PRAWN HATCHERY TECHNOLOGY IN THE PHILIPPINES

Rolando R. Platon
SEAFDEC Aquaculture Department

PRAWN HATCHERY TECHNOLOGY IN THE PHILIPPINES

Rolando R. Platon

The development of a hatchery system for prawns was started 30 years ago in Japan. Although the earliest prawn hatchery was developed for P. japonicus, it was adopted in other countries to produce postlarvae of other penaeids. This early system involved the production of natural feeds in the same tank used for larval rearing (Sigueno, 1972). Tanks ranged in capacity from 10 to 200 tons. The phytoplankton and zooplankton bloom in the tank was induced by addition of fertilizers. A highly diverse biological population was thus maintained in the larval rearing tank as larval feed while supplementary feeds were given during the postlarval stages. Differences in environmental conditions and economic systems led to different modifications of the earlier hatchery system for each country's specific needs.

The most significant modification of the early system was made in the United States 15 years later. In this system, instead of inducing a plankton bloom in the larval rearing tank, pure algal cultures were produced separately and then fed at predetermined amounts to the larvae in the larval rearing tanks (Cook and Murphy, 1966; Mock and Neal, 1974). The rearing tanks were of 2-ton capacity while algal tanks for mass production of algae were of 200-300 liter capacity. The sea water used for larval rearing was treated thoroughly to get rid of all suspended matter. For algal production, the medium was artificial salt dissolved in tap (fresh) water. This method is now used in other countries like Panama, Tahiti and Brazil.

Based on the method of providing plankton feeds to the larvae, the earlier system is often referred to as the fertilized or ecological system and the later system as the unfertilized or feeding system.

Because the phytoplankton and zooplanton production in the larval rearing tanks depends on the quality of sea water taken into the hatchery tanks, the fertilized system is highly site-specific. Before deciding on using this hatchery system in a specific location it would be necessary to ascertain the occurrence and seasonal fluctuation of the biological population of the seawater intended to be used for at least one year.

Since there is no selective production of natural feeds, some organisms coming with the water into the larval rearing tank may be undesirable. They also get to be propagated in the tank. This explains the low dependability and low larval survival rate in the fertilized system.

The production of natural feeds is limited by the concentration of fertilizers placed in the tank; higher fertilizer concentration is toxic to the larvae. Thus, the stocking density is normally low at 30-50 larvae per liter with survival rates averaging about 20 percent from nauplii to postlarvae.

This system is highly dependent on weather; sunlight is essential for natural feed production in the larval rearing tank.

The unfertilized system is more sophisticated and involves a number of independent processes, namely: mass production and storage of pure algal cultures, mass production and storage of pure rotifer cultures, and larval rearing operations. The natural feed production is independent of the larval rearing operation and may be done during the off-culture period of the larvae. The feed may be stored for later use. These feeds are normally stored in frozen form and thawed before feeding. The use of only selected desirable species of natural feeds explains the higher dependability and higher larval survival rate with the unfertilized system. A much higher technical expertise is however required for the maintenance and production of pure algal cultures. Stocking densities for this system may be as high as 200 larvae per liter with survival rates ranging from 60-80 percent from nauplii to postlarvae.

This system has been used for the larval rearing of P. aztecus, P. duorarum and P. setiferus (Cook and Murphy, 1966).

Figure 1 shows the hypothetical relative efficiencies of the fertilized and the unfertilized systems. The slope of each line represents the efficiency of the system, i.e., postlarval production per investment cost. The unfertilized system has a higher efficiency but requires a higher initial investment cost (I_u) and a higher production level (P_u), for an economically viable operation. On the other hand, the efficiency of the fertilized system is lower but requires a lower investment cost (I_f) and a lower production level (P_f) for an economically viable operation.

As the hatchery capacity increases and goes beyond P_o, it would be cheaper to shift to the unfertilized system. It is important to note, however, that since the fertilized system is highly site-specific, the point P_o may vary from one location to another.

