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IN THIS ISSUE:

SEA BASS: THE PROFITABLE ALTERNATIVE, p. 1

OPERATING A SEA BASS HATCHERY, p. 2

- **Selecting a Suitable Site, p. 2**
- **Tank Systems, p. 3**
- **Seawater and Freshwater Supply System, p. 5**
- **Source of Breeders, p. 6**
- **Breeding Techniques, p. 6**
- **Egg Collection, Transport, and Hatching, p. 8**
- **Larval Rearing, p. 9**
- **Harvest and Transport of Fry, p. 10**

MASS PRODUCING SEA BASS HATCHLINGS FOR EXPORT, p. 11

SEAFDEC/AQD'S NEWEST HATCHERY TECHNOLOGIES, p. 11

TRAINING COURSE IN CULTURE OF NATURAL FOOD ORGANISMS OPENS, p. 12



“Better life through aquaculture”

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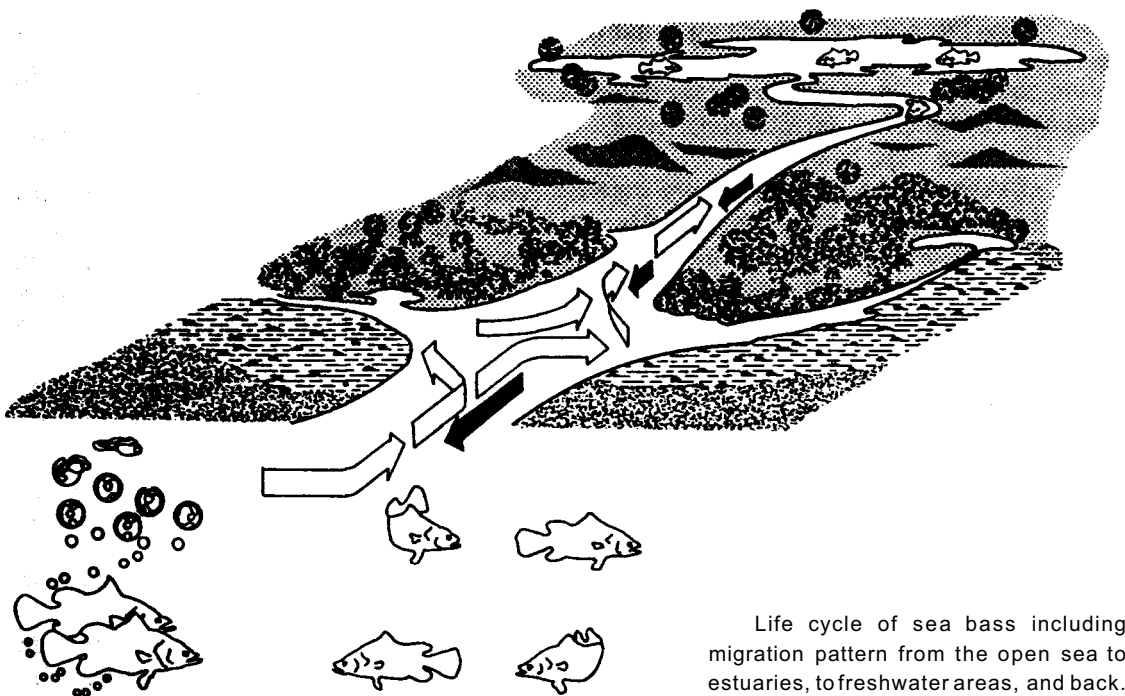
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SEA BASS: THE PROFITABLE ALTERNATIVE

With the recent decline in demand for locally grown shrimps, sea bass is becoming one of the profitable alternative fish species to culture. It has long been a popular culture fish in Thailand, Singapore, and Malaysia and is fast gaining ground in the Philippines.

Sea bass eggs are spawned and fertilized in the sea and the larvae enter brackishwater swamps and mangrove areas where they thrive on the abundant food found in these nursery grounds. Sea bass also inhabits estuaries, rivers and lakes, and returns to marine waters to spawn, thus completing a life cycle spent in both freshwater and seawater, as the figure below shows:



Sea bass juveniles mature initially as males after 3-4 years but invert to females on the 6th year. However, not all males become females because primary females do occur. In captivity, sea bass can be spawned quite readily with or without the use of spawning agents.

The onset of their natural breeding season is indicated by the appearance of sea bass fry in milkfish fry collections. The breeding season coincides with the monsoon months from late June until late October. Because sea bass is an incidental species in most fry collections, its collection from natural fry grounds is not reliable, largely inefficient, and tedious.

In general, sea bass is an opportunistic predator throughout its life cycle. Fish less than 4 cm feed on "microcrustacea" almost exclusively; 30-cm fish have diets of "macrocrustacea" and fish; larger individuals predominantly prey on fishes. In captivity, sea bass accepts pelleted rations. Its growth rate varies depending on culture conditions but is generally high. Sea bass fed trash fish in cages grow from an average of 22 g to 573 g in 7 months, and in ponds, from 7.8 g to 369 g after 7.5 months.

The Aquaculture Department of the Southeast Asian Fisheries Development Center (SEAFDEC/AQD) continues to encourage the development of sea bass culture. Research advances in the breeding of sea bass broodstock in captivity at SEAFDEC/AQD in 1983 to the

present have led to the development of a technology to mass produce sea bass fry in a hatchery. Mass fry production is necessary before sea bass culture could flourish.

OPERATING A SEA BASS HATCHERY

To maximize profit, certain economic as well as biological factors have to be kept in mind:

- The market for which the fry is intended must be identified and carefully assessed.
- The cost of production under local economic conditions should be thoroughly appraised so that resources can be used efficiently.

