracted from a publication of the International Development Research Center of Canada (IDRC-115e: G.I. Pritchard. Fisheries and aquaculture in the People's Republic of China. Ottawa, Ont., IDRC, 1980 32 p.: illustrated). Dr. Pritchard is Director of Aquaculture and Resource Development, Department of Fisheries and Oceans, Ottawa, Canada KIA 0E6. Dr. Pritchard visited the People's Republic of China in 1974 as a member of one of the first scientific and technical missions on fisheries to that country in more than two decades and has maintained an avid interest in their fisheries and aquaculture development.

W.H.L. Allsopp, Associate Director (Fisheries) of the IDRC Agriculture, Food and Nutrition Sciences Division says in his foreword: "The fisheries success of the People's Republic of China well illustrates the guiding principle that should be applied to the structuring of fisheries in developing countries... This has been achieved with low capitalization and labour intensive systems, both of which are of prime socio-economic importance in most developing countries. . . The results of these efforts have made China one of the top fish-producing nations in the world and the leading nation in aquaculture production with more than 50% of the world's finfish production."

The views expressed are those of the author and do not necessarily represent the views of the IDRC.

The coastal and inland fisheries of the People's Republic of China are among the most productive in the world, providing diversity in human diets and food of high nutritional quality that is much in demand. As yields of fisheries on a global scale tripled in the 25 years before peaking in the early 1970s, China rightfully claimed to have kept pace with countries much more dependent upon science and technology. Harvests today put China among the top four fishing nations in the world. The manner in which this status was attained differs from all others.

Unable to compete in distant ocean fisheries, but faced with a need to provide food, China turned to husbandry and intensive use of resources within its national control. Emphasis was placed on freshwater fish culture, which had both a long tradition and a large body of know-how. China was therefore little affected by the economic fishing zones now being established in many parts of the world and the associated curbs on the plunder of wild marine resources. Other countries so affected are now being forced to move toward intensive forms of fish production and therefore look with much interest to experiences within China.

The Government of China also has become more receptive to modern fishing methodologies, extending its own coastal fishing zones and opening international exchanges in science and technology. Problems in such areas as detection and harvesting of fish that move freely in the upper strata of the sea are acknowledged, and solutions are being sought. Benefits are foreseen from introducing international science into the traditional Chinese fisheries.

It is therefore most timely to examine the fisheries and their supporting science in relation to the national goals and priorities of the People's Republic of China, to review the perceptions of fisheries science until 1970 and the trends since, and to provide a general assessment of the fisheries and the future outlook.

The Fishing Industry and its Resource Base

Freshwater and marine fisheries are both important protein sources for the People's Republic of China. Elaborate systems of dams, flood controls, reservoirs, canals, and irrigation trenches provide the key to successful food production in China, and inland fish culture is but one phase of both an intensive and an integrated land-use system. Thirty percent of the approximately 6,880,000 tonnes of fisheries production (FAO 1977a) comes from inland fisheries (exclusive of subsistence food fisheries in natural waters for which there is no assessment), making China the largest cultured-fish producer in the world.

The freshwater fisheries are located throughout much of the People's Republic of China's 20 million hectares (ha) of freshwater rivers, reservoirs, lakes, and ponds. About half of that area is suitable for fish culture, and in keeping with the Chinese principles of multiple, intensive use of all natural resources, virtually all suitable waters are stocked with fish and managed to some degree (Ryther 1979). Production, however, is concentrated in areas of the big lakes and river systems, the Yangtze basin being the largest followed by the Pearl basin. There are about 20 species of freshwater fish of economic importance in the country, with emphasis being placed on the four native Chinese carps that constitute the so-called Kia-yu or household fish. These fish, cultured in family ponds in China for generations, are the silver carp (*Hypophthalmichthys molitrix*), a phytoplankton feeder; the bighead (*Aristichthys nobilis*), a zooplankton feeder; the grass carp (*Ctenopharyngodon idella*), which feeds on grasses and other aquatic plants; and the black carp (*Mylopharyngodon piceus*), which feeds on molluscs and snails. These household fish may be cultured together with several varieties of the common carp, bream, dace, tilapia, or other nonpredator fishes.

The marine fisheries are located along the 14,000 km of coastline, where there are good harbours. The present fishing capability is limited to an area within 320 km from shore as China has never had a distant high-seas fishery. Within this coastal area of China lies one of the largest and most productive fishing shelves in the world, extending from the Bohai Sea in the North, through the Yellow Sea and East China Sea, and into the South China Sea. The shelf has a great variety of fish, urchins, and prawns. More than 80 species are of commercial importance including herring, mackerel, sardines, hair-tail, yellow croaker, butterfish, sharks, eels, flounder, prawns, sea cucumbers, oysters, jellyfish, and seaweeds.