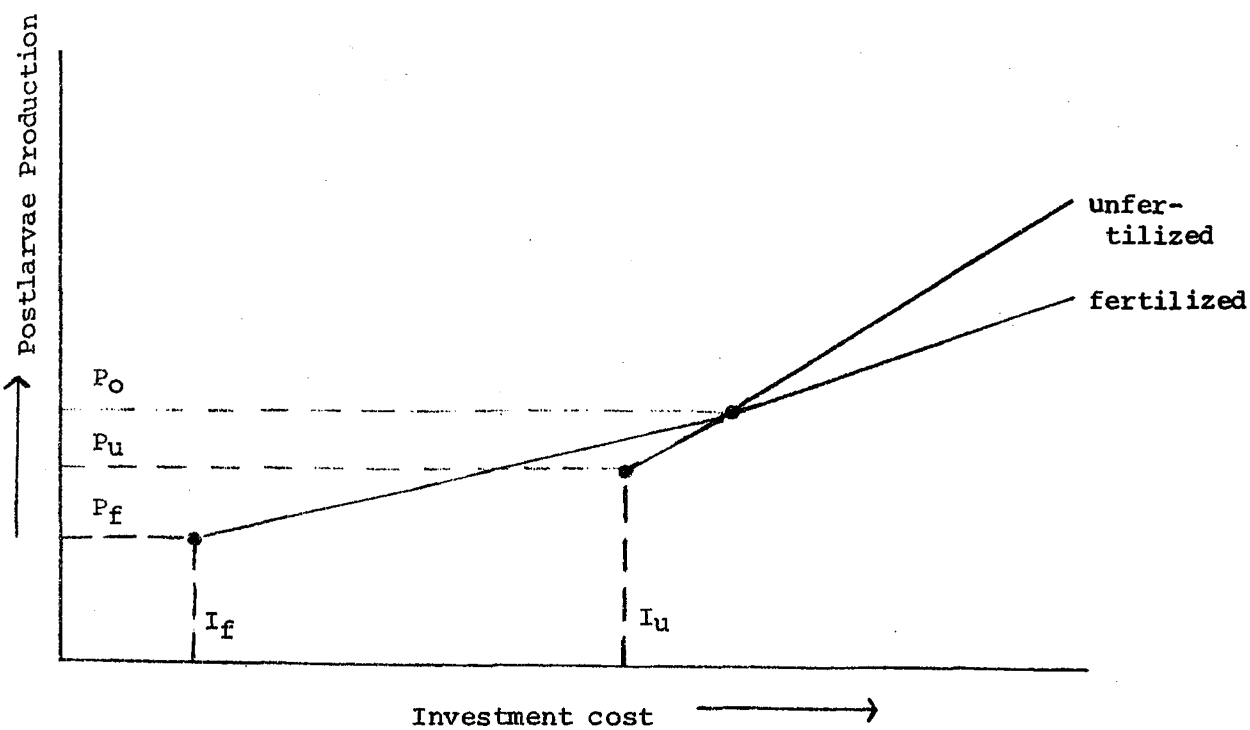

Fig. 1 Relative Efficiencies of the Fertilized and Unfertilized Systems

Hatchery Technology in the Philippines

1. MSU-IFRD

The first successful prawn hatchery operations for the mass production of postlarvae in the Philippines was at the MSU-IFRD in Naawan, Misamis Oriental which started operations in 1973. Its highest annual production was 2.75 million achieved in 1974.

The MSU-IFRD hatchery consists of eight 16-ton and four 60-ton concrete tanks under a translucent plastic-roofed structure. Three 180-ton circular and four 10-ton rectangular tanks are without roofing. One-half ton rectangular wooden tanks are used for the culture of natural feeds for the larvae.

The feeds used in the hatchery consist of mixed diatoms, *Brachionus* and minced clam or tuna fish. The mixed diatoms are introduced from the zoea stage throughout the rearing period. *Brachionus* is given from the mysis stage throughout the postlarval stages.

The mixed diatoms consisting of Chaetoceros, Skeletonema, Thalassiosira, Nitzchia and Rhizosolenia are propagated in one-half ton wooden tanks. This is done by pumping sea water into the algal tank and adding fertilizers. A good phytoplankton bloom is normally achieved in 2 to 3 days. Portions of this highly concentrated diatom culture are then transferred as starters in other tanks. Programming of the diatom production is observed in order to supply the diatom requirement in the rearing tank at the various stages during the rearing period. Portions of diatom cultures which are ready to be fed to the rearing tanks are left behind and transferred into other algal tanks to serve as starters for subsequent culture.

In case of shortage of diatoms, i.e., when the mixed diatom cultures would not bloom in algal tanks, bread yeast is introduced into the rearing tanks or fertilizer is added in the rearing tank to induce phytoplankton bloom.

Brachionus is cultured in separate tanks using Chlorella as feed. Pure culture of Chlorella is always maintained from where the portions are obtained to feed the Brachionus.

Minced clam or tuna fish is blended finely and homogeneously before introducing into the rearing tanks during the postlarval stages.

2. SEAFDEC Aquaculture Department

The prawn hatchery of the SEAFDEC Aquaculture Department in Tigbauan, Iloilo started operations in 1975. The hatchery complex consists of six 50-ton and six 120-ton rectangular concrete tanks under a structure with translucent plastic roofing. There are also four 200-ton rectangular concrete tanks located outside the roofed structure.

During the early operations, the larval rearing techniques used were similar to those used in MSU-IFRD. However, it was observed that the bloom of the desirable diatom species was not always obtained. There was much fluctuation of the biological population in the sea water such that during some periods of the year the desirable diatom species were practically absent.