Since these considerations make use of biological phenomena as basis for production, it is necessary to understand the biology of sea bass and the environmental processes occurring in the hatchery. Profit or loss largely depends on being able to ensure the maintenance of conditions conducive to larval development, growth, and survival. In practice, bear in mind the generalizations listed below:

- Developing eggs and larvae are the most vulnerable stages in the life history of the fish and therefore require proper care, good quality water, and sufficient supply of suitable food.

- "Good quality" water is a relative term; it refers to water that can support and maintain environmental requirements and sanitary standards necessary to sustain larval growth. Quality refers to suitable temperature and salinity, sufficient supply of oxygen, and minimal concentration of ammonia, other toxic substances, and pathogens.

- *Temperature.* Its effect on larvae is largely biochemical and is reflected on growth performance. Extremely high or low temperature causes death. Sudden temperature changes cause stress and stressed larvae give unsatisfactory return.

- *Salinity.* Changes in salinity influence the water balance of the larvae. In waters with high salt content, water is drawn out from the larva; in waters with low salt, the larva draws in water - both causing stress and eventual death.

- *Oxygen.* Necessary for almost all organisms to sustain life, oxygen must be available at all times especially when the hatchery carries heavy biological load.

- *Ammonia.* The end-product of protein breakdown among organisms, ammonia retards growth and causes stress and eventual death. Therefore, its presence in the water must be minimized.

- *Toxic substances.* These occur in the form of metabolites produced by the growing and feeding larvae, inorganic and organic wastes from sewage disposal systems inadvertently taken in with hatchery water, chemicals accidentally dumped in water, and others. Such substances have adverse effects on the larvae, hence water must be free from these substances.

- *Pathogens.* These disease-causing organisms occur anywhere in nature, hence cannot be totally eliminated. The water used must not contain high density of pathogens. As the saying goes, an ounce of prevention is always better than a pound of cure.

Item One: Selecting a Suitable Site

The major criterion in selecting a site for the construction of a sea bass hatchery is the ecological requirement for spawning and egg and larval development. A suitable site should have access to a sufficient supply of pollution-free seawater. The salinity should range from 25 - 32 ppt. For practical reasons, the hatchery should also be near the source of eggs; however, a hatchery may have its own broodstock facilities.

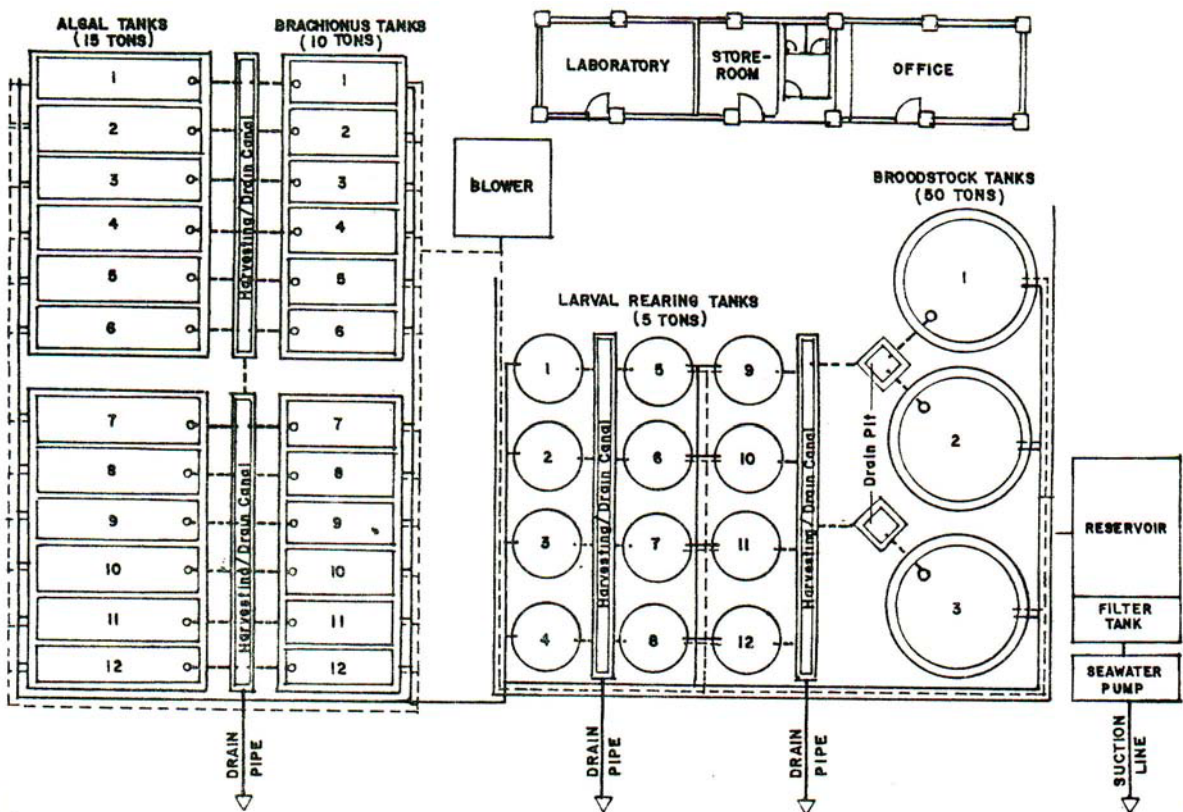
The site should be spacious, gently sloping, and protected from strong winds and wave action. A gently sloping area gives the advantage of using gravity to distribute water from an elevated storage facility, and affords protection from water inundation or flooding during the rainy season. The area should also be located where natural protection from adverse weather conditions (e.g., typhoons) is possible.