The fishing industry of China is a traditional source of employment. More than one million families are engaged in collective fishing enterprises, which alone account for 80% of production; the remainder comes from the state-owned fishing corporations. These corporations are owned by provinces, municipalities, cities, counties, and regions, and differ greatly in size and function. The largest are at Luda also called Dairen (Dalian) in Liaoning Province in the north, at Yantai on the Shantung (Shandong) Peninsula, at Tsingtao (Qingdao) in Shantung Province, and in Shanghai. Numerous smaller state corporations are distributed throughout the length of the country. They include the South China Sea State Fishing Corporation on Hainan Island, the State Fishing Corporation on the Raychow Peninsula in West Kwangtung (Guangdong) Province, the State Fishing Corporation at Foochow (Fuzhou) in Fukien (Fujian) Province, the Corporation at Wenzhow in Chekiang (Zhejiang) Province, and various others.

Virtually all vessels and gear used in this fishing industry are manufactured domestically although some designs are copied from abroad.

Domestic markets quickly absorb much of the production of finfish, shellfish, and marine plants although some high-priced products are processed and set aside for export. Live fish sold to Hong Kong constitutes a substantive portion, second only to shrimp, of the U.S. $100 million fish exports from the People's Republic of China (Environment Canada 1976).

The Fisheries Sciences in Relation to Goals and Priorities

Central responsibility for fisheries matters in China fell under the Ministry of Agriculture and Forestry until June 1979, when a separate General Administration of Aquatic Products directly responsible to the State Council (FAO/UNDP 1979) was established. Thus, objectives and priorities have been frequently entwined with those of food production. Fisheries was identified as one of 108 items selected as key projects in the nationwide endeavour for scientific and technological research at the National Science Conference in March 1978. Fang Yi (1978), Minister in charge of the State Scientific and Technological Commission, called for a comprehensive survey of resources in fisheries, for study of the rational exploitation and utilization of the resources with the protection of the ecological systems, and for study of the rational arrangement of these undertakings to provide a scientific basis for the all-round development of food production.

The fishing industry of China is a traditional source of employment. More than one million families are engaged in collective fishing enterprises, which also account for 80% of the production; the remainder comes from the state-owned fishing corporations.

Specifically, Fang Yi called for increasing water-life production, for fish breeding, and for marine fishing and processing to contribute to improving the ingredients of the people's diet. He promised the establishment of up-to-date centres for experimental fishing and coordinated efforts to tackle key scientific problems. Emphasis was also to be placed on basic theory and sciences of food production and on laying a solid foundation for constant innovation in techniques for expansion of production. These statements, offered in the spirit of the "Four Modernizations" campaign, which is China's effort to modernize agriculture, industry, national defence, and science and technology by the end of this century (Culliton 1979a), may well set the tone for China's development in the decades ahead.

To appreciate the impact of the Fang Yi statement on fisheries sciences, it is necessary to look at what has gone before. But first, one should also note the contributions of fisheries to international goals and priorities. Information on the successful technology for the multispecies culture of native Chinese carp is actively sought by many developing nations, and special programs of technology transfer, training, and scientific exchanges have been proposed (Tapiador et al. 1977; Culliton 1979b). Also, the conduct of marine fishing operations in coastal and offshore waters of China provides a means for exercising sovereignty over geographic areas of potential dispute (Choon-Ho Park 1974; Kenji Asakawa 1962).

Perceptions of Fisheries Science to 1970

The silk line and tapered bamboo rod in all likelihood were the first examples of Chinese fishing technology to be transferred and adapted throughout the world, but even these items were probably predated by nets and other fishing implements. Considerable literature on fishing was produced in ancient China, but most of this is inaccessible to those unversed in the language. Earliest distinct mention of fishing was 1122 BC, so centuries were necessary for the evolution of the fish catching and hatching techniques that have long held fascination to the Western World. Fishing laws with respect to closure and the willful destruction of fish were extremely strict and had existed from time immemorial. To the Chinese, in all probability, belongs the credit of having invented pisciculture, or the art of breeding and rearing fish artificially. Even though this is not quite certain, they were undoubtedly among the first in the field. These facts and other fascinating stories about Chinese fishing can be found in William Radcliff's book (1926) *Fishing from Earliest Times.*

Two significant events, which preceded publication of this work, opened Chinese fisheries to Western view. First, there was the publication in Paris of the work entitled *La Pisciculture et la Peche*

