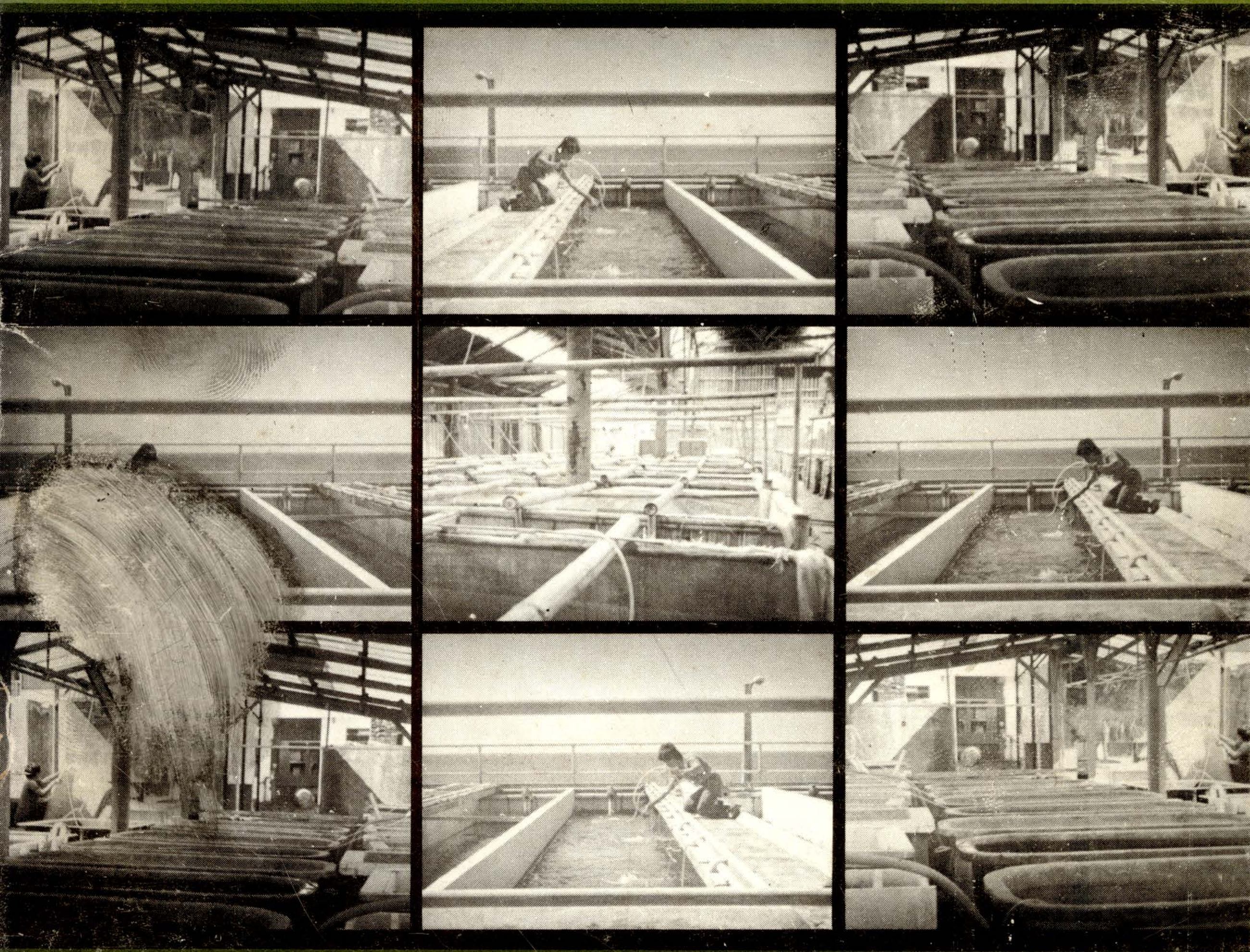
Aquaculture Extension Manual Series No. 9

# A GUIDE TO PRAWN HATCHERY DESIGN AND OPERATION



AQUACULTURE DEPARTMENT
Southeast Asian Fisheries Development Center
Iloilo, Philippines 1984

COVER:

Various prawn hatchery
tanks and designs
R. RUDIO/R.V. RIVERA

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# A GUIDE TO PRAWN HATCHERY DESIGN AND OPERATION

The Aquaculture Extension Manual series of the SEAFDEC Aquaculture Department is a project under its Training and Extension Program to disseminate technologies generated and verified by Department researchers and extension specialists.

This manual was prepared by the

WORKING COMMITTEE ON PRAWN HATCHERY

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## FOREWORD

*The development of appropriate fishfarming techniques is a paramount concern of the Aquaculture Department of the Southeast Asian Fisheries Development Center (SEAFDEC). Since its establishment in 1973, the Department has been holding regular consultations with government planners, extension workers, fishfarmers and the private sector to better serve the needs of the aquaculture industry. Its research efforts focus on the culture of economically important aquatic species, particularly prawn which commands a high price both in the local and export markets. It puts emphasis specifically on the improvement of prawn broodstock, larval rearing, and nursery techniques. In addition, regular training courses on prawn hatchery and nursery operations are being conducted to develop the much-needed technical manpower for the prawn industry.*

*In 1978 the Department published its first extension manual entitled "Design, operation and economics of small-scale hatchery for larval rearing of sugpo,* **Penaeus monodon** *Fabricius", authored by Engr. Rolando R. Platon. Since then, as a result of its continuing research and the field verification efforts spearheaded by Mr. Porfirio G. Gabasa, Jr., the Department has simplified various aspects of hatchery operations to suit local conditions and to meet the needs of hatchery practitioners.*

*There is a need to update our first extension manual to incorporate our modest findings since 1978. Indeed, improved hatchery techniques could well contribute towards increasing seed supply for prawn production. They could also help reduce the capital and operating requirements of a prawn hatchery. It is hoped that this manual will be of interest not only to prawn hatchery operators and fishfarmers, but also to extension workers, businessmen, teachers and students.*

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## I. INTRODUCTION

The development of the prawn industry greatly depends on a steady supply of fry. Since limited numbers of fry can be obtained directly from the sea, research efforts in recent years have focused on improving prawn hatchery techniques to increase fry production (Fig. 1).

There are a number of prawn hatchery techniques practised by operators. They have evolved from continuing studies to simplify ways of rearing and feeding prawn larvae that will ensure high survival and production of fry.

To operate a prawn hatchery, you will have to consider the following:

- Site selection
- Hatchery facilities and equipment
- Knowledge of prawn larval stages
- Spawner and broodstock collection and transport techniques
- Larval rearing techniques
- Postlarval rearing techniques
- Fry harvest, packing, and transport techniques

Each of these aspects is fully explained and illustrated in the following sections.

The simplified procedure, however, does not eliminate the need for a trained technician who can fine-tune the techniques and identify problems that need immediate solutions from time to time in different sites.

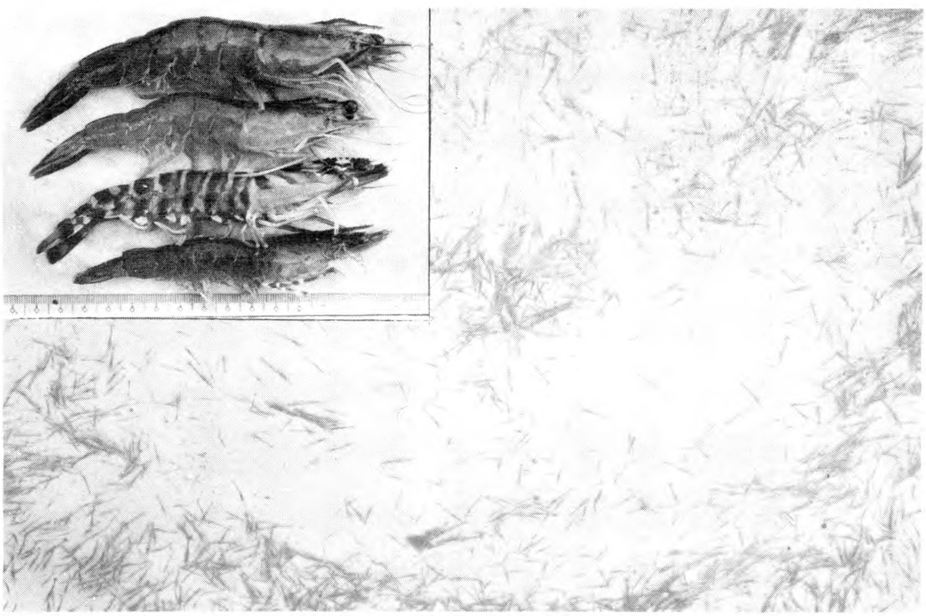


**Fig. 1. Prawns command a high price both in local and export market.**

## II. SITE SELECTION

Site is an important factor in putting up a prawn hatchery. In choosing a suitable site for a prawn hatchery, consider the following: spawner source, location, climate, seawater quality, availability of electric power, accessibility and freshwater supply.

### A. Spawner Source

It is ideal for hatcheries to be near the source of wild prawn spawners and broodstock. You have to know the seasonality and volume of prawn catch in the prospective area. Fishermen in the locality can help you determine the best collection site, and the number and type of gear used. Many of them have already acquired expertise in identifying and handling spawners and broodstock.

### B. Location

The hatchery should be located near the seashore where clean seawater can be pumped to the hatchery easily and economically. The site must be free from pollution, that is, away from sources of agricultural and industrial wastes. It should also be away from rivers and streams that can lower the seawater salinity and can bring down water from ricefields or densely populated communities to the prospective site.

### C. Climate

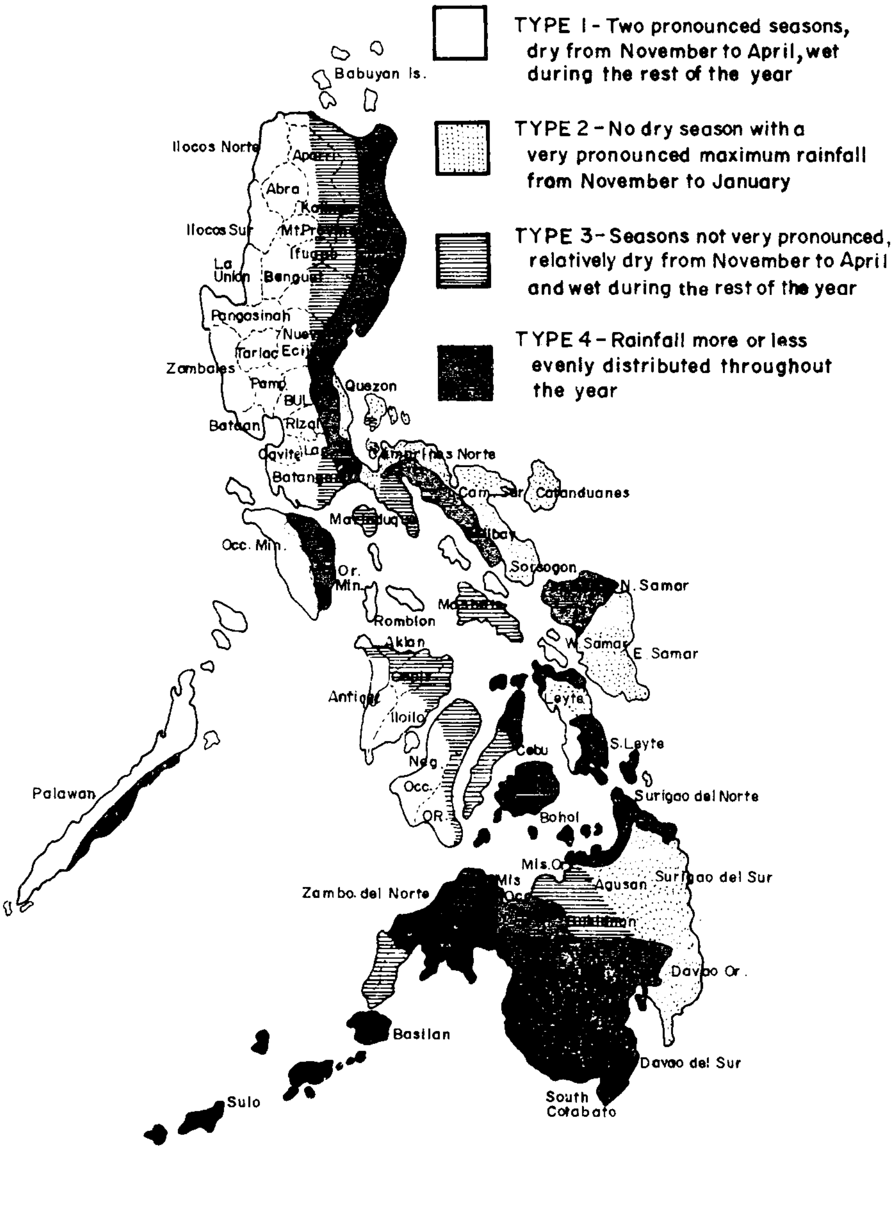
Climate in the Philippines is classified into four weather types (Fig. 2), namely:

- Type 1 – Two pronounced seasons, dry from November to April, wet during the rest of the year
- Type 2 – No dry season with a very pronounced maximum rainfall from November to January
- Type 3 – Seasons not very pronounced, relatively dry from November to April and wet during the rest of the year
- Type 4 – Rainfall more or less evenly distributed throughout the year

The prospective hatchery must be located, if possible, in areas where there are Types 1 and 3 climatic conditions.

