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Milkfish broodstock technology of SEAFDEC/AQD

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SEAFDEC/AQD scientists have been working on milkfish breeding since the late 1970s. Following successful breeding of milkfish in captivity, SEAFDEC/AQD published in 1984 a guide for the establishment and maintenance of milkfish broodstock.

This guide was updated in late 1992, now considering several developments -- improved egg collection techniques, a standard egg transport procedure, the spontaneous maturation and spawning of milkfish in concrete tanks, and an improved hatchery technology.

SEAFDEC/AQD's broodstock management techniques are described below.

Sources of broodstock

Milkfish juveniles (weight, 250-350 g) can be obtained from brackishwater ponds and fish pens where they have been cultured for a few months to a year.

Milkfish juveniles are transported to the broodstock cages or tanks in a floating fish cage or in a 1.5-m dia. canvas tank with 0.5-m deep water with aeration. The canvas tank may be suspended at the back of a pick-up truck or placed in the hull of a pumpboat.

For a start, about 100 juveniles can be stocked in a 10-m dia. cage or tank. After three years, half of this stock can be transferred to another 10-m dia. cage or tank until maturity is attained. At this time, another 100 juveniles can be stocked in another 10-m dia. cage or tank.

Holding facilities for broodstock

Floating cages must be located in a well protected area with minimum wave action even under adverse weather conditions. The site should have good water circulation, sandy-muddy substrate, and a minimum water depth of 5 m at the lowest tide.

Milkfish are then reared in 6- or 10-m dia. x 3-m deep floating net cages. Coralon net (mesh size, 5.7 cm; size of twine, 210d/60) previously treated with coal tar is used as cage netting. A net allowance of about 30% is provided to have good water exchange. The top is covered with a similar net size to prevent fish from jumping out. The bottom is covered with fine knotless net (mesh size, 3 mm) to retain sinking food. The cages are supported by floats which are either cylindrical styrofoam or empty plastic drums (0.6-m dia. x 1 m) fitted to the cage frame, but allowing for easy rotation to check fouling. Canvas cloth or fine net (mesh size, 1

In the book-launching ceremony of the manual on Management of Milkfish Broodstock held March 4 at Iloilo City, SEAFDEC/AQD Chief Efren Ed. Flores (far left) noted that the manual's mass reprinting will be funded by the Fisheries Sector Program of the Department of Agriculture. This is significant in view of the Philippine Government's move to privatize the NBBP stations.

Senior author Arnil Emata (far right) hands over a complimentary copy to the representative of the private sector, Dr. Salvador Dolar. Looking on is Dr. Cesar Villegas, Head of AQD's Training and Information Division.
mm) is wrapped around the floats for protection against fouling organisms.

Cage maintenance is done regularly and involves:

1. Daily inspection to detect tears in the netting and to remove debris and fouling organisms;
2. Periodic rotation of cylindrical floats, repainting of wooden frame or galvanized iron (GI) pipe with coal tar; and
3. Changing of nets every 2 months or as needed to protect it from fouling organisms.

Fouled nets are sun-dried, cleaned, and repaired. When the spawning season starts, nets are left alone so that fish are not disturbed. Stress results in gonadal regression and delay of spawning.

Land-based concrete tanks measuring 8 m x 8 m x 2-m deep are sufficient for milkfish broodstock. A double pipe drainage is installed to allow water to flow out from the bottom. Water inlets and aeration lines are located at the top. A black sack cloth covers the tank to minimize excessive growth of algae.

Daily water inflow should be adjusted to change at least 50% of the water volume. The sides and bottom of the tank should be brushed monthly. The tank can be drained to at least a foot in depth for brushing. During the spawning season, water inflow should be increased so that brushing and draining can be minimized.

In both tanks and cages, optimum stocking density should not be more than 1 kg/m³.

**Feeding**

Two- to four-yr old milkfish are fed twice daily with commercial fish pellets (24% protein) at 3% of their total body weight. Upon nearing maturation by the fourth year, fish are fed twice daily with commercial shrimp pellets with 36-42% protein and 6-8% lipid. Daily feeding ration is increased to 4% of total body weight. Feeds are broadcast to the fish by hand.
Determination of gonadal development

From the fifth year and thereafter, the fish are sampled in March and in November to determine the stage of gonadal development and to determine the sexual composition of the stock. A sex ratio of one female to one male or two females to one male is adequate for egg production. Unsexed fish can be kept in a separate cage or tank to be sexed later in the season or in the next season. Excess males can be sacrificed, or released to the sea in order to save on feeds. (See separate section on reproductive biology, p.7.)