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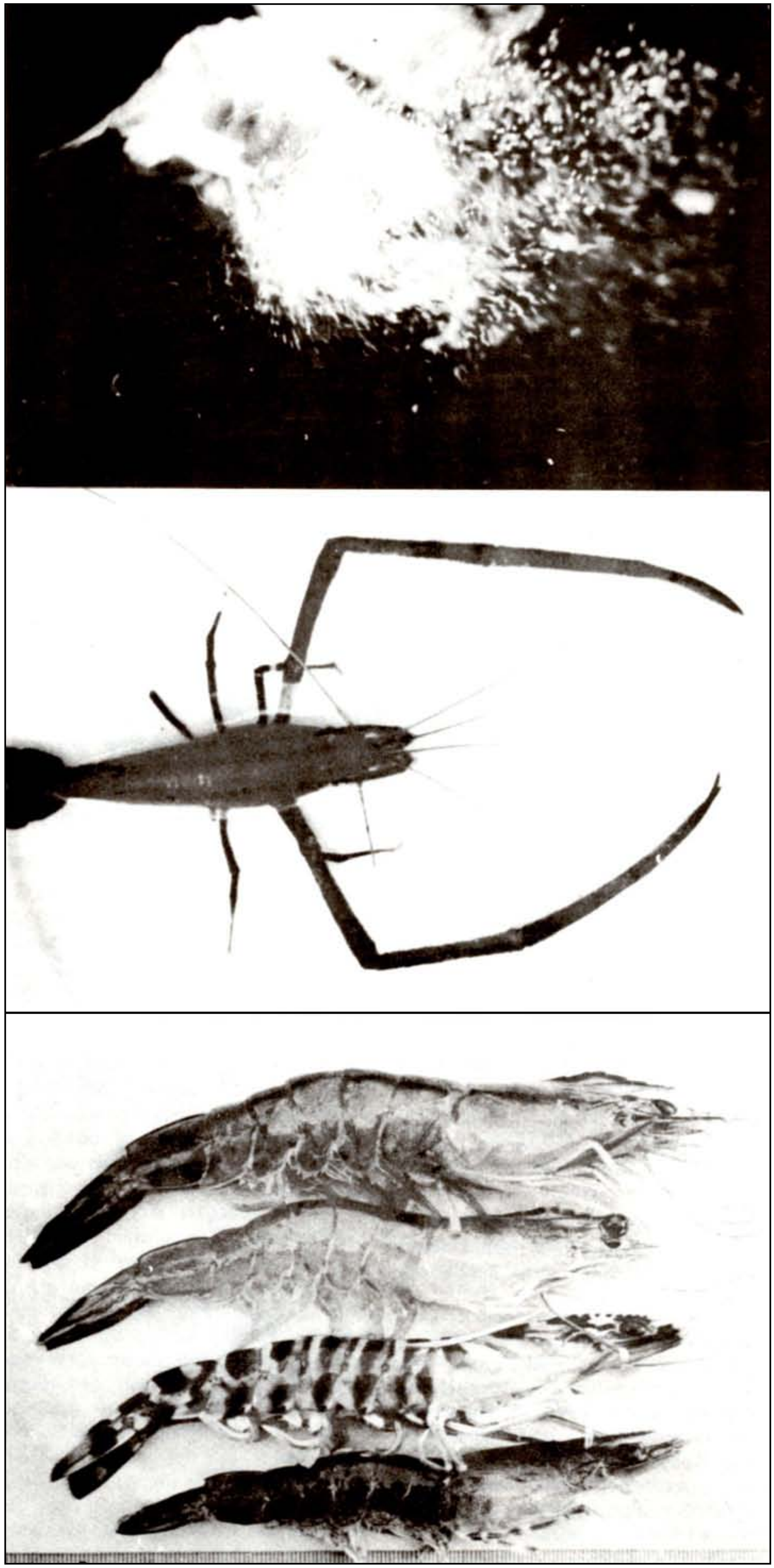
do we say shrimp or prawn?



At SEAFDEC AQD, *Penaeus monodon* is generally referred to as the giant tiger prawn. Photos show (a) Female *P. monodon* while spawning; (b) Male adult *Macrobrachium rosenbergii;* and (c) other potentially important species include (from top) *P. merguiensis, P. indicus, P. japonicus* and *Metapenaeus ensis.*

Increasingly, the distinction between the terms shrimp and prawn is being defined, but not much has been gained in arriving at a consensus. Even if one were to be nonchalant and ask What's in a name? that wouldn't be any help for what *may well turn out to be a communication problem.*

During the FAO World Scientific Conference on the Biology and Culture of Shrimps and Prawns held in Mexico City June 12-21, 1967, there was a mutual but unwritten agreement that the term "shrimp" will refer to the saltwater penaeid species while "prawn" will be used for the freshwater palaemonid group (Dr. H. Rabanal, personal communication). At the SEAFDEC Aquaculture Department, there is no hard-and-fast rule, although the No. 1 crustacean species, Penaeus monodon *Fabricius, is generally referred to as the giant tiger prawn.*

In his introduction to the Shrimps and Prawns of the World: an annotated catalogue of species of interest to fisheries *(FAO Fisheries Synopsis No. 125) published in 1980, L.B. Holthius traces the origins of the names shrimps and prawn and the various usages as applied in different parts of the world. Here's an extract from his introduction to that book:*