The seawater source should have minimal siltation problems and should be far from mouths of rivers as freshwater runoffs will cause high turbidity and drastic fluctuations in water salinity. The site should also have an ample supply of freshwater. Freshwater is necessary when water of low salinity may be required. It is also necessary for cleaning and washing hatchery equipment and facilities.

The site should also have access to a reliable source of electric power and to transportation and communication facilities.

Item Two: Tank Systems

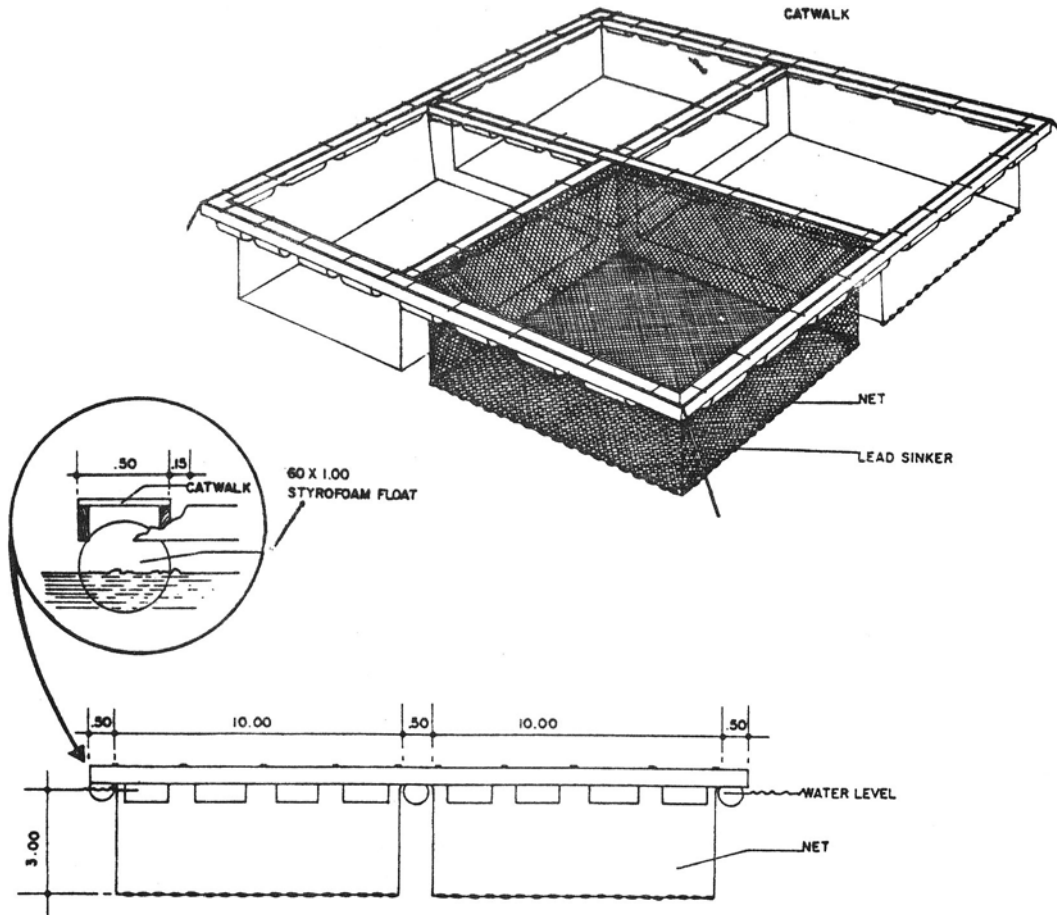
Three major kinds of tank systems are needed in a sea bass hatchery: (1) broodstock, (2) larval rearing, and (3) natural food tanks. Figure below shows a sample layout of a sea bass hatchery with broodstock facilities. The design may be modified according to available capitalization and the physical characteristics of the site. With certain modifications, most prawn hatcheries may be converted into sea bass hatcheries.



Sample layout of a sea bass hatchery including broodstock facilities.

Broodstock holding structures. Sea bass breeders or spawners are maintained in these structures which are installed either on land or in open waters. Land-based structures include

circular or rectangular concrete tanks. The tanks are usually big and have water capacities of more than 50t. At SEAFDEC/AQD, breeders are kept in rectangular cages measuring 4m × 4m × 3 m as illustrated below:



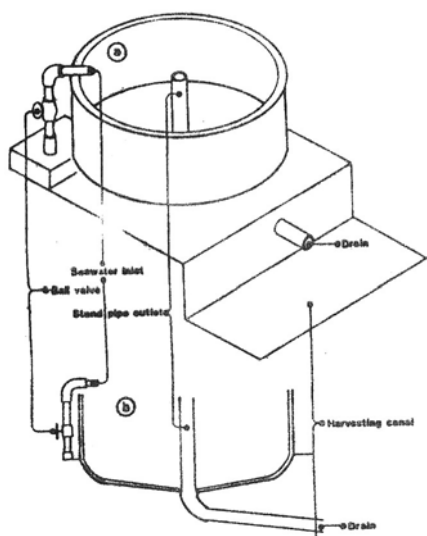
AQD designed floating cage for sea bass broodstock: Material of wooden or bamboo frames, polyethylene net (5.2 cm stretched mesh), and styrofoam buoys (After Marte et al., *SEAFDEC/AQD & IDRC Tech. Repr. No. 11*, p. 10. 1984).

Larval rearing tanks. Sea bass larvae are reared in concrete tanks, such as those used by SEAFDEC/AQD, or ft circular canvas tanks, such as those used for prawns by private operator. These tanks are provided with roofings to protect the larvae from direct sunlight. Circular task have conical bottom and a centrally located drainage pipe connected to the canal as figure on next page shows. This design facilitates cleaning and harvesting.