### D Seawater Quality

Seawater for hatchery use must have a salinity range from 30 to 35 parts per thousand (ppt.). To know the suitability of seawater for prawn larval rearing, conduct at least 3 trial runs




From Phil. Almanac and Handbook of Facts, 1975, p. 35.

**Fig. 2. CLIMATIC TYPES OF THE PHILIPPINES**

in small containers (500 to 1,000 liters capacity) using seawater from the proposed site during both dry and rainy seasons (Fig. 3). The production of prawn postlarvae (PL) from eggs to $PL_{20}$ (that is, 20 days of postlarval life and about 32 days after hatching) with at least 5% survival rate indicates the likelihood of success in actual operations.

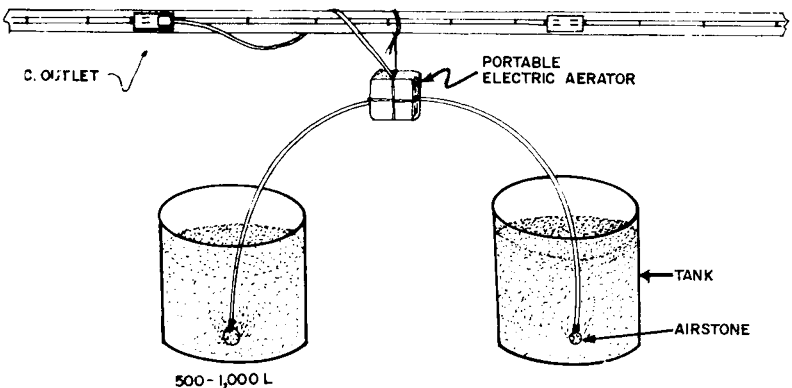



Fig. 3. Trial runs using small containers

E. **Availability of Electric Power**

Continuous electric power is needed during the entire larval rearing period for running aerators, pumps, lights and other hatchery equipment. Have a stand-by generator in case of power failure.

F. **Accessibility**

The hatchery should be accessible by land or by water for convenient marketing of fry and for transporting supplies, materials, and other necessities (Fig. 4).

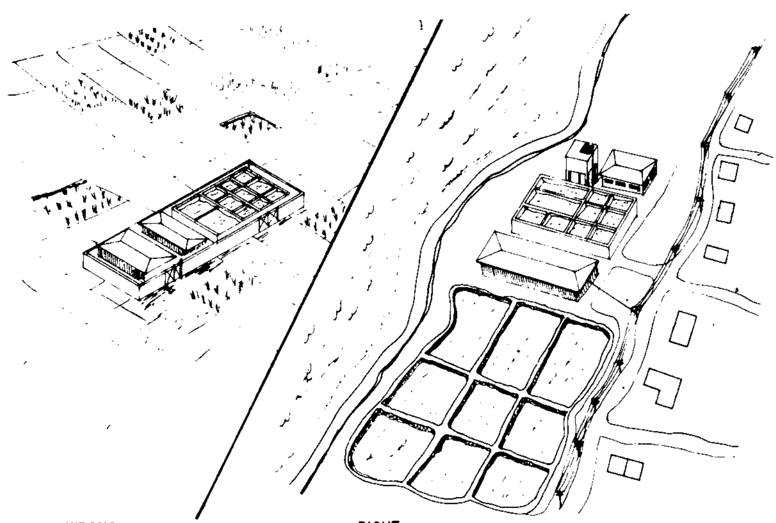



Fig. 4. Prawn hatchery must be located near seawater source

G. **Freshwater Supply**

Continuous freshwater supply is necessary in the hatchery for lowering salinity when acclimating postlarvae, for washing, and for other uses (Fig. 5).

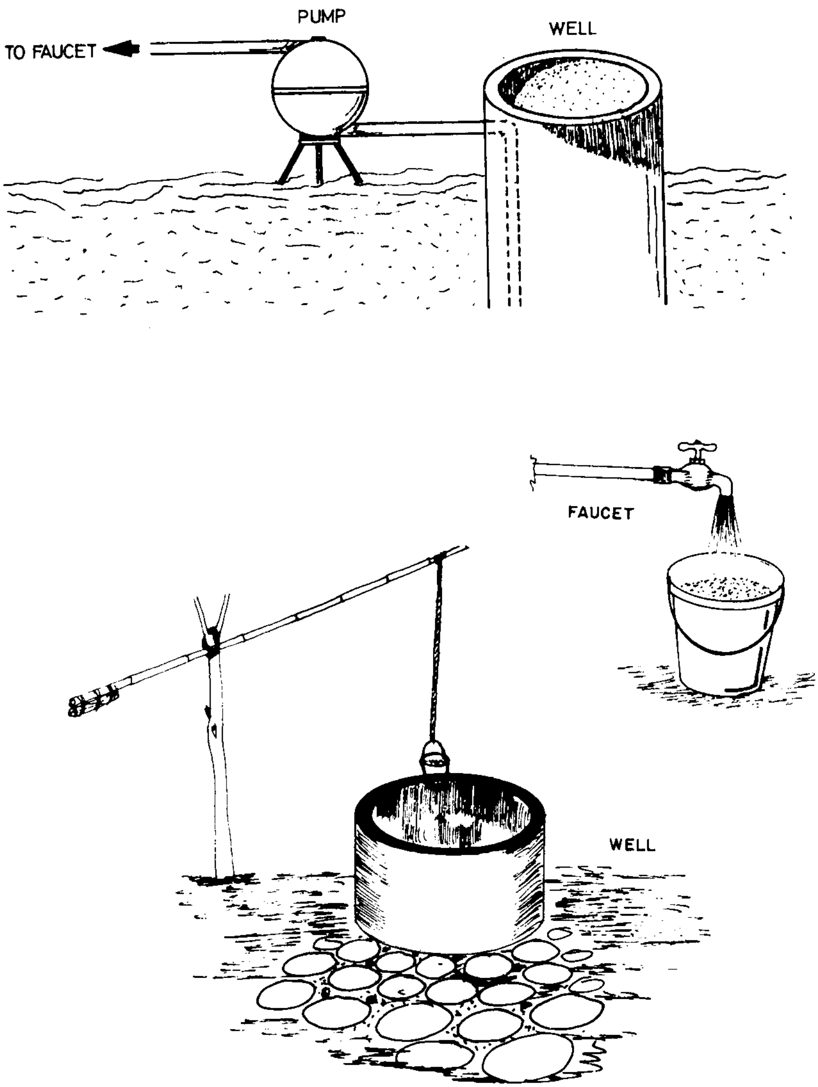



**Fig. 5. Different sources of freshwater supply**

## III. HATCHERY FACILITIES AND EQUIPMENT

A prawn hatchery must have complete facilities and necessary equipment for successful operation. It should have suitable tanks for larval, postlarval and algal or phytoplankton cultures; and air and seawater supply systems. A building to accommodate at least the larval tanks and other important hatchery materials and equipment is equally necessary.

A suggested lay-out for a prawn hatchery is shown in Figure 6.

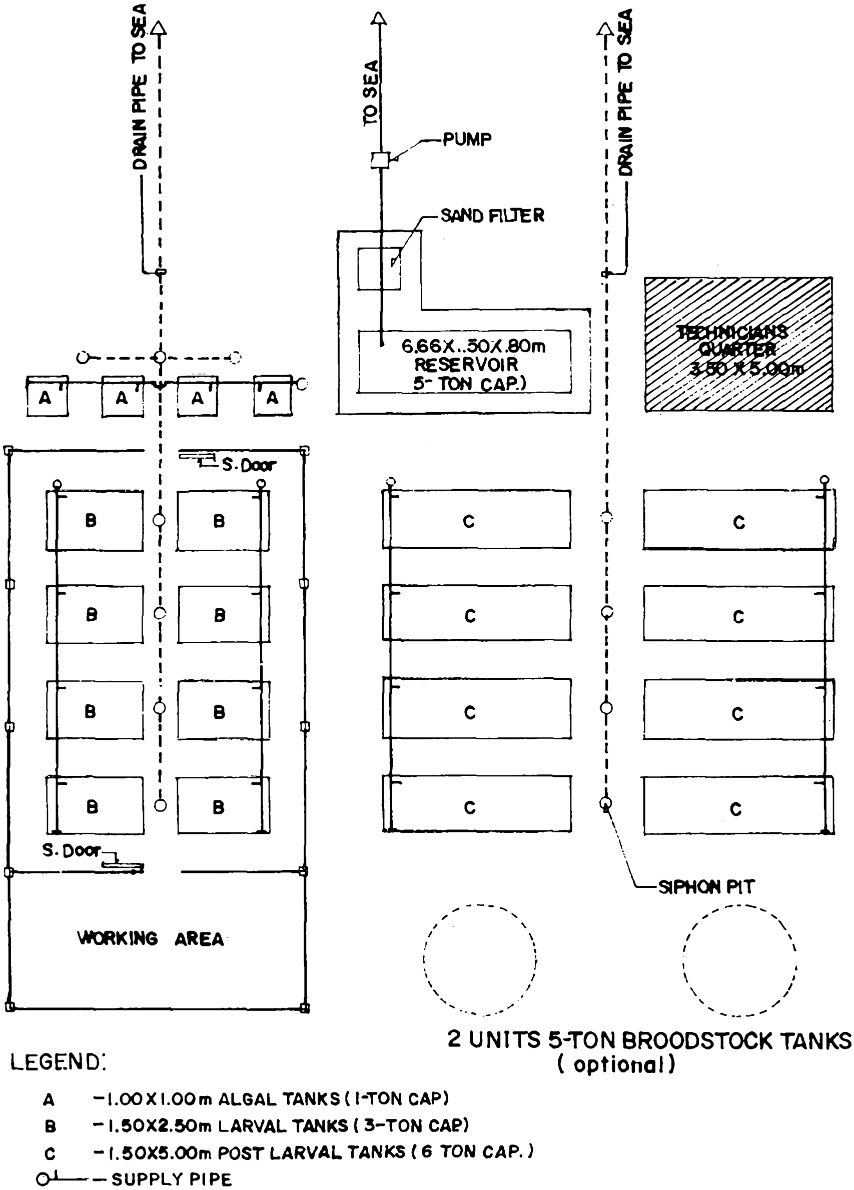


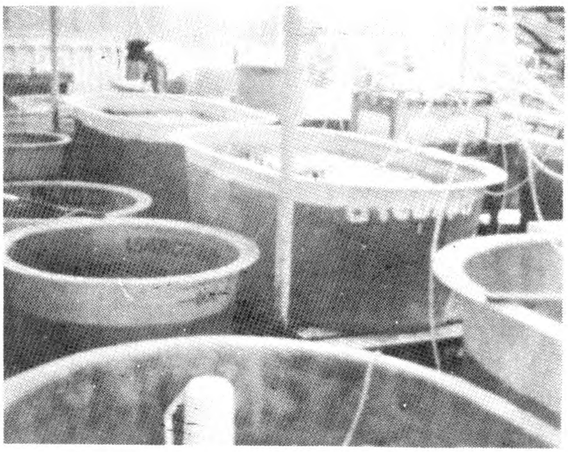

Fig. 6. **Lay-out of a prawn hatchery (After Gabasa and Suñaz, 1983).**

## A. Larval and Postlarval Rearing Tanks

Tank capacity varies from 1 to 20 tons. For economical operations, a larval rearing tank should have a water-holding capacity of 3-5 tons while a postlarval (nursery) rearing tank should hold 6-10 tons, both at 1 meter depth. A 3-ton larval rearing tank can hold from 150,000 to 300,000 nauplii obtained from a single spawner.

Tanks may be made of concrete, fiberglass or marine plywood. These may be circular, rectangular or square with sloping bottom for convenient harvesting (Fig. 7). Slope should be towards the long side at about 5 cm for every 1 meter. The tank should be elevated about 20 cm from floor level for easy draining of water. A 2-meter gap between two rows of tanks is ideal to allow ample working space. The whole floor area should be levelled and, if possible, cemented for convenience.