Because of the existing confusion in the use of the names "shrimp" and "prawn", it seems useful to draw some attention to this problem. It is impossible to give a short definition of either name, as in different regions these terms are used for different animals or animal groups, and even within a single region the usage is not consistent. Both terms of course have originated in Great Britain. There "shrimp" stands for members of the family Crangonidae (*Crangon crangon* being the "Common Shrimp"), while the term "prawn" is used for species of Palaemonidae (*Palaemon serratus* being the "Common Prawn"). But also Crustacea not belonging to these two families are often indicated as shrimps and prawns, and here the difficulty starts. The term prawn is then usually employed for the larger forms (often those that are more laterally compressed and have a well-developed rostrum), so *Pandalus montagui* leach is known as "Aesop Prawn" and even *Nephrops norvegicus* (L.) is sometimes indicated as "Dublin Bay Prawn". The term "shrimp" is commonly used for the smaller forms (often dorsoventrally depressed and with a poorly developed rostrum): the name "Opossum shrimps" is given to the Mysidacea, "Skeleton shrimps" to the Caprellidae while for instance Gordon (1958, Nature (Land.), 182:1186) referred to *Thermosbaena* as "a thermophilous shrimp from Tunisia". Even in England the use of the two terms is not consistent, so *Pandalus montagui* is not only referred to as "Aesop Prawn", but sometimes also as "Aesop Shrimp" or "Pink Shrimp", while the mysid *Praunus flexuosus* (O.F. Muller) (the generic name *Praunus* Leach, 1814, itself is a latinization of the word "prawn), is known both as "Chameleon Shrimp" (e.g. Eales, 1950, Littoral Fauna of Great Britain, ed. 2, p. 122) and "Chameleon Prawn" (e.g. Ingle, 1969, A Guide to the Sea Shore, p. 95).

Summarizing, we may say that in Great Britain the term "shrimp" is the more general of the two, and is the only term used for Crangonidae and most smaller species. "Prawn" is the more special of the two names, it being used solely for Palaemonidae and larger forms, never for the very small ones.

In North America the name "prawn" is practically obsolete and is almost entirely replaced by the word "shrimp", even the species of Palaemonidae, like those of *Palaemonetes* ("Grass Shrimps") and *Macrobrachium* ("River Shrimps"), are usually indicated as shrimps. If the name prawn is used at all here, this seems to be done only for the smaller Palaemonids and Atytds, which, e.g. in Pennak's (1953, p. 451) "Freshwater Invertebrates of the United States", are indicated as "Freshwater prawns". Where in England the word "prawn" denotes the larger Natantia (the English Oxford dictionary defines prawn as "a marine crustacean-like large shrimp"); in America, if used, it refers to the small species (the American Webster dictionary gives as definition of prawn "a small crustaceous animal of the shrimp family"). Although in both Britain and North America, shrimp is the more general term (in America far more strongly so than in Britain), the usage of the term "prawn" is almost the direct opposite in the two regions, denoting in Britain the larger palaemon-like animals, in America the smaller ones.

In South Africa the larger Natantia, starting with *Macrobrachium* and including the Penaeidae are called "prawns" and smaller species like *Caridina* and *Acetes* shrimps. A sharp division cannot be made here either, so Chuang (1961, on Malayan Shores, p. 181, pl. 80) used the names "Snapping-prawn" and "Pistol-prawn" for Alpheids.

In Austria and New Zealand the Crangonidae are called shrimps, the Palaemonidae (even the small species) and Penaeidae, prawns. Hale (1927, The Crustaceans of South Australia) listed furthermore the Processidae and Atyidae as shrimps, the Hippolytidae, Alpheidae, Pandalidae and Campylonotidae as prawns. However, several other Australian authors use the name Pistol shrimp for Alpheidae, while also the more prawn-shaped *Stenopus hispidus* is given the name Banded shrimp.

All in all the situation is quite confused, and nowhere a sharp distinction seems to be made between shrimps and prawns. In general one can say that the larger Palaemonidae and Penaeidae (thus the species that are commercially most attractive) are called shrimps in America, and prawns in most of the rest of the English-speaking world. The word shrimp being used almost everywhere for the Crangonidae and other small forms, but many exceptions occur here.

In French, the general term "crevette" is quite generally used for both shrimps and prawns and fortunately causes no problems. In Spanish, the general term for shrimps and prawns is "camaron" (camarao in Portuguese). The word "gamba" is less generally used; in fact it is applied only to a few species. The most confusing Spanish term is "langostino". In Spain, "langostino" is the official name for *Penaeus kerathurus,* in Argentina it is applied to *Pleoticus mulleri,* in Cuba to *Macrobrachium* species, and in Venezuela to various of the larger species of shrimps. Moreover, the term "langontino" is used in Chile for two species of galatheid Crustacea (*Cervimunida johni* Porter and *Pleuroncodes monodon* H. Milne Edwards). The similar French word "Langoustine" stands for *Nephrops norvegicus* (L.).