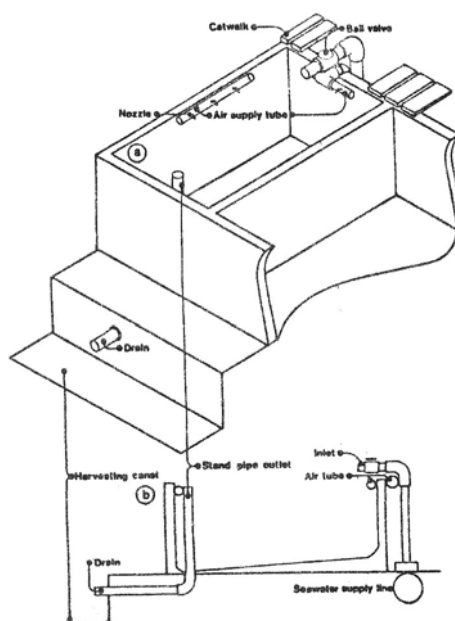
Rectangular concrete tanks may also be used. These have a flat bottom and the drainage is usually located opposite the inlet pipe. There is no functional difference between circular and rectangular tanks but the latter has practical disadvantages which include difficulty of siphoning dirt that accumulates in tank comers and formation of "dead corners" or portions of the water column in the tank where there is no water circulation.

Canvas tanks can also be used for larval rearing. These may be cheaper to construct but do not last as long as concrete tanks. In the long run, concrete tanks will turn out cheaper.

Natural food tanks. Tanks are required for the culture of live food organisms, e.g.,



Circular tank: isometric (a) and cross-sectional views (b).



Rectangular tank: isometric (a) and cross-sectional views (b).

Chlorella, *Brachionus*. The tonnage ratio of *Chlorella* to *Brachionus* tanks is about 1.5:1, that is, for every ton of *Brachionus* tank, 1.5 t of *Chlorella* is needed. The ratio of *Brachionus* to larval rearing tanks is 1:0.5.

Circular canvas or rectangular concrete tanks with capacities of more than 10 t can be used for the culture of algal food. These tanks should be situated outdoors to enhance the propagation of *Chlorella* which needs sunlight.

Item Three: Seawater and Freshwater Supply System

The seawater supply should be clean and free from pollutants. If the water is relatively clear, it can be pumped directly to an elevated filter tank, stored in the reservoir, and then distributed by gravity to the different culture tanks. During heavy rains when the seawater may become turbid, water may be pumped into a sedimentation tank to allow suspended solids to settle. Only the upper layer of clear water is pumped into the filter tank.

The pumping capacity of the marine pump needed in the hatchery will depend on the water volume requirement, pumping time, and total head. Total head is the difference in elevation between the surface of the source of water and the point of discharge. The daily water volume requirement can be calculated from the total volume of the tanks and the rate of water exchange.

In some instances, salinity lower than what is normal of seawater (35 ppt) is necessary, in which case freshwater is added to seawater to bring down the salinity to the desired level. Also, routine hatchery activities like cleaning and washing of tanks, basins, filter bags, and other hatchery equipment require freshwater. The hatchery therefore should have ample supply of freshwater.

For aeration, roots blower is commonly used. Water depth, number of aeration outlets, and cross-sectional area of the outlets have to be considered in determining the required blower capacity. In addition to the basic facilities and life-support systems, the hatchery should also have a small laboratory where a microscope and other laboratory equipment may be kept, and a store-room as well.

Item Four: Source of Breeders

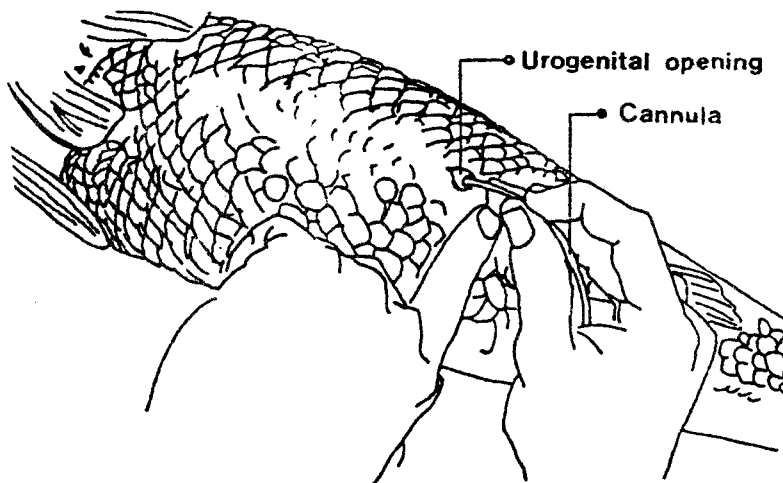
Adult sea bass spawners may be obtained from natural spawning grounds or from a broodstock farm. Wild spawners weighing 2-8 kg each are caught by gill nets, hook-and-line or fish traps, often near rivermouths during the months of June to October. They must be wound- and disease-free, with no missing body parts, and strong and active upon capture. Ripeness of the reproductive organs (i.e., gonads) can be checked as follows:

1. Transfer fish into a shallow tank filled with seawater containing 250 ppm (0.25 ml/l of seawater) of anaesthesia. Ethyleneglycol monophenyl ether (or 2-phenoxyethanol available from Merck, P.O.B. 4119, Darmstadt, Federal Republic of Germany) is a common fish anaesthetic.

2. Turn over anaesthetized fish on its back.

3. Gently massage the abdomen following a head-to-tail direction. A milky white substance of medium-thick consistency extruded out of the urogenital opening indicates the presence of milt among sexually ripe male spawners.