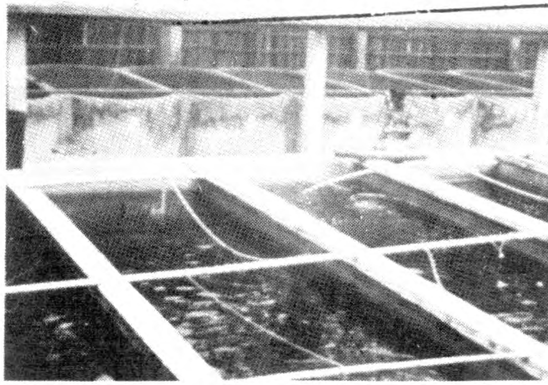


**Fig. 7. Different tank designs and capacities**

Tanks may also be constructed using inexpensive and locally available materials like bamboo and wooden slats with plastic sheet lining for holding water (Fig. 8). Bamboo poles are used for tank support frame and lateral braces, while flattened bamboo or wooden slats are used for tank side walls. For inside bottom and side lining, use polyethylene sheet with a maximum width of 3 meters and gauge thickness of 0.06 mm. About 5 meters of plastic will be needed for a 3-ton tank. The plastic sheet lining should be doubled for added safety (Fig. 9).

The use of inexpensive and readily available materials like bamboo and plastic is appropriate for small investors. A big expense is not incurred when the hatchery is yet on a trial run and losses are minimized when a change in design and expansion of the hatchery is undertaken.

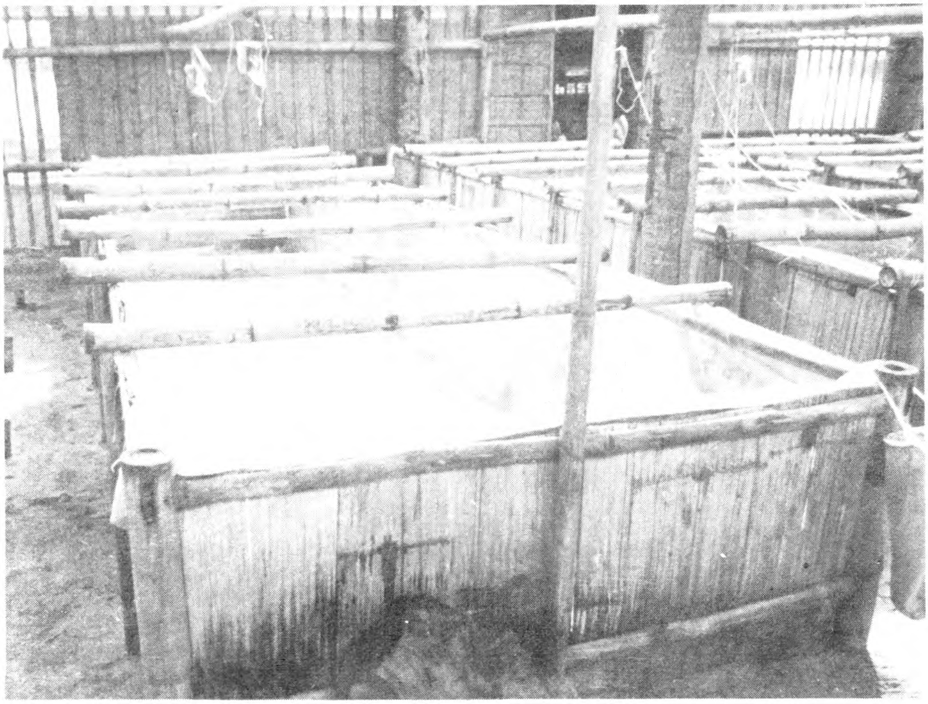


Fig. 8. Rows of bamboo tanks with plastic sheet lining

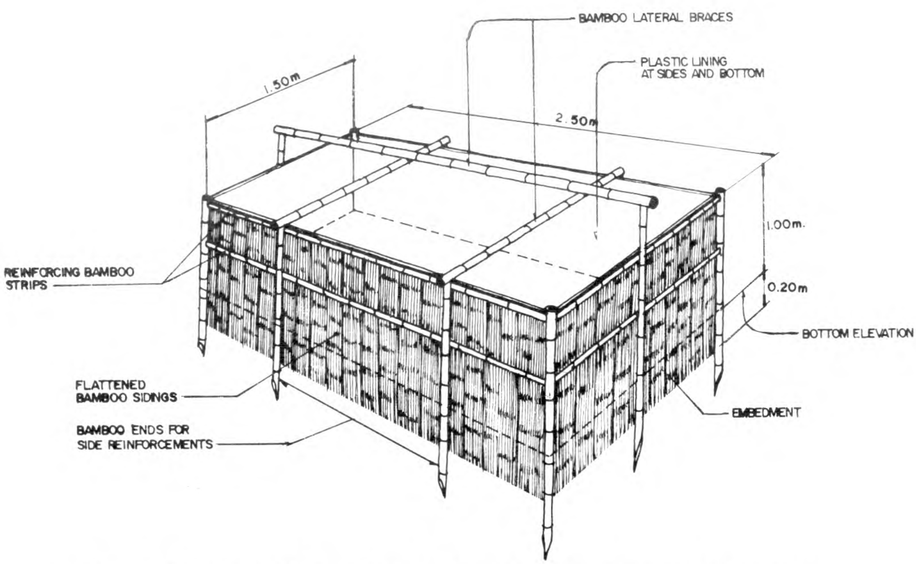



Fig. 9. Details of a 3-ton larval tank made of bamboo and plastic lining (After Gabasa and Suñaz, 1983).

B. **Algal Culture Tanks**

Small and shallow tanks of not more than 1 ton capacity and about 0.5 m deep should be used for algal or phytoplankton culture. Adequate light is necessary for faster algal growth. These tanks may also be made of bamboo and plastic materials.

C. **Air Supply**

Aeration is essential in a hatchery to provide oxygen in the culture water and to keep larvae and food in suspension. It is commonly supplied by an electric blower, a compressor or a portable aerator. To save electricity, however, portable electric aerators (5 watts, 2-way type) are recommended (Fig. 10). Here are some advantages of using aerators:

1. tanks can be aerated individually (two aerators for every tank), therefore, energy consumption is reduced when the hatchery is partially operating; and
2. there are no aeration lines to be cleaned and disinfected regularly.

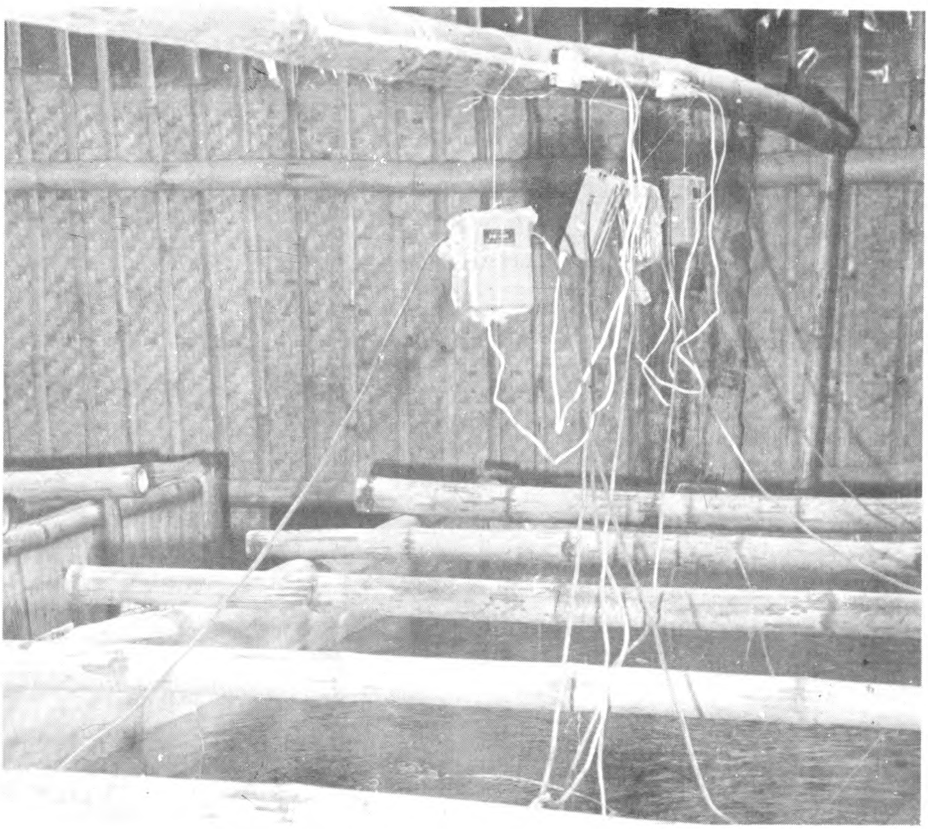


**Fig. 10. Portable electric aerators used in bamboo tanks**

D. **Seawater Supply**

Hatchery operations require adequate seawater which can be supplied through the following procedures:

Seawater can be drawn from the sea to the hatchery in any of 4 ways each using electric motor (746 watts 1 Horsepower) pump. Choose the one best suited to the proposed site.

1. *Pumping direct from the sea* – Use a single suction line laid a few feet above the seabed. The intake pipe opening should be fitted with a screen to prevent fish and other unwanted organisms from being sucked in. Draw water direct to the hatchery where it may be filtered before use (Fig. 11).

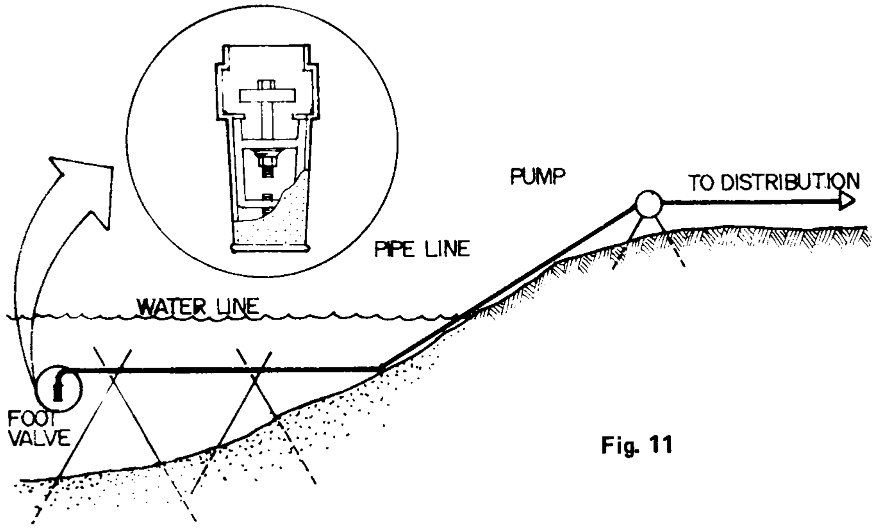



**Fig. 11**

2. *Pumping from a sump pit* – Seawater is pumped to the hatchery from a sump pit which is supplied by an embedded pipeline extended offshore (Fig. 12).

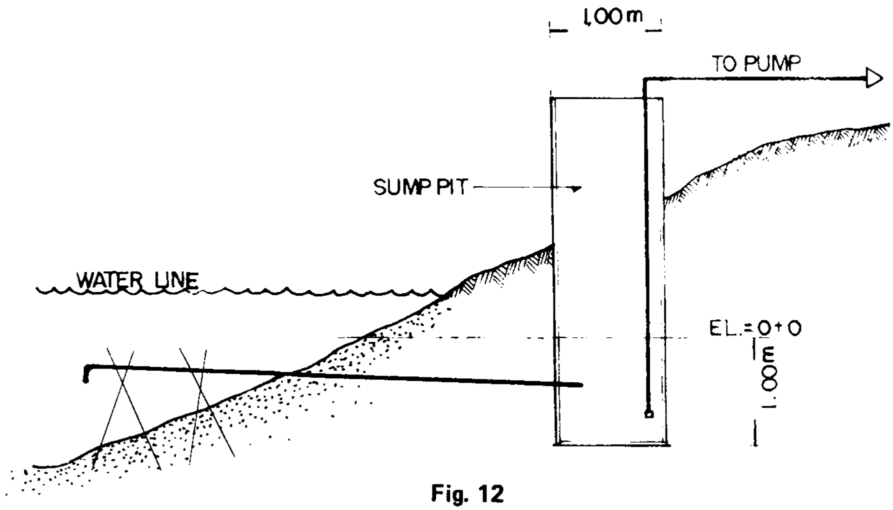



**Fig. 12**

3. *Pumping from inshore well* – A culvert inshore well is constructed within tidal range near the hatchery. Gravel is arranged at the bottom of the well to prevent sand from being sucked into the intake pipe. Seawater is filtered here, hence, it can be pumped directly to the hatchery tanks without further filtration (Fig. 13).