The stage of gonadal development can be monitored through the cannulation biopsy technique. To facilitate this, the nets of the floating cages are lifted gradually, or the concrete tanks drained. Disturbance must be minimized to prevent any physical injury to the fish.

Fish are individually scooped out and then placed in a 400-l fiberglass tank containing 200 l seawater and 200 ppm (40 ml) 2-phenoxycethanol (an anesthetic). The anesthetic should be mixed with a little water before it is placed in the tank. Anesthetized fish are characterized by loss of balance (ventral side up), immobility, and rapid and shallow opercular movement.

Fish are weighed and then transferred to a shallow trough (0.5 m x 1.5 m x 0.15-m deep) containing 100 ppm 2-phenoxycethanol to keep the fish anesthetized.

Cannulation biopsy is done in the following manner:

In the wooden trough, the fish is laid on its dorsal side. To determine the presence of white viscous milt, its ventral side is gently pressed, starting from halfway of the abdomen to the anal region.

If no milt oozes out, a cannula (or polyethylene tubing with a 0.86 mm inner dia. and a 1.52 mm outer dia.) is inserted into the genital pore. Difficulty in inserting the cannula through the genital pore may be encountered among broodstock undergoing their first maturation and among fish examined early in the breeding season. The free end of the cannula is held in the mouth. The cannula is aspirated while slowly being withdrawn from the fish.

The cannula is immediately inspected. A milky whitish substance indicates a maturing or mature male. Spherical yolky oocytes appear translucent to opaque (quite distinct from fatty tissue which lines the abdominal wall). Cannulated gonadal tissue are then blown into a small covered tube and 5% formalin solution is added to preserve oocytes for examination and measurement.

A few oocytes are pipetted from the tube and placed on a glass slide. The diameter of 10-30 oocytes are measured under a microscope provided with an ocular rule. Oocyte size indicates degree of sexual maturity. Females with an oocyte diameter equal to or greater than 0.67 mm are considered near final maturation and spawning. As revealed by induced spawning studies, those with oocyte diameter less than 0.67 mm are maturing or early matured.

Following sampling, the fish are placed in a recovery tank with flow-through water and aeration. Fish must be fully recovered and swimming normally before they are returned to the main tank or cage. Recovery from anesthesia in fresh seawater can be facilitated by holding the fish in the caudal peduncle and swinging it back and forth until opercular movement becomes normal and equilibrium is regained.

Spawning and egg collection

Mature milkfish are left to spawn naturally in cages or tanks.

When spawning is expected, the cage is prepared for the collection of spawned eggs. A manually operated egg collector is installed over the floating cage. The egg collector is constructed of two parallel GI pipes (0.75-in. dia.) connected to a central shaft supported by a wooden truss frame. A fine net (mesh size, 0.6-0.8 mm) is attached to the parallel pipes with a detachable conical net bag on the far end. A bamboo pole attached to the central shaft serves as a handle for manual rotation of the egg collector around the cage.

To retain spawned eggs, a 5.8- or 9.8-m dia. circular hapa net made of nylon netting (mesh size, 1 mm) is installed inside the 6- or 10-m dia. floating net cage, respectively. A half sack of sand or gravel is dropped to the bottom of the hapa net lining to maintain its cylindrical shape. The hapa net is set in place at night. It is taken out of the water at daytime on alternate days to extend its life span and to increase the water circulation in the cages. As soon as eggs are
found during sampling of water from the cage, confirming that spawning has occurred, the egg collector is operated within 10 min. to an hour. Delay in collecting eggs can drastically decrease egg collection as egg cannibalism by milkfish spawners is known.

In land-based broodstock tanks, the presence of eggs is checked daily around midnight by scooping water in a beaker. When present, the eggs are immediately collected. The egg collector consists of 2 airlift PVC pipes (4-in. dia.) with outflows directed to a 1 m x 1 m x 1 m hapa net supported by a PVC pipe frame. Two egg collectors are installed in each tank at the corners opposite the water inflow. Additional airlift pumps are installed with their outflows directed towards the egg collectors. The hapa nets are raised and rinsed, and the eggs scooped out. The nets are cleaned and sundried during the day, then installed at night in anticipation of the next spawning.