4. When no milt is extruded after repeated massage of the abdomen, the tapered end of a polyethylene cannula (Clay Adams PE 100, inner diameter - 0.86 mm, outer diameter = 1.52 mm, available from Becton, Dickinson & Company, Parsippany, New Jersey 07054, USA), is gently inserted 10 cm into the urogenital opening of the fish, as figure shows. The other end of the cannula is then gently aspirated by mouth as the inserted end is carefully withdrawn from the fish.



Sampling for sex determination. A cannula is inserted into the urogenital opening to obtain egg or sperm sample.

5. Inspect the contents of the cannula. A milky substance indicates milt, whereas tiny spherical bodies are eggs and the spawner is female.

6. Blow out eggs into a small vial containing 5% buffered formalin solution as fixative.

7. Transfer a few eggs onto a glass slide and measure the diameter of 30 eggs with a calibrated microscope. Calculate the average egg diameter. A female having an average egg diameter of at least 0.40 mm is sexually ripe.

Wild and sexually immature adults can be reared in captivity until the gonads ripen. Breeders may also be obtained after 3-5 years of rearing fry and juveniles in sea cages, tanks, or earthen ponds.

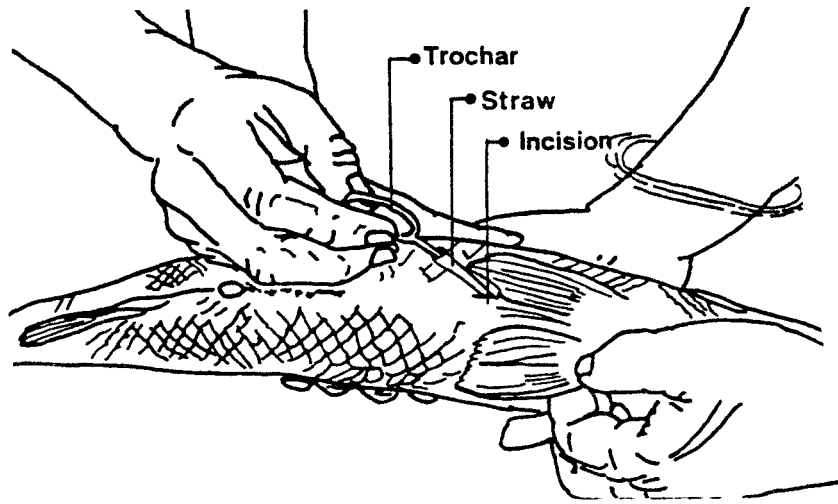
Item Five: Breeding Techniques

Successful attempts to manipulate the reproductive cycle in sea bass have employed three hormones, namely: human chorionic gonadotropin (HCG), luteinizing hormone-releasing hormone analogue (LHRHa) and 17 α -methyltestosterone (MT). These hormones induce the

gonads to mature earlier than is normal during the natural breeding season or trigger sexually mature fish to spawn. The following technique focuses on the use of these hormones.

Hormonal induction of sexual maturation.

This technique involves implantation of two hormones, LHRHa and MT. Starting in late February, monthly implantation of these hormones at a dose of 0.1 mg/kg body weight results in gonadal maturation of male and female sea bass in



Implantation of hormone pellet using a metal trochar and straw guide.

floating net cages in May or two months earlier than the known peak breeding period in the wild. The procedure for hormone implantation is as follows:

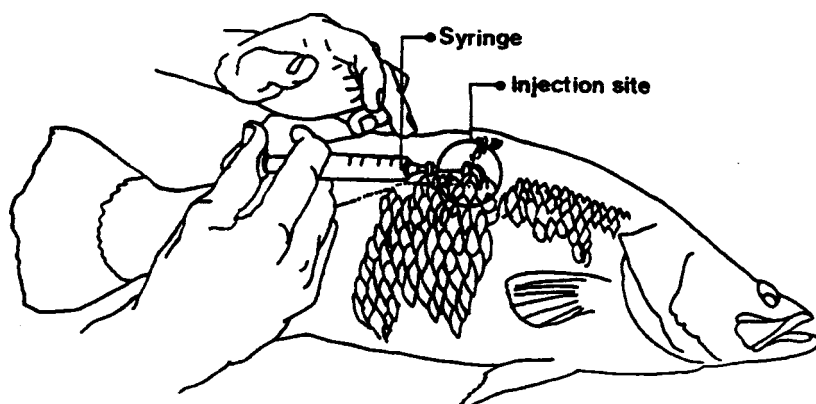
1. Condition healthy adult broodstock (more than 4 years old) in floating net cages for at least 2-3 months.
2. Implant the correct hormone dose (incorporated and pelleted in a matrix of cholesterol powder) on the ventral side (7-8 cm from the anus) of the fish as in the figure above.
3. Apply to the wound a small amount of oxytetracycline ointment (Terramycin ointment from Pfizer, Inc., Metro Manila).
4. Let the fish recover in a tank of fresh seawater before placing it back into the cage.
5. Implant fish monthly from February to May.
6. Check monthly for the presence of milt or yolky eggs by cannulation.

Hormonal induction of spawning. Although HCG and LHRHa are two common spawning agents in sea bass, LHRHa is more cost-effective than HCG. Hence, the following steps involve only LHRHa to spawn mature sea bass in floating net cages:

1. Spawning cages are lined with fine mesh *hapa* net (0.6-0.8 mm or "skin" cloth). Alternatively, spawning tanks may be used.
2. Check the initial egg diameter of ripe females and the presence of freely flowing milt among mature males.
3. There are two effective methods of introducing LHRHa to mature fish: injection or pelleted hormone implantation.