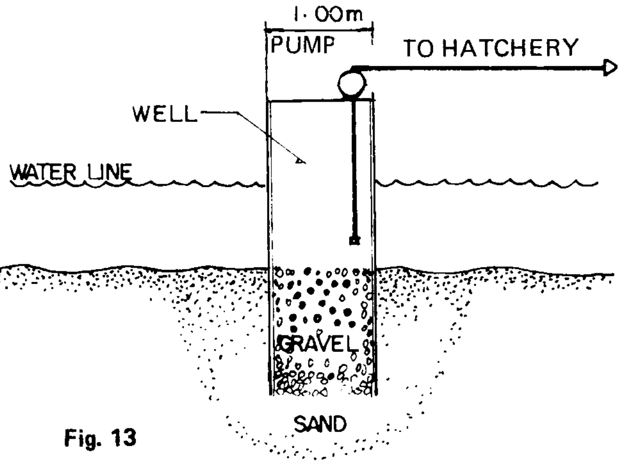



Fig. 13

4. *Pumping from seabed using perforated PVC pipes* – A series of perforated polyvinyl chloride (PVC) pipes are attached to a central intake pipeline embedded in the sand within tidal range. One end of each PVC pipe is closed while the other is attached to the main pipe. Individual PVC pipes are wrapped with 1 cm thick foam which filters seawater that passes through the side holes. Seawater is then pumped directly to the hatchery tanks (Fig. 14).

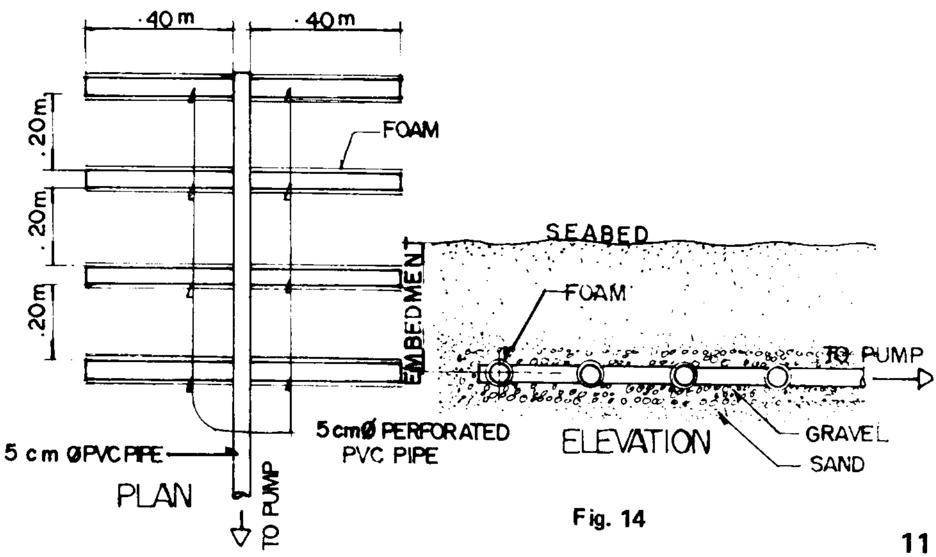



Fig. 14

### Filtration

Seawater passes through a filtration unit which consists of layers of sand and graded gravel that serve as filter (Fig. 15). It is necessary in the hatchery to reduce turbidity of seawater and to remove debris and undesirable marine organisms like fish eggs and larvae. Seawater is introduced at the top of the filtration unit.

The filtration tank may be a separate unit or incorporated as a component of the reservoir. It is usually made of marine plywood or concrete. The unit can be cleaned by periodic backwashing.

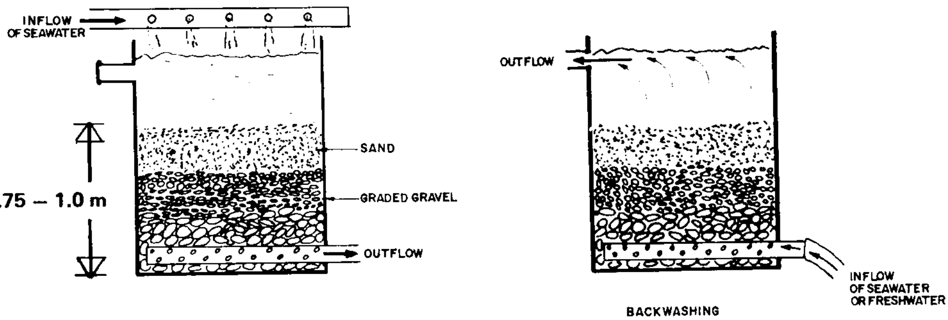



**Fig. 15. Cross-section of a sand and gravel filtration unit**

### Storage and distribution

A hatchery should have a reservoir to facilitate changing of water when needed. A reservoir should have a capacity of 30-50% of the maximum total water consumption per day. It should be elevated to allow water to flow by gravity for distribution to all tanks (Fig. 16). In the absence of a separate reservoir, empty tanks in the hatchery can be used to store water.

PVC pipes are commonly used for seawater distribution. Rubber hose or bamboo pole (with nodes removed) may be used as substitute.

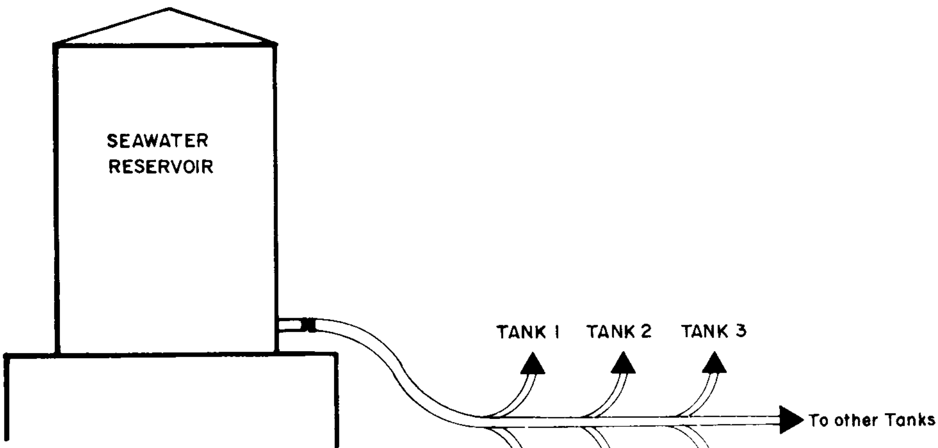



**Fig. 16. Distribution of seawater to tanks by gravity**

E. **Building**

A concrete building is not necessary to house the hatchery. Inexpensive and locally available materials such as nipa, bamboo and coconut lumber can be used to construct a building to accommodate larval rearing tanks (Fig. 17). Nursery tanks may be placed outdoor and covered individually with plastic sheet or canvas. An area should be provided for monitoring, storage, and for technicians' quarters.

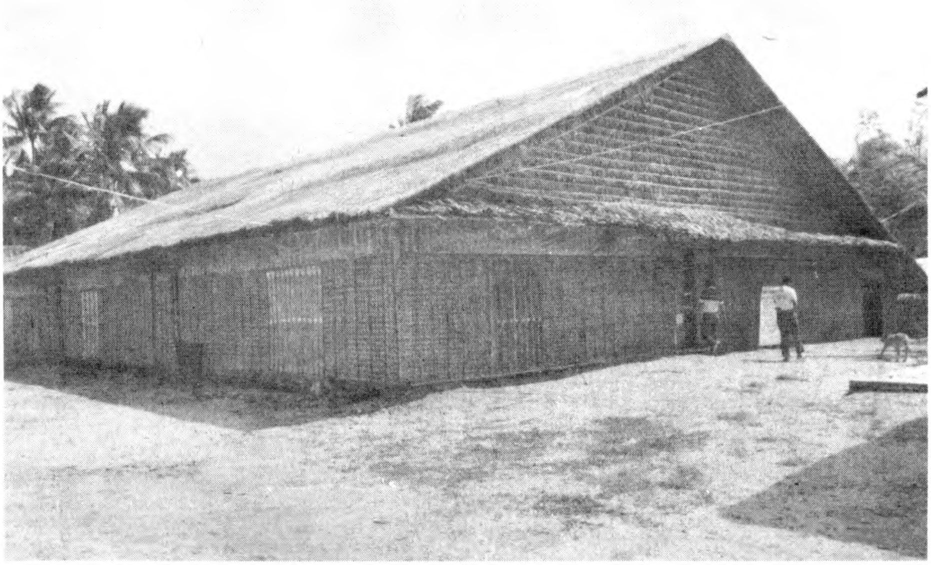


**Fig. 17. Hatchery building can be made of inexpensive, locally available materials**

F. **Hatchery Equipment**

The basic equipment needed in a hatchery are:

1. Beaker or any transparent plastic or glass container, 200 ml to 1 L capacity – for counting and checking the condition of the larvae (Fig. 18)

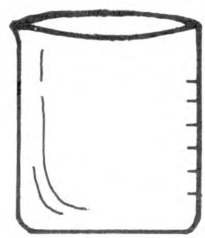


**Fig. 18**

2. Thermometer (alcohol or mercury type) – for monitoring water temperature in the tank (Fig. 19)

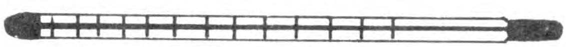


**Fig. 19**

3. Hemacytometer – for counting algae (Fig. 20)

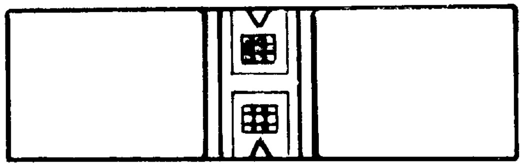


Fig. 20

4. Refractometer – for monitoring water salinity (Fig. 21)

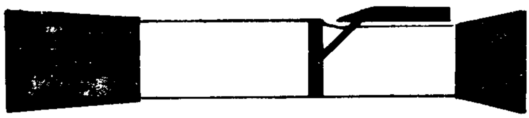


Fig. 21

5. Hydrometer – for measuring specific water gravity (which will indirectly measure salinity). This can be used as substitute for refractometer (Fig. 22)

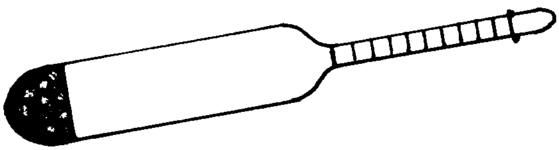


Fig. 22

6. Microscope – for monitoring feed density (Fig. 23)

7. Refrigerator – for storing stock cultures of algae and feeds for postlarvae

8. Drainers of varying types and mesh sizes – for draining the water (Fig. 24)

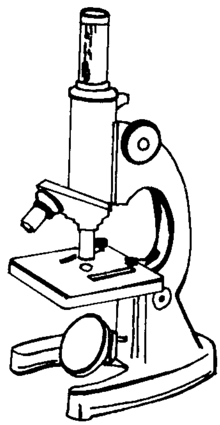


Fig. 23

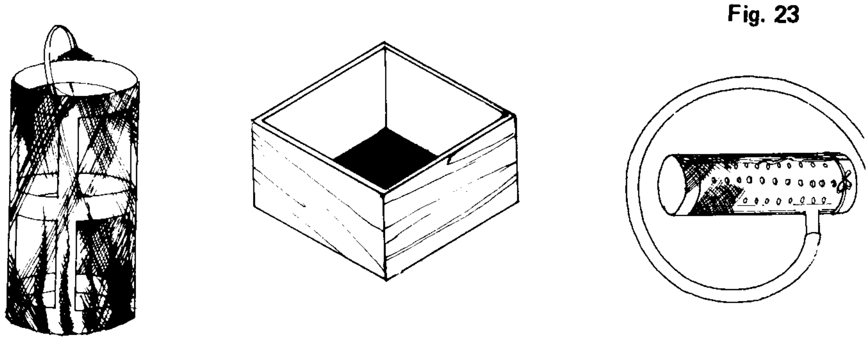


Fig. 24

9. Harvesting box – for harvesting fry (Fig. 25)

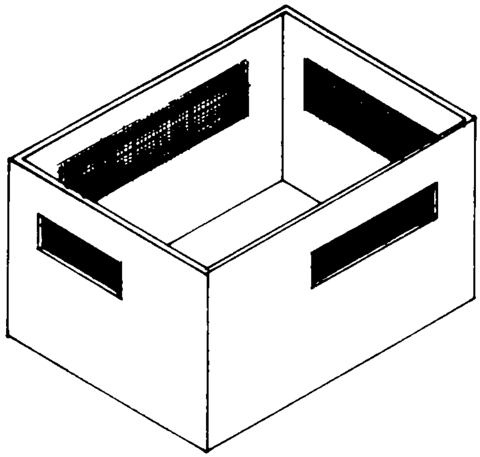


Fig. 25

10. Scoop nets – for scooping larvae or fry from tanks or from harvesting box (Fig. 26)

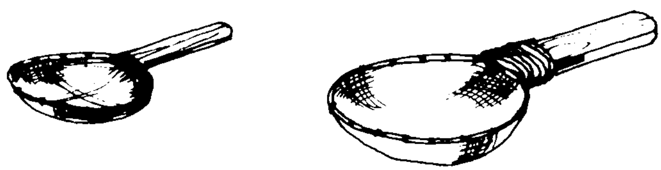


Fig. 26

## IV. LARVAL STAGES

Hatchery operators and technicians should be familiar with the various larval stages (Fig. 27) to guide them in proper feeding and other hatchery procedures.