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Fisheries and Aquaculture...

(From page 5)

en Chine by Pierre Dabry de Thiersant (1882), an expert sent out by the French Government to report fully on fishing in China. Second, was the holding in London of the International Fisheries Exhibition of 1883 for which China mounted a comprehensive exhibit both illustrating and documenting fisheries that had been set apart for hundreds of years (Whymper 1883; Campbell 1883).

The years that followed these disclosures had few significant changes to report (Yen Wei-Ching W. 1980), and little attention was paid to the Chinese fisheries until after 1945 when Westerners again became aware of the importance of Far Eastern fish culture. Developments that occurred within the industry are probably best examined in comparison with those elsewhere, as was ably done by Drews (1951) using Japan as the contrast. Drews became convinced that the exploitation of aquatic resources had been subjected to the cultural controls of human attitudes, and that the supporting science too had fallen under a similar influence of cultural values with a loss of objectivity. He set out systematically to compare the cultivation of food fish in China with that in Japan, and his results showed several sharp contrasts.

The first was a matter of antiquity, Chinese fish culture being much older than that of Japan. Pisciculture, a term used synonymously with fish culture and aquaculture, was truly important in China at an early time but remained unimportant in Japan until quite modern times. Also, pisciculture was an almost wholly autochthonous development in China, whereas it undoubtedly entered Japan from the adjacent continent in a relatively perfected state. Not only was fish culture native to China but, more important in this context, it remained so. In contrast, Japan borrowed diligently and in many cases improved on what was borrowed. In time, the cultural force that was followed changed from the East to the West, and the Japanese continued with a genius for synthesis, to borrow, to assimilate, and to change the new patterns as they had the old.

Turning to the contemporary patterns of fish culture in the two countries, Drews found additional contrasts that were readily observable. One was the striking difference of species reared. The Chinese relied almost exclusively upon the carp family that prefer warm and turbid freshwater, although they also reared mullet. In Japan, several non-cyprinid fish were reared, including eel, trout, salmon, and smelt, all of which are anadromous and prefer clear waters that are cool or cold. The kinds of fish reared also differ in respect to size and to the importance of non-native species. Although pond fish are usually immature and small when marketed, it is significant that all fish reared in China will reach medium to large sizes if permitted to do so. This contrasts with the number of really small fish reared in Japanese ponds. Again, all the species of fish reared in China are native in origin whereas in Japan species foreign to the islands have come to play some part in aquaculture. Further, in Japan, public health is protected by official limitation of the use of raw "night soil" in ponds used for rearing food fish. There is no similar Chinese prohibition of the use of this source of fertilizer.

Shao-Wen Ling (1977) presents the picture from another viewpoint. The traditional systems of aquaculture were practiced in China by the common man without help from the government for years. It was only at the beginning of the 20th century that the government felt that new concepts and ideas should be applied to the field. At that time modern sciences had already been introduced into China, and young students and scholars were sent abroad to study biology. Nobody was trained specifically in fisheries, but some of the young biologists took an interest in it and became fisheries biologists and fish culturists. In those days most of the biology teachers in China were trained in foreign countries and were taught using foreign textbooks and foreign organisms as examples. In the early 1920s a group of progressive young biologists began to study Chinese animals and plants and write biology textbooks in Chinese. Although these efforts were devoted mainly to natural studies, fisheries as a subject was beginning to receive attention, and some of the young scientists tried to interpret the traditional aquaculture operations on a scientific basis. Many of the old fish masters were illiterate, but they possessed invaluable practical experience and skill. By observing weather conditions, the colour of pond water, or the movement and behaviour of fish, they could determine reasonably accurately the water quality of the pond and the health of the fish. They could detect important deviations from the norm, and knew how to correct or prevent such undesirable happenings without the aid of expensive equipment. Asian scientists gradually began to apply their knowledge of biological and physical principles to the practices of the old masters. It was at this time that fish polyculture became known to the world.

Before World War II, most scientific fisheries work involved the survey and interpretation of existing practices. With the realization of the potential of aquaculture to produce cheap food, efforts began to pour into fish culture, and experiments were initiated to improve and refine existing practices. It was not until the early 1950s that serious efforts were made to produce select "seed," or stocking material. Traditionally, "fry seed" of the major carps was collected from natural habitats. In 1955 the technique of using hormones (e.g., human chorionic gonadotropin and fish pituitary gland extract) to induce spawning provided a major breakthrough. Many fish that could not be spawned previously could now be induced to reproduce in simple hatcheries under controlled conditions so that successful mass production of select fish seed of many of the important cultivable species resulted.

Today, Chinese fish culture remains indigenous and extremely practical. Success is assured through controlled water supply and timely drainage. One of the major contributing factors is the availability of electric power in every rural area (Tapiador et al. 1977).