- *Injection.* An LHRHa dose of 20-100 µg of the hormone/kg body weight is recommended. Inject the hormone at a point 5-10 scales below the dorsal fin of the anaesthetized fish as in the figure on the next page. Prevent unnecessary spillage during injection by gently pressing on the point of injection as the hypodermic needle is withdrawn. Mature male fish may receive at least 40 µg hormone/kg body weight. Inject hormone during daytime. Let fish recover before returning it to the spawning cage or tank. Maintain a 1:2 (female:male) sex ratio in the spawning cage. Wait for fish to spawn two nights after the hormone injection. Mature fish injected with higher than 20 µg LHRHa/kg will spawn thrice consecutively.

- *Pelleted hormone implantation.* Prepare fish for implantation: weigh; anaesthetize;



Injection of hormone into the fish muscle.

measure egg diameter. Implant pellets with a dose of 5-75 mg to ripe male and female fish in daytime. Stock implanted fish in the spawning cage or tank at a 1:2 (female:male) sex ratio. Fish will spawn two nights after implantation of the pelleted hormone. Mature female fish implanted with 5-10 mg LHRHa/kg will spawn once; 20-40 mg/kg, twice or thrice consecutively; 40-70 mg/kg, up to four successive times.

Item Six: Egg Collection, Transport, and Hatching

Collecting eggs from tanks. Spawned eggs are collected early in the morning (5-7 A.M.) as follows:

1. Check for the presence of spawned eggs in the tank by examining water samples collected with a glass container. Fertilized sea bass eggs float and are normally transparent.
2. If eggs are present, securely place at the outlet canal a wooden box with a fine mesh screen bottom.
3. Slowly lower the water level in the tank and transfer spawners to another tank.
4. While the tank is gradually being drained, gently scoop out eggs from the wooden box and transfer them to a 15-l pail containing aerated fresh seawater. This procedure minimizes impact-related stress and mortalities during draining and collection of eggs.
5. Screen out any debris mixed with the collected eggs.
6. Rapidly but gently transfer eggs to a fiber glass tank containing 250 l of aerated fresh seawater.
7. Refill spawning tanks with seawater and return spawners.

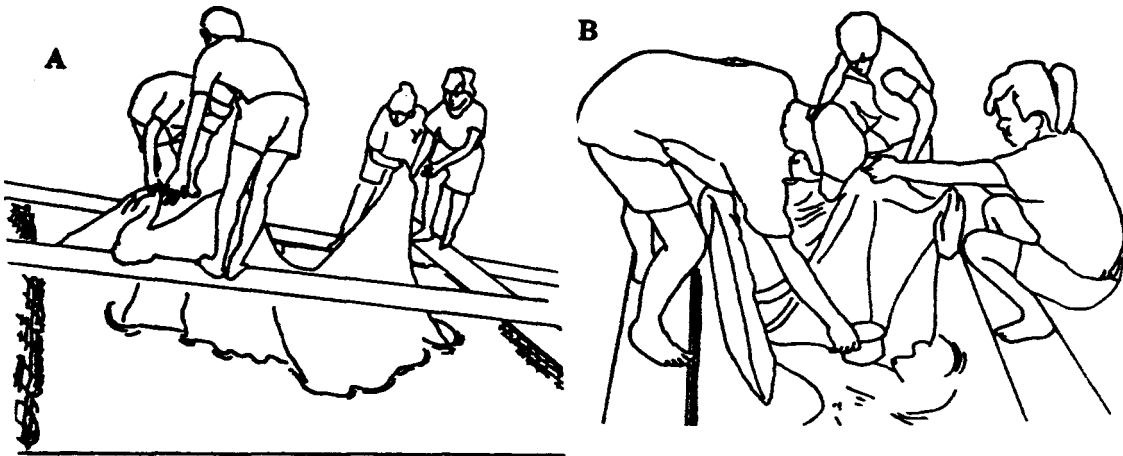
Collecting eggs from floating net cages. To facilitate egg collection, cages are lined with a fine mesh *hapa* net installed a few days before the anticipated day of spawning. Collect eggs as follows:

1. Check for the presence of spawned eggs in the cage by examining water samples in a glass container.
2. If eggs are present, transfer spawners to a spare cage or a large fiberglass tank.
3. Slowly lift the fine mesh *hapa* net of the stocking net cage. At the same time, splash the sides of the net to wash out adhering eggs. Continue lifting and splashing the *hapa* net until eggs are fully concentrated to one side.
4. Gently scoop out eggs from the *hapa* net and transfer to a pail of seawater.
5. Rinse the *hapa* net cage before installing it back to the stocking cage. Transfer spawners back to this cage.
6. Remove any extraneous debris mixed with collected eggs.

7. Rapidly but gently transfer collected eggs to a fiberglass tank containing 250 l of aerated seawater.

Egg transport. If hatchery facilities are located some distance away from spawning tanks and cages, these steps are followed during egg transport done early in the morning (5-7 A.M.):

1. Vigorously swirl seawater in the fiberglass tank containing collected eggs. Let dead eggs (white and opaque) settle down; good ones float.
2. Carefully siphon out dead eggs from the tank bottom.
3. Scoop out good eggs with a fine-mesh drain net and transfer to a graduated glass beaker.



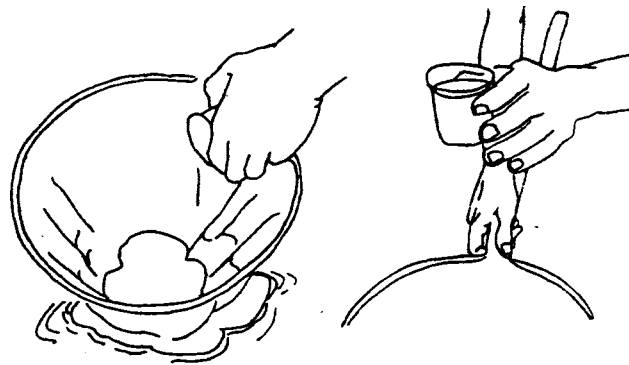
Harvesting spawned eggs: (A) the *hapa* net is lifted to concentrate the eggs; (B) washing the sides of the net to remove adhering eggs.