Hatching of eggs usually occurs about 12 to 15 hours after spawning. The newly-hatched larva, called nauplius, does not feed yet but subsists on the yolk reserves found in its body. Feeding starts at protozoea stage which is indicated by thread-like feces trailing behind. The larvae swim in a forward motion picking food at random. At mysis stage, the larvae start to feed on animal organisms in addition to algae. They swim forward or backward and occasionally bend their abdomen in quick jerks. The postlarval stage follows mysis. The post larva at this stage resembles an adult prawn and becomes more carnivorous in feeding.

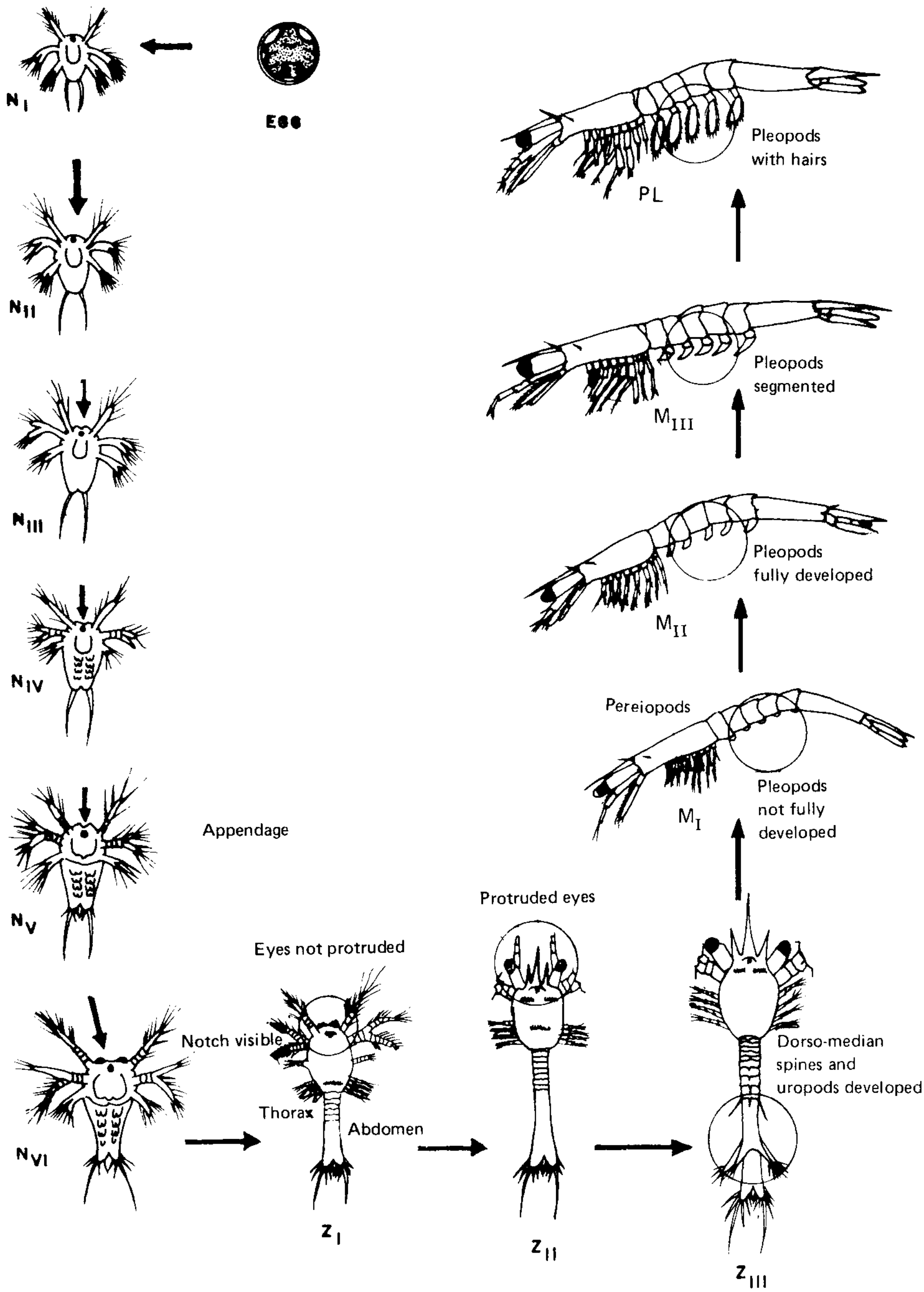



**Fig. 27. Prawn larval stages (Motoh, 1979)**

## V. SPAWNER AND BROODSTOCK COLLECTION AND TRANSPORT

Prawn spawners are very important to a hatchery. A prospective hatchery operator must know where spawners are abundant. If the source is far from the hatchery site, proper spawner collection and transport should be considered.

Wild spawners are usually caught in fish corrals or by trawl nets. Experienced collectors select mature prawns by examining the back portion of the body against light to observe ovary formation (Fig. 28). Only spawners with late maturing or mature ovaries are selected and brought to the hatchery (Fig. 29).

If wild spawners are scarce, have an alternate source-broodstock. Select male and female prawns weighing at least 50 g and 80 g, respectively, which will serve as broodstock. They are induced to mature and spawn by ablating one eyestalk. Details on the ablation procedure may be found in *Broodstock of Sugpo P. monodon* Fabricius (Primavera, 1983).

F5g. 28. Examining the back portion of prawn spawner against light

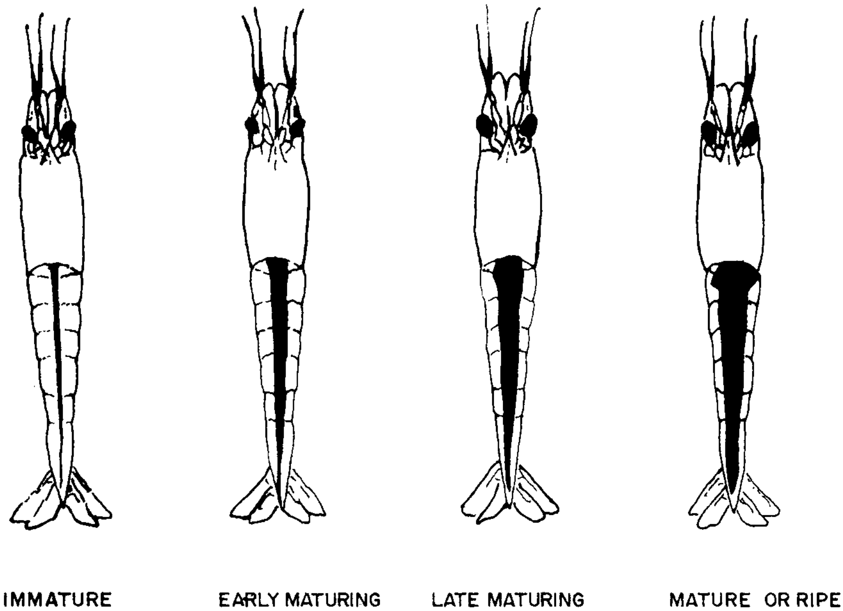



**Fig. 29. Different stages of ovarian maturity of prawn showing the dorsal exoskeleton (Primavera, 1983)**

Spawners or broodstock are transported using either of these methods:

1. Place spawners or broodstock in a covered canvas or hydro tank with battery-operated aerators. A one-ton tank can accommodate up to 200 adult prawns if travel time is 4-5 hours. It is advisable to transport spawners or broodstock early morning or late afternoon to minimize stress due to high temperature during daytime (Fig. 30).

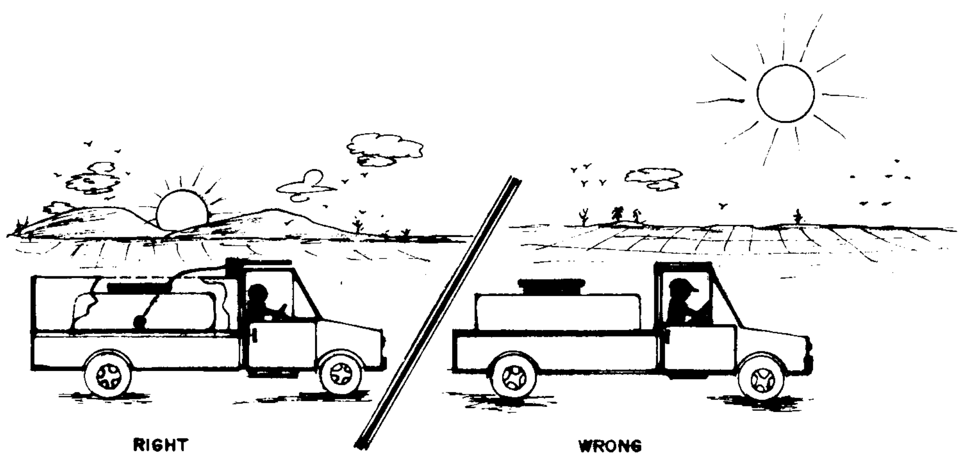



**Fig. 30. Transporting prawn broodstock or spawner**

2. Wrap spawners individually in screen net or put them inside 5 cm diameter perforated PVC pipes. Place these in double polyethylene plastic bags at 3 pieces per 5-6 liters of seawater. Add oxygen before bags are tied with rubber bands. Lower temperature by placing wrapped ice cubes on top of plastic bags (Fig. 31).

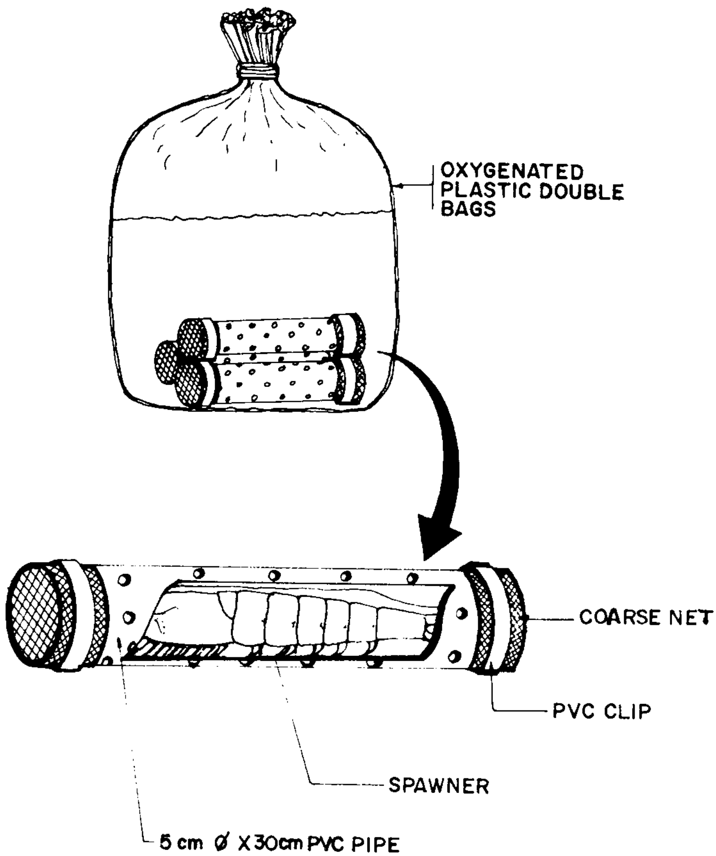



**Fig. 31. Spawners inside individual perforated PVC pipes are placed in oxygenated bags for transport**

Spawners should reach the hatchery on the same day they are caught. If spawning occurs prior to transport, wait until the eggs hatch into nauplii and prepare to transport them.