Fertilized milkfish eggs are spherical, finely granulated, pelagic, non-adhesive, transparent with a slight yellow tinge, and have no oil globule. A developing embryo is visible 10 h after spawning. The time of spawning may be back-calculated from the stage of embryonic development at the time of egg collection.

Following collection in cages, the conical bag is detached and placed in a pail containing 10 l of seawater. Milkfish eggs should not be allowed to stay out of seawater for more than a few minutes. The eggs are released from the net bag, taking care to dislodge eggs sticking to the net. The collected sample is then aerated to keep the eggs afloat, then transferred to a container with 400-l filtered seawater.

**Determination of percent egg viability**

The percentage of viable eggs is the ratio of the total number of live eggs to the total number of eggs. This value is used to monitor the performance of a batch of eggs and is also used in computing the hatching rate and the number of larvae stocked.

Viable or live eggs are transparent with a narrow perivitelline space and a blastodisc. Depending on the time of egg collection, an embryo may be visible. Dead eggs are opaque, and the unfertilized ones have no perivitelline space.

**Transport of eggs**

The hatchery must be located as close as possible to the broodstock cages or tanks to minimize mechanical damage of eggs due to handling and transport.

The time spent for preparing eggs for transport and transport of eggs itself should be kept to a minimum. About an hour prior to transport, packing preparations should be underway following these steps:

Shut off the aeration. Swirl the water in the container at least once to concentrate dead eggs at the bottom. Siphon out dead eggs.

Set a double-lined plastic bag inside the bayong and fill with about 15 l filtered seawater (salinity, 28-32 ppt).

Scoop eggs with a fine mesh (0.6-0.8 mm) scoop net. With a beaker, take about 150-200 ml of eggs from the scoop net and quickly transfer to the bayong. About 60,000 eggs are contained in 100 ml.

Saturate each plastic bag with oxygen and seal tightly with rubber bands.

Bayong bags should be kept in the shade throughout transport. Water temperature in the
Milkfish broodstock... from p. 6

bags should not go beyond 30°C.

In the hatchery, each plastic bag is placed in a hatching tank with 400-l filtered and well-aerated seawater. After a 15-min acclimation, the plastic is opened and the eggs released. The eggs are stocked at 250-300 per liter.

Determination of hatching rate

Milkfish eggs hatch between 20 and 24 h from spawning at temperatures of 26-32°C and salinities of 29-34 ppt. The number of normal larvae (straight body and without deformities) and abnormal larvae (curled body) is determined under a microscope. The hatching rate and percentage of normal larvae are also determined.

Hatching rate is the ratio of the total number of larvae to the total number of five eggs. The percentage of normal larvae is the ratio of total number of normal larvae to the total number of larvae. Both values are indicators of the performance of a batch of eggs.

Postscript

Research on broodstock nutrition is very important for further refining AQD's broodstock management techniques. The production of good quality eggs and larvae depends on proper broodstock nutrition. Another area for research is the method of obtaining gonadal maturation and spawning in milkfish outside its breeding season. Success in these two areas -- broodstock nutrition and off-season maturation and spawning - will augment the seed supply of milkfish perhaps to the point where dependence on natural supply will be minimized, if not, eliminated.


References on milkfish available at SEAFDEC/AQD

Publications

  Old price: P200 US$40
  New price: P100 US$20

  Old price: P80 US$30
  New price: P40 US$15

  Old price: P150 US$35
  New price: P75 US$15

  Old price: P230 US$45
  New price: P115 US$20

Video tapes

• Caring for Milkfish Larvae. 14 min.
  Old price: P420 US$40
  New price: P200 US$20

• Milkfish from the Wild to the Farm. 16 min.
  Old price: P480 US$50
  New price: P200 US$20

• Milkfish Fry Collection, Handling and Storage. 16 min.
  Old price: P495 US$50
  New price: P200 US$20

• Milkfish Fry Acclimation and Fingerling Production in Freshwater. 10 min.
  Old price: P315 US$30
  New price: P200 US$20

• Milkfish Culture Systems. 10 min.
  Old price: P310 US$30
  New price: P150 US$15

Other references on milkfish that were not published by AQD are available c/o The Library, SEAFDEC/AQD, Tigbauan 5021, Iloilo, Philippines. When writing, please indicate specific area of interest, e.g., cage/pen culture.