The modification of the hatchery operation has resulted into one which now involves the mass production of unialgal cultures as larval feeds. The algae which are mass produced are Chaetoceros, Skeletonema and Tetraselmis. The mass production of these algae involve a series of culture volumes from one-liter dextrose bottle to 3-liter jar, 200-liter tank, 1-ton tank and finally 40-ton rectangular concrete tank. Except for Tetraselmis which is introduced directly from the algal tank into the rearing tanks, *Chaetoceros* and *Skeletonema* are concentrated and washed with the use of sand filters before feeding into the rearing tanks.

Chaetoceros and *Skeletonema* are fed starting from the earlier zoeal stage, while *Tetraselmis* is introduced starting from the later zoeal stage. All these are continuously given until harvest.

Brachionus is introduced starting at the mysis stage until the time when brine shrimp is introduced in the early postlarval stages.

Finely blended mussel meat or shrimp meat may be used as substitute for brine shrimp. However, the rearing water quality deteriorates faster when feeding with mussel or shrimp meat.

In 1978, the Department's big concrete hatcheries produced a total of 8.2 million with an average survival rate of about 15 percent from nauplius to P_5.

3. Barangay Sugpo Hatchery Project

The Barangay Sugpo Hatchery Project was organized in January 1977 and charged with the function of developing a small-scale compact hatchery system for *P. monodon* which would serve as a model for fish farmers in adopting a prawn hatchery technology that is within their economic and technical capabilities. It also serves as a training facility around which rectangular training programs can be conducted on all phases of hatchery operations.

The Barangay Hatchery Project also conducts studies aimed to further simplify the available hatchery technology in order to minimize the capital and technical inputs for small-scale viable operations.

The design and operation of a small-scale hatchery system has been prepared and published as the Department's Aquaculture Extension Manual No. 1. The use of 2-ton tanks is appropriate for small-scale operators. It allows flexibility in hatchery operation and is easily manageable when it comes to disease prevention and control.

Barangay Hatchery runs in Tigbauan gave a highest production of 70,000 P_5 per tank of 2-ton capacity with s survival rate of about 60 percent from nauplius to P_5. The average survival rate is about 30 percent with an initial stocking of 100,000 nauplii per 2-ton tank. In Batan, the highest survival rate from the Barangay Hatchery runs was more than 90 percent from nauplius to P_5, with an average of 50 percent. In the Zamboanga SEAFDEC-MRSF experimental station, preliminary barangay hatchery runs have shown promising results (Gutierrez, personal communication).

Aside from P. monodon, hatchery runs were also conducted for P. japonicus, P. indicus, P. merguiensis and M. ensis in Tigbauan.

During September and October 1977, 10 fishpond operators from West Visayas participated in a training program on Sugpo Hatchery Management in Tigbauan, Iloilo. Of the 10, five have built their own hatcheries.

The second group involving seven trainees underwent a similar training program from October to November, 1978 held in the Department's substation in Batan, Aklan.

State-of-the-Art of Hatchery Technology in the Philippines

The SEAFDEC Aquaculture Department's Aquaculture Extension Manual No. 1 presents the basic guidelines on the design and operation of a small-scale hatchery. Among the more significant aspects are:

1. Source of Spawners

The hatchery should be near the source of spawners because -- while there are existing techniques for transporting spawners over long distances -- the quality of eggs is greatly affected by the transport stress.

Transport of nauplii contained in a continuously aerated tank or in oxygenated plastic bags have been tried and may be better alternatives to transporting spawners.

2. Seawater Quality

The biological quality of seawater intended to be used in the hatchery depends on the type of hatchery system to be adopted. With the fertilized system, it would be desirable for the seawater to contain an abundance of small sized diatoms, e.g., Chaetoceros, Skeletonema, etc. throughout the year.

For the unfertilized system, the above requirement for seawater is not necessary.

For any system however the seawater must not be affected by agricultural or industrial wastes. Turbidity should be as low as possible with salinity in the range of 28-32 ppt.

3. Seawater Supply System

Intake systems

Pipe extending into the sea

The seawater may be pumped directly from the sea into the hatchery facility or the seawater may be allowed to flow by gravity through a pipe extending to the sea into a sump from where it is pumped to the hatchery facility.

Inshore well

Water from a well near the shoreline is already prefiltered to eliminate the need for a filtration unit. However the salinity of some inshore wells are easily affected by heavy runoff. This intake system is desirable only if unialgal cultures are maintained in the hatchery for larval feeds.