4. Quickly transfer (100 ml of eggs) to a double-lined plastic bag containing 15 l of fresh aerated seawater.

5. Bubble, then inflate with oxygen until the air space occupies 2/3 of the total volume of the plastic bag.

6. Tie plastic bag with several rubber bands and place into a *pandan* bag or *bayong*.

7. Keep loaded bags in a cool, dry place. Never expose eggs to heat in such areas like near running motor (in pumpboats or land vehicles) or in open decks receiving direct sunlight.



Drained eggs ready for transfer to transport bags.

Egg Incubation and hatching. Incubate fertilized eggs (diameter = 0.80 mm) in 500-l fiberglass tanks at a density of 1200 eggs/l or less. Provide gentle aeration to keep the eggs suspended in the water column. Hatching will occur approximately 14 h after fertilization at 28°C and 32-33 ppt.

Item Seven: Larval Rearing

Upon hatching, transfer larvae from the incubation to the rearing tank. Stock larvae at an initial density of 30 ind/l. Higher densities, e.g., more than 90 ind/l, may be adopted based on production targets (in terms of fry size and number of individuals harvested) and level of

capitalization. Reduce the density to 15 ind/l when larvae reach 10 days old and further to 6 ind/l when 20 days old.

Live food. Larval rearing of sea bass is largely dependent on the use of live food organisms, e.g., rotifer (*Brachionus plicatilis*), *Artemia* (newly hatched nauplii, enriched nauplii, subadult or adult biomass), and the freshwater cladoceran *Moina*.

Approximately 36 h after hatching of eggs, add rotifers to the rearing tanks at 15-20 ind/ml until larvae reach day 12. Maintain this density by daily addition of rotifers. Also add 60 l of *Chlorella* in peak bloom to attain a density of $1-3 \times 10^5$ cells/ml. *Chlorella* is added to maintain water quality and serve as food for rotifers. From day 12 to 15, gradually reduce rotifer density until it is totally removed by day 15.

Wean larvae to newly hatched *Artemia* nauplii over a 3-day period (day 12-14), although weaning may be done as early as day 8 or later depending on food availability and production target. During weaning, provide *Artemia* at increasing densities of 0.5-2.0 ind/ml/day. On days 15-17, increase *Artemia* density to 5-10 ind/ml/day.

Feed larval fish enriched *Artemia* nauplii from day 18-23 at a density of 5-10 ind/ml/day. This is important because sea bass exhibits higher survival rate during metamorphosis when fed enriched *Artemia*.

As the larvae grow bigger, they ingest larger feed particles. They are fed subadult or adult *Artemia* biomass at 1 ind/ml/day or higher.

As an alternative to *Artemia*, *Moina* may also be fed to 25-day old sea bass at not less than 1 ind/ml density. When using *Moina* as feed, lower the salinity of rearing water to approximately 10 ppt and feed at least 4 times a day.

Non-live feeds. Some non-live feeds used include frozen *Artemia* biomass, trash fish, and artificial diets. These feeds can, in excess, cause rapid deterioration in the quality of rearing water. Thus, food ration and feeding frequency must be controlled to avoid water fouling.

Prepare frozen *Artemia* biomass by freezing freshly harvested subadult or adult *Artemia* in plastic bags, each to contain the amount needed for one day feeding. During feeding, break the frozen biomass into small pieces and distribute in the tank. As it thaws, the *Artemia* particles will slowly separate allowing the sea bass larvae to swallow each piece whole.

Only fresh trash fish should be used. Remove head, entrails, and bones, then chop to fine bits the remaining flesh. During feeding, give trash fish slowly to allow fish ample time to feed before the trash fish particles sink to the bottom. Feed at least 3 times a day.

Artificial diets hold promise for sea bass fry production. However, feeding management has not yet been standardized and the economics is still unknown.

Item Eight: Harvest and Transport of Fry

Twenty-one-day old sea bass fry, approximately 1 cm total length, can be harvested from the hatchery for rearing in nursery systems. Transporting them to the farm site is easy since the fry are quite hardy.

Harvest the fry by partially draining the water in the tank. Using a fine-mesh scoop net or small basin, scoop the fry and transfer them to a container, preferably big white basins. To estimate the number of harvested fry, put a known number of fry in a basin with a known volume of water. Use this as model for visual estimation of the number of fry in similar basins. Distribute fry into the other basins containing same volume of water as the model and visually compare the number of fry in these basins with the model.

Pack the fish in double-lined plastic bags filled with fresh seawater. Inflate the bags with oxygen at water-to-air ratio of 1:2, seal with rubber bands, then put bags inside burlap bags or styrofoam boxes. The density normally used during transport of 1-cm fry is 500 fry/l or 5000 fry/10 l of transport water. However, as much as 1600 of 1-cm fry/l can be packed for 8 h of transport

at 28°C. For practical purposes, always adjust the loading density, based on the duration of transport and size of fry to be transported. Do not feed fry at least 24 h before transport so as to reduce production of metabolic wastes. It is best to transport fry during cooler periods of the day, i.e., early morning or late in the afternoon.

Source: **Sea Bass Hatchery Operations** by M.M. Parazo, L.Ma.B. Garcia, F.G. Ayson, A.C. Fermin, J.M.E. Almendras, O.M. Reyes, Jr., E.M. Avila. Aquaculture Extension Manual No. 18, SEAFDEC Aquaculture Department, Tigbauan, Iloilo, Philippines. July 1990.