Turn off the aeration, then partly cover the tank. Siphon the nauplii that gather in the lighted portion into a clean plastic container by using a 1.0 cm plastic tubing (Fig. 32). Fill each container with nauplii and seawater up to the brim to minimize shaking during transport. Each 20-L container can accommodate from 300,000 to 400,000 nauplii without oxygenation for 4-5 hour transport.

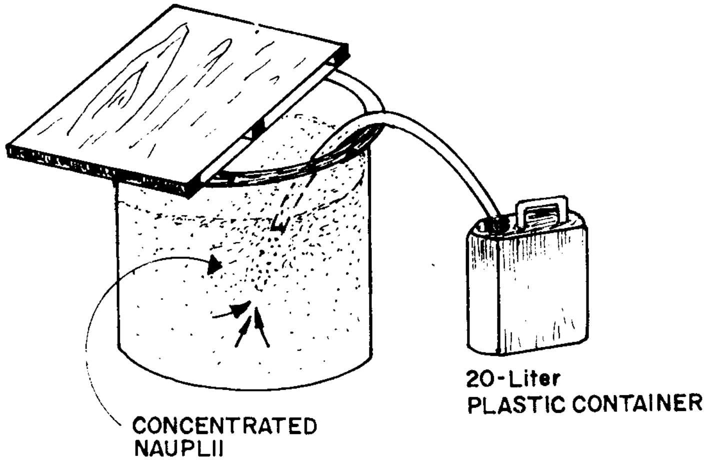



**Fig. 32. Siphoning of nauplii into a plastic container for transport**

## VI. LARVAL REARING

Larval rearing is the most important part in prawn hatchery operations. It involves spawning and hatching of the eggs, stocking of nauplii, providing adequate feeds and observing the right feeding scheme. Success of fry production lies in properly carrying out these procedures.

### A. Spawning and Hatching

Wild or ablated spawners are made to spawn in tanks provided with aeration and clear filtered seawater with salinity of 30-35 ppt and temperature of 28-30°C. Spawning usually takes place between 10 PM and 4 AM and lasts from 2 to 7 minutes.

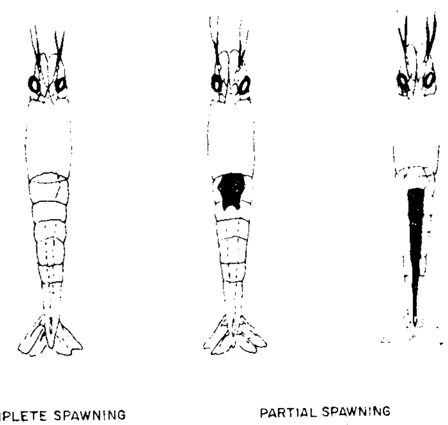



**Fig. 33. External appearance of ovaries of prawn after spawning**

Remove spawners from the tank the morning after spawning has taken place, which is evidenced by the appearance of pink-orange scum on the water surface and walls of the tank. Spawning is considered complete when all eggs in the ovary, from the anterior to the posterior lobes, have been extruded. Spawning is partial when there are some eggs left in any of the lobes (Fig. 33). Transport and handling stress may cause non-spawning or partial spawning. Prawns that partially spawned may either spawn again or resorb their ovaries.

The number of eggs produced by one gravid prawn in a complete spawning ranges from 100,000 to 400,000 for ablated females and 200,000 to 1,000,000 for wild unablated females. Eggs hatch into nauplii from 12 to 15 hours after spawning.

1. **Egg rinsing**

   Egg rinsing is done by draining the water from the spawning tank through a hose with strainer (mesh size = 0.25 mm). This will retain the eggs while new seawater is introduced.

2. **Egg counting**

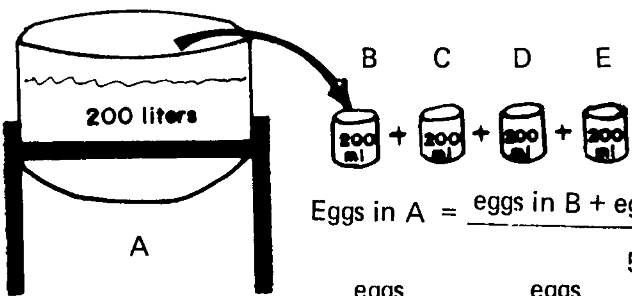
   The following method is used to determine the total number of eggs in each tank (Fig. 34):

   a. Agitate water in the tank to keep the eggs in suspension and evenly distributed.

   b. Take at least four 200 ml samples in a beaker.

   c. Count the eggs by computing the average of the four samples and multiplying this by 5 to arrive at the number of eggs per liter (5 x 200 ml = 1,000 ml or 1 liter).

   d. Multiply the number of eggs by the total water volume to get the estimated total population of eggs in the tank.




$$\text{Eggs in A} = \frac{\text{eggs in B} + \text{eggs in C} + \text{D} + \text{E}}{5}$$

$$= \frac{\text{eggs}}{200\text{ ml}} \times 5 \quad \frac{\text{eggs}}{\text{liter}} \quad \times \text{ water volume of A}$$

**Fig. 34. How to count eggs**

The above procedure is also used to estimate the number of larvae. However, about 3-4 one liter samples are taken from a 3-ton tank.

B. **Stocking Nauplii**

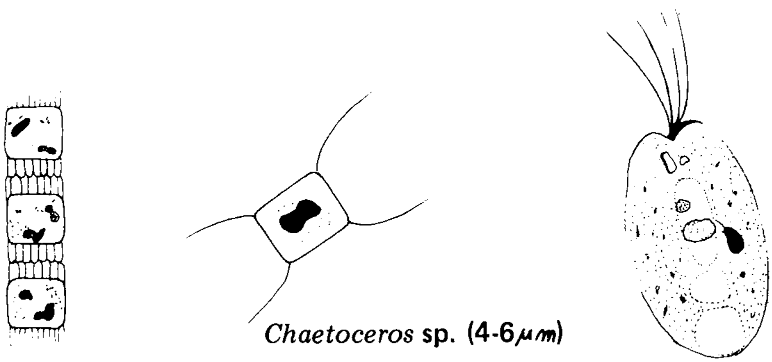
It is convenient and less stressful to transfer larvae to the rearing tank while they are still at the nauplius ($N_{II}$-$N_{V}$) stage. Initial stocking density in larval rearing tanks ranges from 50 to 100 larvae/liter. Before stocking, clean the rearing tank thoroughly by scrubbing and rinsing with water.

C. **Feeds and Feeding**

It is necessary for the hatchery operator to be familiar with the different types of feeds and feeding methods to ensure proper nutrition of the larvae.

1. **Algae (Phytoplankton) Culture**

Phytoplankton are microscopic plants used as food for prawn and shrimp larvae (Fig. 35). Live diet is important especially in the early stage when prawns start feeding. Algae are mass cultured 2-3 days before feeding and should be maintained throughout the larval rearing period.



*Chaetoceros* sp. (4-6$\mu m$)

*Skeletonema* sp. (5-8$\mu m$)

*Tetraselmis* sp. (10-15$\mu m$)

**Fig. 35. Commonly used algae for feeding.**

a. **Outdoor mass culture of selected algae**

(1) Place filtered seawater in culture tank.

(2) Fertilize with 100 g of 46-0-0 (N-P-K) or urea and 10 g of 16-20-0 inorganic fertilizers per ton of seawater.

(3) Add 50-100 l algal starter per ton of seawater and aerate.

(4) Harvest algae after 1 or 2 days when blooming occurs which is indicated by brownish color for diatoms (*Skeletonema* or *Chaetoceros*) and greenish for *Tetraselmis*. Use this either for feeding or as starter for subsequent culture.

Monospecies algal starters can be obtained from SEAFDEC Aquaculture Department Phycology Laboratory and from other existing hatcheries.

b. **Outdoor mass culture of mixed diatoms**

Mixed diatoms *(Chaetoceros, Rhizosolenia, Navicula, Thallasiosira* and *Nitzschia)* are found in seawater. Mass culture of these can be done using this method:

(1) Place unfiltered seawater in algal tank.

(2) Fertilize with 100 g to 46-0-0 and 10 g of 16-20-0 per ton of seawater.

(3) Aerate and leave for 2 or 3 days until water turns brown, indicating mixed diatom population bloom. This can be used for feeding or as starter for next culture.

However, diatom species are seasonally available, thus, growth of some unwanted species is possible.

2. **Preparation of Other Larval Feeds**

a. **Egg Yolk**

Chicken eggs are readily available. Hard-cooked egg yolk can be used as feed for prawn larvae. They are economical and convenient to prepare.

Here's how to prepare egg yolk for feeding (Fig. 36).

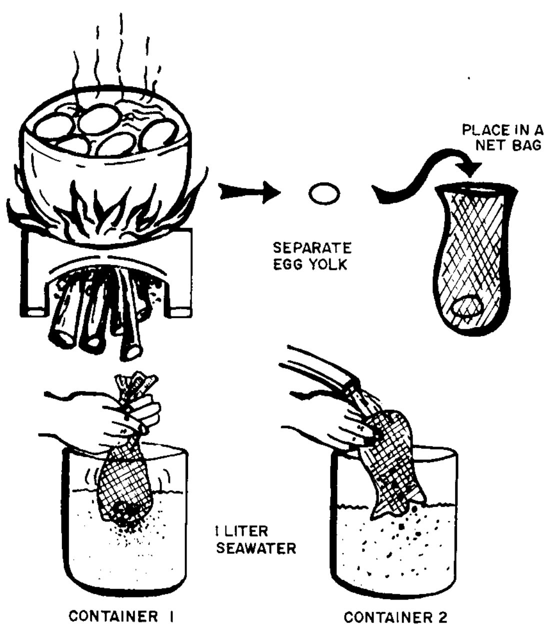



**Fig. 36. Egg yolk preparation for feeding**

(1) Boil chicken eggs for about 10-15 minutes. One egg yolk is enough to feed a 10-ton tank of larvae at one time.

(2) Allow eggs to cool.

(3) Separate egg yolk from shell and egg white.

(4) Place only the egg yolk inside a small net bag 15 x 8 cm (mesh size of 40-100 microns) which serves as strainer.

(5) Submerge the bag in seawater while holding its mouth. Dissolve egg yolk by alternate squeezing and swirling in seawater in container 1.

(6) Dilute retained egg particles in the bag with seawater in container 2 (about 16-19 g egg yolk in 1 liter seawater). This is now ready for feeding.

b. **Artemia (Brine Shrimp) Cysts**

*Artemia* cysts are "eggs" with hardened shell that can withstand long storage in a dry state without affecting its viability. *Artemia* nauplii are a good food for prawn mysis and postlarvae.

To hatch *Artemia* cysts:

(1) Weigh desired number of grams cysts of *Artemia* cysts (1 gram will yield approximately 300,000 cysts).

(2) Place cysts in a hatching container with clean seawater. The container should be conical, transparent and provided with a bottom stopper. Five grams of cysts correspond to every liter of seawater (Fig. 37).

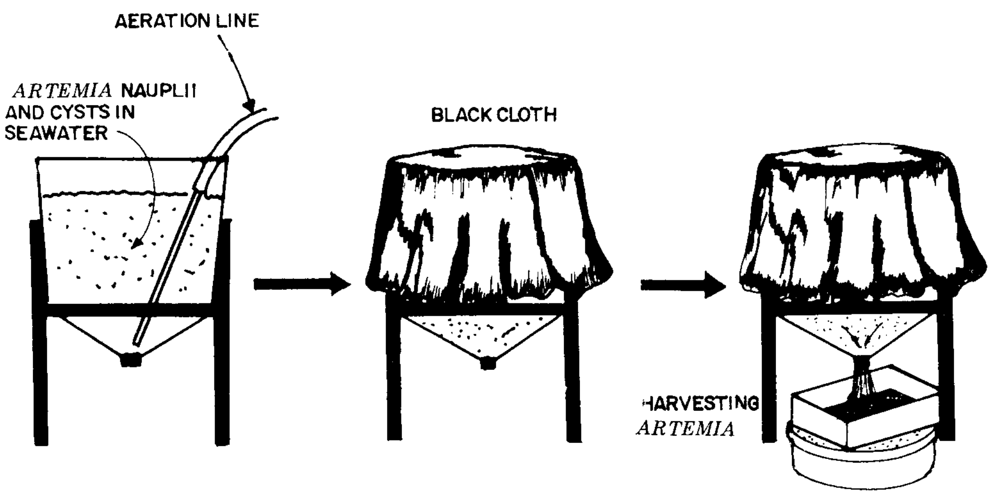



**Fig. 37. Harvesting of *Artemia* nauplii**

(3) Incubate for 24-48 hours under continuous aeration.