Today, Chinese fish culture remains indigenous and extremely practical. Success is assured through controlled water supply and timely drainage. One of the major contributing factors is the availability of electric power in every rural area.

The predilection for fish culture in inland waters tended to discourage Chinese investments in marine fishing and in particular deep-sea fishing. Solecki (1966) reviewed this pattern of development and concluded that present-day Chinese economists are quite right in stating that in 1949 when the People's Republic of China was formed, the fishing industry was far behind the more industrialized fishing nations. The underutilized resources then offered the centralized government opportunities for development, and the fishing industries underwent sweeping organizational changes as in other branches of the economy. Mechanization of the fleet followed within the next 2 decades with the construction of more than 1000 vessels to harvest coastal waters up to 320 km, a considerable extension of fishing capability as traditional junks were limited to 16-19 km.

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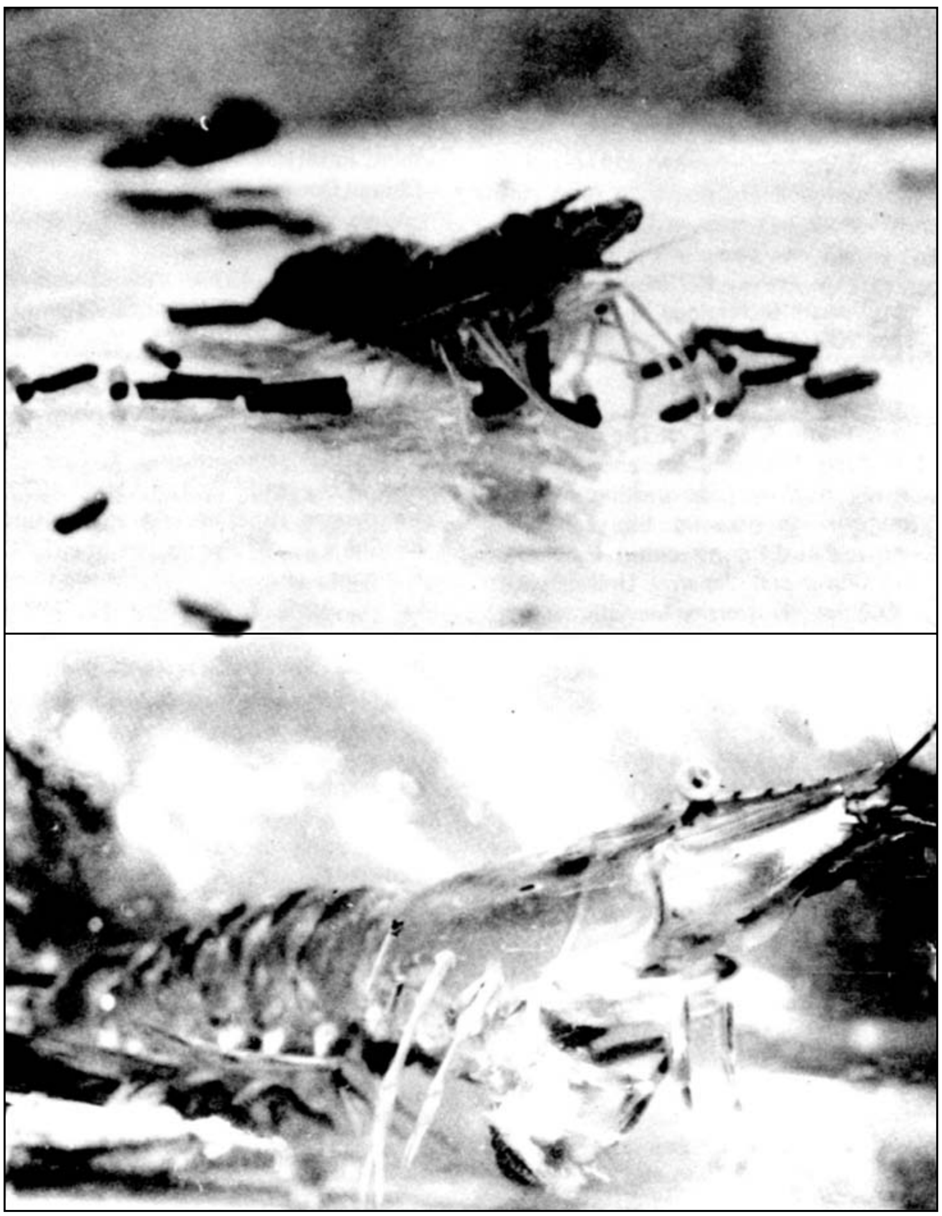
Determine Aquatic Organism's Nutritional Needs



Frieda B. Taub's opening comments during the nutrition workshop of the 1972 Annual Workshop of the World Mariculture Society speak well of the directions being followed by the nutrition and feed development research project of AQD where research in this area focuses on development of practical diets suitable for milkfish and prawns at their various life stages. A three-pronged approach has been adopted in the last few years to dwell on the nutritive value of feedstuffs, nutritive requirements of both species, and digestive physiology of milkfish. As Moderator of that workshop in 1972, Ms. Taub of the University of Washington College of Fisheries provided much of the impetus and challenge for this kind of investigation now being carried out by the Department. Her comments follow:

"As we approach the final workshop, it becomes apparent that a great number of conditions must be met simultaneously to assure high production.