Intertidal sump

This involves the use of a sump normally made of concrete culverts placed in an intertidal area. Pumping is done only during high tide. The top portion of the sump should not be reached by the highest tide. The bottom should be higher than the low tide to enable complete draining. The inlet hole at the bottom which also serves as a drain hole may be fitted with a detachable and rotating PVC pipe-and-elbow assembly by which water may be allowed into the sump only when the tide has risen to a level when its scouring effect on the ground is minimal. From the sump, water is pumped to the hatchery facility. From this type, it is necessary to have a reservoir which is capable of holding water adequate to supply the needs in the hatchery until the next high tide.

Filtration

Except for seawater from a well, it is necessary to filter from the seawater larger organisms such as fish and jellyfish, as well as silt and mud during heavy runoff. A fine sand filter is adequate for this purpose.

Distribution lines

All pipes and fittings should be made of PVC and should be fully exposed for easier maintenance.

4. Air Supply System

A blower or compressor provides the oxygen requirement to the culture water and induces circulation and agitation necessary for the uniform suspension of cultured organisms.

For light feed particles, ordinary airstones evenly located inside the culture tanks would be adequate for uniform feed distribution. However, for heavier feed particles which settle at the bottom even with the use of airstones, airlift pipes would be desirable in the culture tank.

Distribution lines should also be made of PVC.

5. Larval Culture Tanks

Larval culture tanks may be made of concrete, fiberglass, marine plywood or any material resistant to seawater and without toxic properties. The tanks may be of any capacity depending on the projected volume of production and availability of spawners.

For the fertilized system, it would be desirable to have shallow tanks for efficient natural feed production in the tanks.

6. Culture of Natural Feeds

Techniques for the mass production of unialgal cultures used for algal rearing have been developed. Unialgal cultures of Chaetoceros, Skeletonema, Isochrysis, Tetraselmis and Chlorella are available at the Phycology Laboratory of the SEAFDEC Aquaculture Department.

Although there is available nutrient formulation for the culture of mixed diatoms it would be necessary to modify the formulation depending on the local species of interest.

For the unfertilized system, the diatom cultures are concentrated and washed by the use of a fine sand filter. Algal flocculation has also been done for Chaetoceros, Tetraselmis, Isochrysis and Skeletonema (Millamena & Jereos, 1978).

Brachionus may be mass produced using Chlorella, Tetraselmis or bread yeast as feed. Frozen Tetraselmis has also been found to be an effective feed for Brachionus.

7. Larval Rearing

Feeding

A significant development is the study on the effectivity of feeding frozen Brachionus and frozen brine shrimp to mysis and postlarvae of *P. monodon*, respectively. This was tried in 2-ton tanks and gave survival rates comparable with those obtained from feeding with live *Brachionus* and live brine shrimp (Platon, 1978).

Another importnat experimental result is the effectivity of feeding dried or frozen algae to *P. monodon* larvae (Millamena & Dereos, 1978). These studies were conducted in 3-liter aquaria using *Tetraselmis*, *Chaetoceros* and *Isochrysis*. These will be tried in 2-ton tanks.

There are some artificial feeds available from Japan, Taiwan and the United States which, finely ground, could be given starting from the mysis stage to postlarvae. In this country, however, larval rearing with the use of these feeds are still limited.

Disease Control

To eliminate infective agents that may come with the spawner and which may be carried over into the larval rearing tanks, spawners are first immersed in water treated with formalin (50 ppm) or furanace (3 ppm).

The most common diseases observed in the hatchery are due to the fungi *Lagenidium* and *Sirolpidium*. Some diseases are caused by bacteria and protozoans.

The Department's Pathology Section has recently obtained significant results in the screening of potential chemotherapeutants for the control of some of these diseases (Po, et al., 1978).

Penicillin and Streptomycin applied alternately every other day at a concentration of 0.3 and 0.5 ppm, respectively in one-ton larval rearing tanks were found effective in controlling bacterial infection (Motoh, 1977).

Present Thrusts of the Barangay Sugpo Hatchery

Larval Feeding with Preserved Natural Feeds

This would simplify the hatchery operation in that it would eliminate the need to synchronize the mass production of natural feeds with larval rearing operations. Natural feed production may be conducted during the off-culture period of the larvae. Emphasis would be given on the economics and adaptability of the operation by small-scale operators.

Refinements of Site Selection Criteria Using Indicator Organisms

Successful operation of hatcheries by small-scale operators will ultimately depend on the biological quality of the seawater in the hatchery site. The seawater will serve as a continuous source of larval feeds. Small-scale operators may not have the resources and technical expertise to maintain their own algal stock culture.

Economical Water Treatment Systems for Small-Scale Hatcheries

Aside from the desirable algae, there may also be extraneous microorganisms present in the seawater which if carried over to the larval rearing tanks would adversely affect larval rearing operations. Physical and chemical methods of eliminating these contaminants would have to be studied and developed.

Engineering Studies

These would be necessary in seeking alternative low-cost construction materials for larval rearing and algal tanks.

Larval rearing tank design and development would also be conducted to find out more efficient systems.