(4) After incubation, remove aeration for 10-20 minutes to allow egg capsules to float. Cover the upper half of the container with black cloth to allow nauplii to concentrate at the bottom.

(5) Remove bottom stopper and drain nauplii into a clean strainer or basin.

(6) Rinse nauplii with seawater.

### 3. Amount of Feed to be Given

#### a) Algae

The amount of algal food to be given to the larvae is computed as follows:

**Without previous feeding**

$$\text{Vol. of algae to be added} = \frac{\text{Vol. of water in rearing tank} \times \text{Desired algal density in rearing tank}}{\text{Algal density in culture tank}}$$

Example:

$$\text{Vol. of algae to be added} = \frac{3{,}000\ \text{l} \times 5{,}000 \text{ cells } \textit{Skeletonema}/\text{ml}}{1{,}000{,}000 \text{ cells } \textit{Skeletonema}/\text{ml}}$$

$$= 15 \text{ liters}$$

**With previous feeding**

$$\text{Vol. of algae to be added} = \frac{\text{Vol. of water in rearing tank} \times \left(\text{Desired algal density in rearing tank} - \text{Algal density in rearing tank}\right)}{\text{Algal density in culture tank}}$$

Example:

$$\text{Vol. of algae to be added} = \frac{3{,}000\ \text{l} \times \left(2{,}500 \text{ cells } \textit{Tetraselmis} - 1{,}000 \text{ cells } \textit{Tetraselmis}/\text{ml}\right)}{300{,}000 \text{ cells}/\textit{Tetraselmis}/\text{ml}}$$

$$= 15 \text{ liters}$$

The counting procedure for algae is shown in Appendix 1.

After several runs, the amount of algae for feeding can be estimated by observing the gut contents of the larvae and color of the culture medium.

b) **Egg Yolk**

Feed larvae using egg yolk solution at 100 ml per ton of seawater (100 ml divided by 3-4 times feeding in one day) to maintain 5-15 particles/ml in the rearing tank.

c) **Artemia**

(1) Using a pipette, take live samples of *Artemia* nauplii from the larval rearing tank and from the pail of harvested (concentrated) *Artemia* nauplii (Fig. 38).

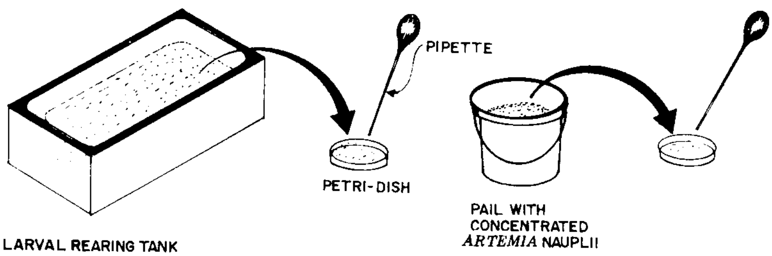



**Fig. 38. Counting of *Artemia* Nauplii**

(2) Place these in separate petri dish or clear bowl and count the nauplii.

(3) Compute the amount of nauplii to be fed using the same formula for algae.

4. **Feeding Scheme**

Recommended feeding method is shown in Table 1.

Algae are introduced in the tank before the nauplii ($N_{VI}$) molt to become protozoea. The density of algae in the rearing tank is maintained at 2,500 to 10,000 cells/ml depending on the species used. If algae fail to bloom, bread yeast may be added as supplementary food for protozoea while waiting for the algae to bloom. Egg yolk is given at late protozoea I to mysis III. *Artemia* are added in the diet starting mysis II until early postlarval stage at the rate of 2-5 *Artemia*/ml. Although zooplankton may be used as feed at mysis stage, they may be difficult to mass produce to meet hatchery needs.

**Table I. Recommended Feeding Scheme for *P. monodon* Larval Rearing**

| Stages | Nauplius $N_I$ $N_{II}$ $N_{III}$ $N_{IV}$ $N_V$ $N_{VI}$ | Protozoea $Z_I$ $Z_{II}$ $Z_{III}$ | Mysis $M_I$ $M_{II}$ $M_{III}$ | Postlarvae $PL_1$ $PL_2$ $PL_3$ $PL_4$ $PL_5$ $PL_6$ . . . $PL_N$ |
|---|---|---|---|---|
| No. of Days | 1.5 days | 5-6 | 4-5 | First day of postlarvae is termed $PL_1$ & 2nd day $PL_2$ & so on |
| Feeds and Feeding Levels | no feeding | | | |
| | | *Skeletonema* or *Chaetoceros*; 5,000-10,000 cells/ml | | |
| | | Egg yolk particles; 5-15 particles/ml | | |
| | | | *Artemia* nauplii; 2-5 *Artemia*/ml | |
| | no feeding | | | |
| | | *Tetraselmis*; 2,500-5,000 cells/ml | | |
| | | Egg yolk particles; 5-15 particles/ml | | |
| | | | *Artemia* nauplii; 2-5 *Artemia*/ml | |
| | no feeding | | | |
| | | Mixed diatoms; 5,000-10,000 cells/ml | | |
| | | Egg yolk particles; 5-15 particles | | |
| | | | *Artemia* nauplii; 2-5 *Artemia*/ml | |

D. **Water Management**

Water quality in the larval rearing tanks deteriorate due to accumulation of fecal matter and decomposition of uneaten food. Daily water change of 30% of the total water volume starting $protozoea_{II}$ has been found to be an effective way of maintaining good water quality for larval growth and development.

A simple way of changing water is by using a siphon with a strainer at the intake-end. Mesh size of the strainer depends on the stage of larval development during water change. Be sure the temperature and salinity of the water source are close to that of the culture water. Observe caution in changing water during and after heavy rains to avoid turbidity and change in salinity and temperature.

Regular siphoning of sediments at the bottom of culture tanks is helpful in maintaining good water quality. This can be done 2 or 3 times a week.

## VII. POSTLARVAL REARING

Postlarval rearing is another important aspect in hatchery operation. The postlarvae ($PL_3$ to $PL_5$) are transferred to the postlarval rearing or nursery tanks to avoid overcrowding of fry and to vacate the larval rearing tanks for the next run.

It is advantageous to nurse the early postlarvae in tanks instead of stocking them directly in nursery ponds. Technicians will be able to (1) better control feeding levels and water quality, (2) eliminate organisms that may prey or compete with the prawn, (3) stock more fry, and (4) facilitate harvesting.

A. **Stocking density**

About 3,000 to 5,000 postlarvae per ton of seawater can be stocked in the nursery tank.

B. **Substrates**

Provide nursery tanks with substrates to serve as additional surface area for postlarvae to cling on and for growth of benthic organisms which may serve as food. Substrates serve also as protection against cannibalism, that is, the tendency of postlarvae to eat each other due to overcrowding.

Most commonly used substrates are made of bamboo slats, fine nylon material, and polyprophylene netting material. They are installed in a vertical position but in various formations like straight row, S-form or zigzag, depending on the needs and size of tank (Fig. 39).

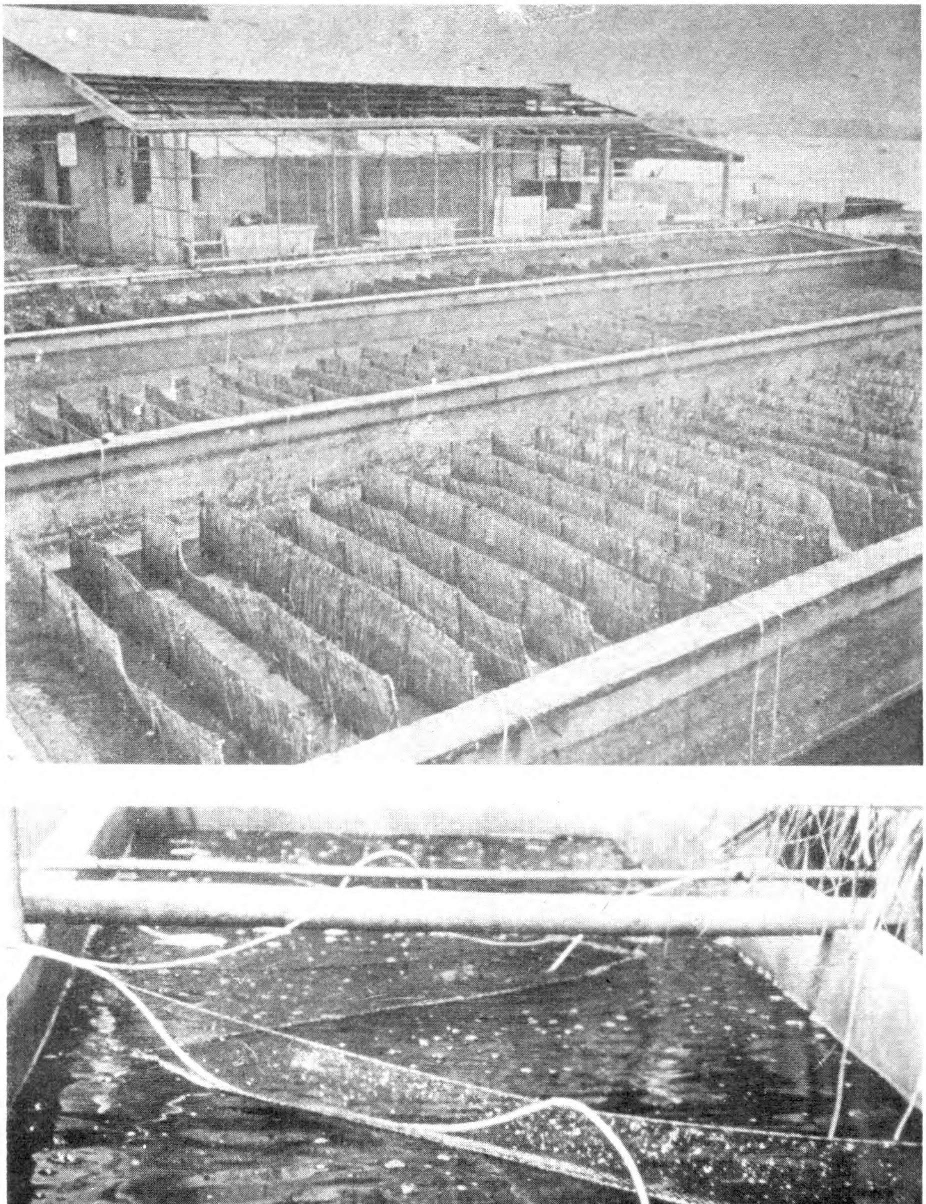


Fig. 39. Bamboo and nylon substrates in nursery tanks

C. **Feeds and Feeding**

Most of the food of prawn larvae up to $PL_5$ consist of phytopiankton and brine shrimp nauplii. At $PL_6$, the post-larvae are gradually introduced to mussel meat, trash fish and *Acetes* (small shrimp used in making "bagoong"), whichever is locally available, until they become eventually used to these kinds of food.

Wash finely chopped trash fish and mussel meat in a screen net before feeding. Feeding is done 2-3 times a day either by broadcasting or by placing feeds in feeding trays. Adjust feed ration according to the amount of uneaten food and corresponding growth of the postlarvae. To be able to know this, observe the feeding habit of postlarvae.

D. **Water Management**

Water in the nursery tank should be changed 4 times a week. Siphon excess feeds and change 30-50% of the total water volume in the tank regularly.

## VIII. HARVEST, PACKING AND TRANSPORT

A. **Harvest**

Harvest fry this way (Fig. 40).

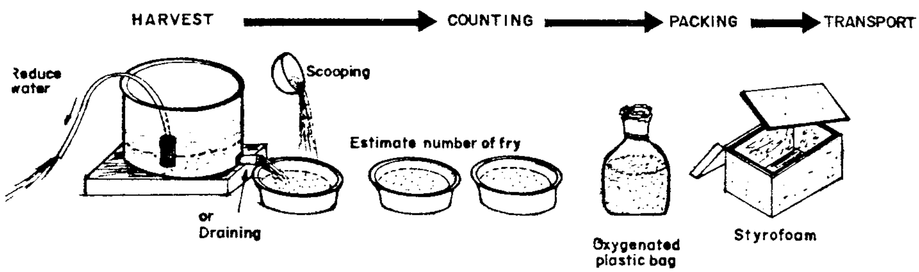



Fig. 40. Harvest, counting and packing procedure

1. Drain the tank by lowering the water level first to about ¼ of the total water volume to reduce water pressure and to minimize stress on fry. This can be done by siphoning the water using a hose fitted with a screen box.
2. If the tank has a drain pipe installed at the bottom, open it and allow the remaining water with fry to flow to the harvesting box or a basin. When drain pipe is not installed, scoop the fry and transfer these directly to a basin. The number of basins will depend on the number of fry to be harvested. The basins should be of the same size and should contain the same amount of water.