"Good nutritional support is necessary to ensure rapid growth, to prevent nutritional diseases and develop and maintain resistance to infectious diseases, and to insure pleasing color and taste in the marketed product. The cost and reliability of feeds are proving crucial to the economic feasibility of mariculture.

"Nutritional studies tend toward either (1) imitation of natural diets, (2) trial-and-error experimentation with existing cheap diets for other organisms, or (3) controlled feeding with chemically defined diets. Use of naturally occurring feeds and supplementation with similar materials are generally successful in low-density culture where the farming effort consists largely of low-cost improvement of an area for limited protection from predators and increased catchabilitv. As the costs of either land or labor force higher density farming, feeds which are more easily formulated and utilized become necessary. If shrimp were chickens, or rabbits, or cows, or trout, ample feeds would be available on the current market. As it is, its needs are not met by existing products. Certainly the potential savings in time and development costs make testing of present feeds an attractive approach. Controlled feeding of chemically defined diets seems at first approach too costly, too time-consuming, and too

September Aquaculture Meet

Seven AQD staff members participated in the recently concluded World Conference on Aquaculture held at the Cini Foundation, Venice, Italy September 21-25, 1981. All but two presented poster-papers and one was co-convenor of a panel.

Organized by the European Mariculture Society and the World Mariculture Society, the theme of the conference was "Realism in Aquaculture: Achievements, Constraints, Perspectives". The program included a keynote lecture by O. Kinne, well known ecologist from the Federal Republic of Germany; 24 review papers on various aspects of aquaculture from T.V.R. Pillay, M. Billo, P. Sorgeloos, R. Billard, and others; and three panels focusing on strategies for aquaculture development in the Third World, ranching in oceanic, coastal, and continental waters, and industrialization of aquaculture. Among some 150 poster papers presented were "Larval rearing of milkfish, *Chanos chanos* (Forsskal)" by J. Juario, M. Duray, V. Duray, and J. Almendras; "Sexual maturation and spontaneous spawning of captive milkfish in floating cages" by F. Lacanilao and C. Marte; and "A comparison of two penaeid prawn broodstock systems — land based tanks and marine pens" by J.H. Primavera and P. Gabasa, Jr.

A trade show exhibiting the products of some 40 companies engaged in aquaculture activities ran parallel to the poster session. Other conference activities included special meetings of various aquaculture groups, showing of selected aquaculture films, a field trip to nearby Turcello and Murano, and evening of classical music at San Stefano Church, and an Awards Dinner in the last evening.

The Conference was important not only for the information shared in the reviews, panels and poster papers but also from the personal contacts made with various workers in the field. Over 1000 participants from all over the world attended.

Five years ago, the FAO Technical Conference in Aquaculture was held in Kyoto Japan. That was a meeting on the governmental level. This one held in Venice by the EMS and WMS is a gathering of non-governmental associations including industry and complements efforts of government.

likely to lead to entanglement in an infinite array of interactions. However, experience with feeds for chicken and trout has indicated that the formulation of the cheapest reliable feed is not possible until the organism's required nutrients and their interactions are known during its various life stages.

"Feeding shrimp poses several unique problems. Are the shrimp being fed or is the pond being fed? What changes occur in the feed before it is eaten: are nutrients lost by leaching or are nutrients added by microbial activity? Is the feed really available to the shrimp? Since mortality can be assessed only at harvesting, how does one estimate the number of organisms for assessment of feeding rates and calculation of feed conversions? How are stocking density, oxygen concentration, temperature, and exposure to disease interrelated with the quality and quantity of the feed tested? How can the effects of container size be reconciled since controlled experiments are usually conducted in small containers, the cost of which would be prohibitive for economic rearing? Large ponds or embayments cannot be managed as yet for the protection of shrimp from either competitors, carriers of disease, or predation.

"These are additional frustrations to the shrimp nutritionist. Perhaps they add to the tentalizing promise of a major breakthrough in the field."

Bare Improvements in . . .

(From page 3)

made of either concrete or marine plywood.

3. Seawater Supply System. Seawater for larval rearing should be clear, relatively free from silt and pollutants, with a salinity range of 30 to 35 parts per thousand.

The seawater supply system consists of an intake pipeline which draws water from the sea, water pump, and water reservoir. This can draw water directly from the sea or from saltwater sump-pit made of concrete circular culvert installed in the sea at 0 + 0 elevation (Fig. 2). In areas where the sea shore is sandy and water is calm most of the year, a sump pit is recommended. Pumped seawater is prefiltered and eliminates the need for a sand or bag filter.