MASS-PRODUCING SEA BASS HATCHLINGS FOR EXPORT

Fish farmer Yeo Kiah Hong, with the technical support and assistance of the Primary Production Department of Singapore, is now able to mass produce sea bass hatchlings for export in his 5000 sq m floating net cage fish farm in the coastal waters off Pulau Ubin. Yeo also sells some of the hatchlings to local fish farmers.

Sea bass (*Lates calcarifer*) is one of the more popular species farmed in the ASEAN region, Hong Kong, and Taiwan. In Singapore, the fish accounts for about 50 % of the total fish production from net cage farming because of its fast growth and good market value. Research done at the Marine Aquaculture Section of Singapore's Primary Production Department showed that the males attain their sexual maturity at the age of 2-3 years and the females at the age of 3-4 years. Spawning follows closely the lunar cycle, usually occurring 3-5 days after new moon and full moon, with each spawning lasting 3-6 days. More eggs are produced at full moon and these are of better quality than those spawned at new moon. Under normal conditions, a female can produce around one million eggs in each spawning cycle, and about 40-70% of the eggs would hatch.

Yeo conducted his first spawning trial in January 1989 and was able to obtain a few million eggs. Encouraged by this initial success, he decided to operate the spawning activity on a larger scale. He has since set up two more spawning net cages and acquired more sea bass brooders. Now he produces 20-30 million hatchlings monthly. The hatchlings are packed in 10-l plastic bags, each containing 50 000 hatchlings and sold to Taiwan and neighboring countries.

Yeo sells the sea bass hatchlings at around 0.1-0.15 cents each or \$1000-\$1500 per million, depending on the season. The hatchlings are raised to fingerlings of 5 cm length size for stocking in ponds or nets. Since sea bass hatchlings and fingerlings are in great demand both locally and abroad, Yeo intends to expand his farm to double its existing size to accommodate more sea bass brooders for hatchling production. He is also keen to venture further into sea bass fingerling production in his floating farm to supply local and overseas markets.

Source: **Primary Production**, No. 297, April 1989.

SEAFDEC/AQD'S NEWEST HATCHERY TECHNOLOGIES

The Aquaculture Department of the Southeast Asian Fisheries Development Center intensified dissemination of its hatchery technologies with the release of its extension manuals on milkfish, sea bass, and prawn hatchery operations.

These technologies, developed through over a decade of research at SEAFDEC/AQD, are

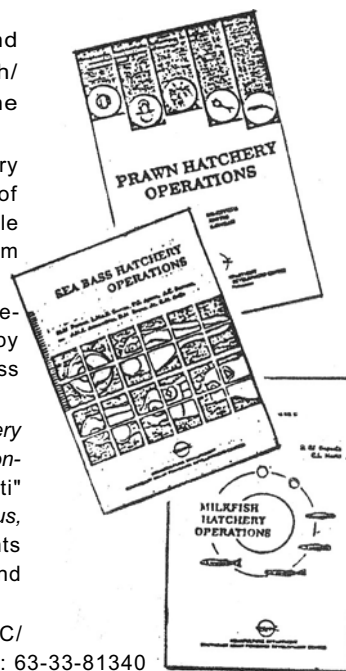
answers to the seed supply problems of the milkfish, sea bass, and prawn grow-out cultures. Hatchery, as an initial phase in finfish/crustacean culture, has become an indispensable step to meet the growing fry requirements of the industry.

Milkfish Hatchery Operations is intended for practicing prawn hatchery operators who would like to diversify operations to include larval rearing of milkfish. Procedures important in the daily operations of a small-scale milkfish hatchery are described in detail. With these procedures, a minimum production of 60 000 fry per run of 21 days could be attained.

Sea Bass Hatchery Operations addresses the principles and procedures for rearing sea bass - from eggs until metamorphosis - as practiced by SEAFDEC/AQD. It also hopes to generate and enhance interest in sea bass as an experimental animal and as food fish to culture.

The techniques described in the updated version of *Prawn Hatchery Operations* are not only applicable to the giant tiger prawn, *Penaeus monodon*, but also to other penaeid and metapenaeid species {e.g., "hipong puti" (*P. indicus* or *P. merguensis*), "hipong bulik" (*P. japonicus*), *P. latisulcatus*, *P. semisulcatus*, and "suahe" (*Metapenaeus ensis*)}. The manual presents the underlying principles and step-by-step instructions on prawn larval and postlarval rearing.

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TRAINING COURSE IN CULTURE OF NATURAL FOOD ORGANISMS OPENS

The Opening Ceremonies of the training course, *Culture of Natural Food Organisms*, kicked off the 1991 training activities of the SEAFDEC Aquaculture Department. Held 13 February, it was attended by senior research and training staff of the institution.

AQD Deputy Chief Satoru Fukumoto welcomed the 13 participants (8 from the Philippines, 2 from Malaysia, and 3 from Thailand): Evelyn Taberna, Gladys Resubal, Nimfa Medina, Violeta Ramos, Heselita Ruinata, Ben Hur Viloria, Imelda Gisalan, and Diomedes Cimagala (Philippines); Mohana Omar A/L Kumaran and Lim Swee Kheng (Malaysia); Pramuan Onlamai, Yupaporn Chaisiha, and Decha Rodrarung (Thailand).

Among the topics covered by the course are the importance of natural food organisms, suitability and nutritive value, selection of food organisms, plankton culture, and *Artemia* utilization in hatcheries.

Practical or "hands-on" activities include collection of plankton samples; isolation and purification of specific phytoplankton species using various methods; monitoring of growth characteristics; laboratory and outdoor cultures of *Chorella*, *Skeletonema*, *Chaetoceros*, *Tetraselmis*, *Brachionus*, and other natural food; and decapsulation, disinfection, hatching, and enrichment of *Artemia*.

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