3. Headcount some harvested fry in a basin. Example, if you have about 5,000 fry in a given volume of water in the basin, place the same estimated number in each of the remaining basins. After harvesting and counting, the fry are now ready for packing and transport.

B. **Packing and Transport**

Prawn fry are packed properly for transport to the grow-out ponds. The number of fry placed in a container will depend on their size and age, travel time and distance, and means of transportation.

*Packing procedure:*

1. Put the fry in a double plastic bag measuring 50 x 90 cm. For 6 hours transport time, about 2,000 $PL_{25}$ to $PL_{30}$ can be accommodated in the bag containing 5 liters of seawater. Decrease the number to 500 for older fry ($PL_{40}$ to $PL_{50}$).
2. To ensure high fry survival, inject oxygen into the bag's mouth, then tie with rubber bands.
3. Place oxygenated plastic bags containing fry either in styrofoam boxes, pandan bags or pails (Fig. 41).
4. If travel time is more than 6 hours, maintain temperature in the container at 22-24°C by placing wrapped ice on top of the plastic bags. At low temperature, the oxygen consumption and molting frequency are decreased. Reoxygenation and changing of water may be done especially when transport time exceeds 12 hours.

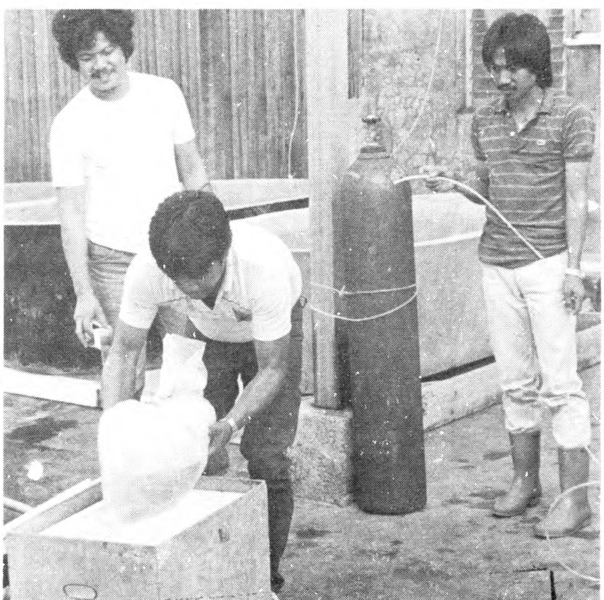


**Fig. 41. Packing of fry for transport**

Live fry transported to nearby ponds may be placed in holding tanks provided with aeration. Upon reaching the destination, fry are acclimatized to the temperature and salinity of the ponds before they are stocked.

## IX. DISEASES

Prawn larvae like other marine animals are subject to almost all forms of infection caused by viruses, bacteria, fungi or protozoans. Injury from excessive handling, over-crowding, temperature and salinity, inadequate nutrition, and poor water quality can stress prawns and leave them vulnerable to infection. These can be detected by frequently observing the larvae. Common manifestations are empty digestive tract, weak or disoriented swimming, broken or deformed extremities, reddening of the body, and incomplete molting. Infection can be prevented by maintaining good water quality, adequate nutrition, and by reducing stress to the larvae and postlarvae.

## X. ECONOMICS

Every prospective hatchery operator will be interested to know if he can profit from operating a prawn hatchery. He needs to know the estimates of costs and income involved in the whole operation.

The information provided in Table 2 is based on early 1984 prices.

**Table 2. Costs and income analysis of a one-year operation of an 8-larval rearing tank hatchery system.**

| | | |
|---|---|---|
| **Capital Expenses** | | |
| Depreciation of hatchery facilities | ₱ 21,530 | |
| Business permit | 100 | |
| Total – | ₱ 21,630 | |
| **Operating Expenses** | | |
| Salaries and wages | 39,000 | |
| Interest | 37,920 | |
| Repair and maintenance | 7,700 | |
| Supplies and materials | 35,730 | |
| Spawners | 60,000 | |
| Electricity | 6,950 | |
| Total expenses for one year | 187,300 | ₱ 208,930 |

| | |
|---|---|
| Gross Production Value (600,000 pcs. $P_{35}$ at ₱500/1,000 pcs. | 300,000 |
| Net Income before Tax | 91,070 |
| Tax | 900 |
| Net Income After Tax | 90,170 |
| Return of Investment | 118.3% |
| Payback Period | 0.7 year |

**Table 3.– Inventory and cost of physical facilities and equipment for an 8-tank hatchery system made of bamboo and plastic sheet materials.**

| *Items* | *Number* | *Cost* |
|---|---|---|
| 1. Larval rearing tank (3 tons) ₱505 | 8 | ₱ 4,040 |
| 2. Nursery tank with cover (6 tons) ₱1,000 | 8 | 8,000 |
| 3. Algal tank with cover (1 ton) ₱400 | 4 | 1,600 |
| 4. Building including working area | 1 | 6,000 |
| 5. Technician's quarters | 1 | 4,500 |
| 6. Water pump (1 HP) | 2 | 3,600 |
| 7. Aerator (5 watts) + outlets | 43 | 8,820 |
| 8. Water intake structure | 1 | 3,000 |
| 9. Water distribution and drainage lines (bamboo) | 1 | 140 |
| 10. Electric wiring and lighting | | 2,820 |
| 11. Sand filter | 1 | 2,000 |
| 12. Seawater reservoir (10 ton) | 1 | 10,000 |
| 13. Microscope (student type) | 1 | 3,500 |
| 14. Refractometer | 1 | 2,000 |
| 15. Hemacytometer | 1 | 500 |
| 16. Water buckets, pails, basins | 4, 4, 4 | 800 |
| 17. Refrigerator | 1 | 5,000 |
| 18. Rubber hose and plastic tubing | | 680 |
| 19. Stand-by generator (16 HP) | | 10,000 |
| TOTAL | | ₱ 77,000 |

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## Appendix I

### How to Count Algae

1. Use hemacytometer and place a cover slip over the center.
2. Take water samples from tanks and place in a test tube.
3. Shake test tube to distribute algae uniformly; get a few drops from the test tube.
4. Place a drop in the V groove of the hemacytometer near the edge of the cover slip. Samples should be free from bubbles and should be evenly distributed when focused under low magnification of microscope
5. Count the algae in the 4 (A-D) corner blocks under high magnification of microscope (Fig. 42).

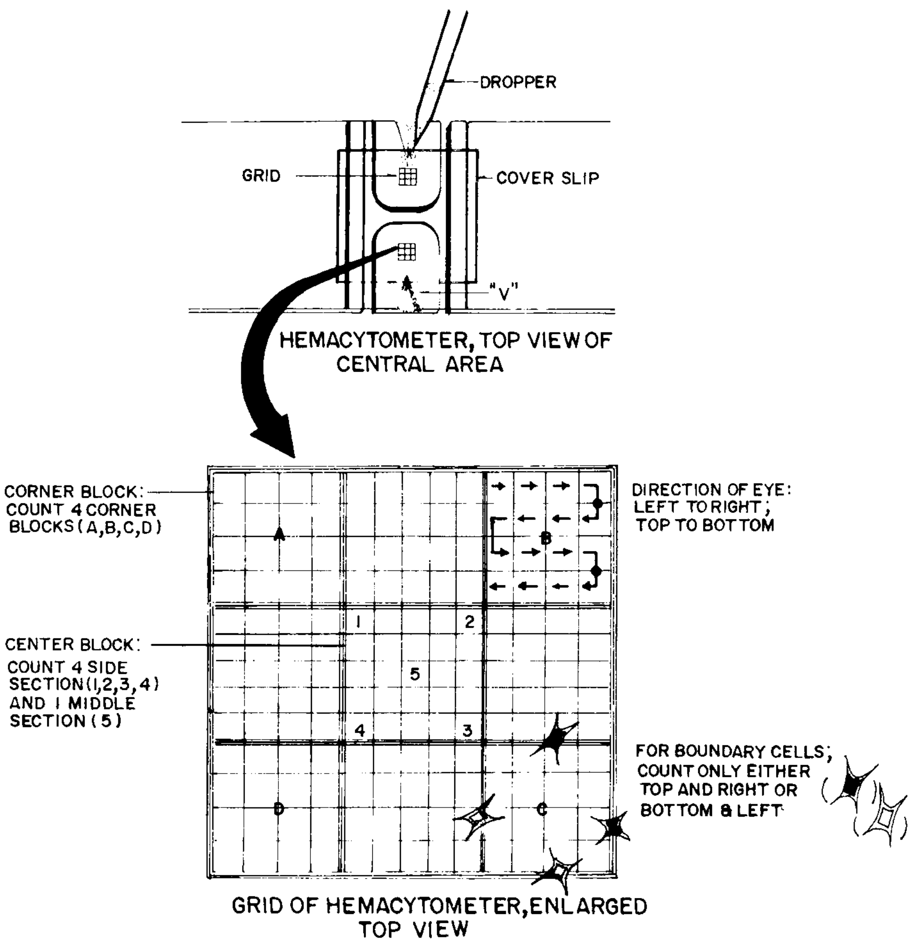


**Fig. 42. Hemacytometer for counting algae**

For cells falling on the boundary line of the corner block, count only those on the left and bottom boundary lines (L-shape) or those cells on the right and top boundary lines (inverted L-shape). Cells occurring in chains should be counted individually (Fig. 43).

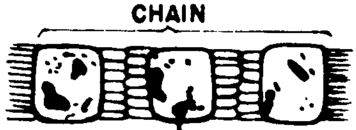


**Fig. 43.** *Skeletonema* **cells**

Computation:

$$\text{No. of cells/ml} = \frac{\text{Total no. of cells in 4 blocks}}{\text{No. of blocks } (= 4)} \times 10^4$$

Example:

$$\text{No. of cells/ml} = \frac{150}{4} \times 10{,}000$$

$$= 375{,}000 \text{ cells/ml}$$

6. If the cell density is too high (above $10^6$ cells/ml), use the center block. Count the phytoplankton in the 4 corner squares and the middle square of the center block.

Computation:

$$\text{No. of cells/ml} = \text{Total no. of cells in 5 sections} \times 5 \times 10^4 =$$

or

$$\text{No. of cells/ml} = \frac{\text{Total no. of cells in 5 sections}}{20} \times 1{,}000{,}000$$

Example:

$$\text{No. of cells/ml} = \frac{68}{20} \times 1{,}000{,}000$$

$$= 3{,}400{,}000$$

## Appendix 2

### HATCHING PERFORMANCE OF COMMONLY AVAILABLE *ARTEMIA* CYSTS

| | Nauplii Size | Hatching Percentage 24 Hrs. | Hatching Percentage 48 Hrs. | Hatching Efficiency 24 Hrs. | Hatching Efficiency 48 Hrs. |
|---|---|---|---|---|---|
| 1. San Francisco Bay Brand | 512 microns | 89 | 90 | 8.4 | 6.6 |
| 2. Sanders (Great Salt Lake) | 492 " | 36 | 63 | 8.3 | 6.2 |
| 3. China | 522 " | 62 | 85 | 8.2 | 7.3 |
| 4. Jackson | 500 " | 18 | 41 | 25.5 | 10.6 |
| 5. Biomarine (Great Salt Lake) | 470 " | 31 | 56 | 13.3 | 10.3 |

## Appendix 3

## LIST OF PRAWN HATCHERIES AND NURSERIES IN THE PHILIPPINES

A. Government/International Organizations

1. SEAFDEC Aquaculture Department — Tigbauan, Iloilo; Leganes, Iloilo; Batan, Aklan (3 hatcheries)
2. Masaganang Sakahan, Inc. (Land Bank) — Magsaysay, Mindoro Occidental
3. Ministry of Human Settlements — Mamburao, Mindoro Occidental
4. MSU — Southern Philippines Development Authority — Naawan, Misamis Oriental
5. Zamboanga Regional Institute of Fisheries Technology — Zamboanga City

B. Private

1. Tagat Industries, Inc./Mr. Alfonso Lim — Tagat, Claveria, Cagayan
2. Mascariñas Hatchery/Mr. Romualdo Mascariñas — Orani, Bataan
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38. Reyes Backyard Hatchery/Reynaldo Reyes – Batan, Aklan

*The remaining hatcheries (out of a total of around 60) are either not operational or not enough information is available. An updating from **Farming of Prawns and Shrimps** (Apud, et. al, 1983).

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