For a small-scale hatchery with 10 to 15 larval rearing tanks, a 2-hp electric pump and a 10 to 15-ton reservoir are adequate to supply the seawater needs of the hatchery.

4. Aeration System. Instead of compressors or blowers, portable aerators can be used to aerate the larval rearing tanks, algal tanks, and nursery tanks. For a 2-ton tank, two 5-watt aerators are adequate.

5. Nursery Tanks. In this hatchery model, nursery tanks are integrated with the hatchery system. Postlarvae harvested from the hatchery and fry collected from the wild should be reared first in the nursery tanks for about a month before stocking in grow-out ponds. Stocking the fry in a controlled environment such as the nursery tank offers several advantages over a nursery pond: (a) higher stocking density of 3,000 to 5,000 fry/sq m with the use of substrates like bamboo; (b) elimination of predators; (c) better control of feeding levels and water quality; and (d) ease in harvesting.

The nursery tanks can be made of either concrete, fiberglass or marine plywood. It can be of any size depending on the fry production capability of the hatchery but should preferably be of 1.5 to 12-ton capacity. Moreover, it should be shallow, not more than 1 meter, to allow easy siphoning of sediments from the bottom. **RDL**

AQD Sponsors Prawn Hatchery Training

Eighteen participants from four SEAFDEC member countries are attending the AQD training in small-scale prawn hatchery management which began September 14 in Panay Stations of the Department.

The participants are: *Yaakob Bin Ahmad* of Kedah, West Malaysia; *Kamal Zaman Bin Mohamed* of Penang, West Malaysia; *Goo Kwee Tiong* of Singapore; *Dain Bin Basrun* and *Foo Ho Tar* of Kota Kinabalu, Sabah, East Malaysia; *Boonchuay Chouthavee* and *Yodchai Karnasuta* of Thailand; *Diosdado G. Ayson, Delminia J. Baguio, Teodulo G. Leonides, Jose B. Manzon, Marina Mendoza, Violeta Ramos, Natalia Reyes, Wilfredo Soriano, Angel Vilgera, Vernon Yap,* and *Patrick Patero* of the Philippines.

A full schedule has been the routine for the 18 participants. The main activity has been larval rearing of *Penaeus monodon* using nauplii from a wild spawner at Batan Substation and an ablated female at the Tigbauan Research Station of the Department.

The main activity has been larval rearing of *Penaeus monodon* using nauplii from a wild spawner at Batan Substation and an ablated female at Tigbauan Station.

An innovative low-cost feeding scheme utilizing *Tetraselmis,* egg yolk, bread yeast, *Brachionus* and *Artemia* singly or in combination was adapted for the various larval and postlarval stages.

Relatively high survival rates from nauplii to P_4 ranged from 20 to 60% in Batan and 10 to 30% in Tigbauan — these were noteworthy because a) in Batan, there was inclement weather caused by typhoon Onsing and b) in Tigbauan, it was the first time that trainees harvested *P. monodon* during their first run, previous training groups succeeded in rearing sugpo to postlarvae only after 2-3 runs.

Of equal significance was the shortened larval rearing period from N_3N_4 to P_4 of only 12 days in the Batan and Tigbauan runs compared to an average of 14-17 days (15-18 days to P_5) from AQD Tigbauan Station data of previous small-scale hatchery runs. This may be partly attributed to the innovative feeding scheme which hastens molting.

In addition to these record-breaking achievements, the trainees had their days and nights full in Batan undertaking: a) a 24-hour monitoring of temperature and salinity during larval development; b) an ecological survey of Batan Bay, Tinagong Dagat and Makato River including spawning and collecting grounds for *P. monodon* spawners; c) visits to small- and large-scale private hatcheries in northern Panay; and d) visits to prawn-milkfish polyculture ponds in Aklan and Capiz including observation of harvesting procedures.

In Tigbauan, side activities of the group were a) larval rearing of *P. indicus* and nursery tank rearing of *P. monodon,* b) observation of spawning behavior of *P. monodon* and *P. indicus* and following egg development up to the morula stage; c)observation of prawn and milkfish fry collection in Villa and Oton, Iloilo and Hamtik, Antique; d) visits to ISCOF farms in Barotac Nuevo and private farms of Leonardo Denila in Banate, and Ernie de Ramos in Dumangas, all in Iloilo; e) observation of *P. indicus* harvest in the Leganes Station; and f) demonstration of fabrication of fiberglass tanks at the Carpentry Unit of PPO.

The shortened larval rearing period in Tigbauan generated an extra 6 days during which the participants plan to broaden their aquaculture education by observing the various research and development activities in the Binangonan Station of the Department and the Central Luzon State University in Nueva Ecija.

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