SEAFDEC/AQD TECHNOLOGY

Larval rearing techniques

Much of the output of the SEAFDEC Aquaculture Department have been on hatchery technology, addressing three main areas of operation: broodstock management, larval rearing methods, and natural food production. Larval rearing techniques for tiger shrimp, milkfish, and sea bass have been successfully transferred to the private sector (see summary on pp. 3-5).

The concept of a multi-species hatchery is new and SEAFDEC/AQD has just started refining a workable and practical method. For instance, the milkfish hatchery techniques transferred to the private sector can be practiced in existing tiger shrimp hatcheries. Hence, diversification to other fish species may follow. AQD researcher Marietta Duray is working on multi-species hatchery; her paper on this topic will soon be published in the journal *Aquaculture Engineering*.

Since the publication of AQD's hatchery techniques in 1990-1991, several new studies to improve hatchery techniques have been completed. These are described below.

Artificial diet for tiger shrimp

Artificial diets have been proven to be effective feeds for larval shrimp. Their use has helped solve problems currently limiting shrimp hatchery production through assurance of a reliable supply of nutritionally balanced larval feed, reduction of the level of technical skill required to operate a hatchery, simplification of hatchery design, and reduction in capital investment.

AQD formulated in 1989 a kappa-carrageenan microbound diet made from locally available ingredients. It was tested in large scale hatchery production of tiger shrimp larvae. The diet has about 50% protein and 14% lipid, and is composed of:

Ingredients	% composition
Shrimp meal	35%
Squid meal	30
Bread flour	11
Cod liver oil	8
Soybean lecithin	2.5
Cholesterol	1.0
Vitamin mix, commercial	6.0
Mineral mix, commercial	4.0
Butylated hydroxytoluene	0.05
Carotenoid	0.25
Celufil	1.95

The results of the trials are very promising. The best feeding scheme so far is as follows:

☞ p. 6

Larval rearing of tiger shrimp, milkfish, and sea bass at SEAFDEC/AQD

(see pp. 4-5 for some notes on this scheme)

WATER MANAGEMENT:

Siphoning of debris and cleaning of tank bottom

WATER VOLUME CHANGED:

30% | 50-70%

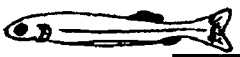
FEEDING SCHEME:

Tiger shrimp

Phytoplankton — 20,000-50,000 cells per milliliter maintained in tank

Artemia — 0.1-0.5 nauplii per liter | 1 nauplii/l | 2-3 nauplii/l

Microparticulates — as recommended by manufacturer



Milkfish

Chlorella — a light green to green color of water is maintained in tank

Brachionus — 10-15 individuals per ml | 5 ind/ml

Nosan — 100 particles per ml (70-90 μm)

Artemia — 0.5 nauplii per ml | 1 nauplii/ml

Sea bass

Brachionus — 15-20 rotifers per ml

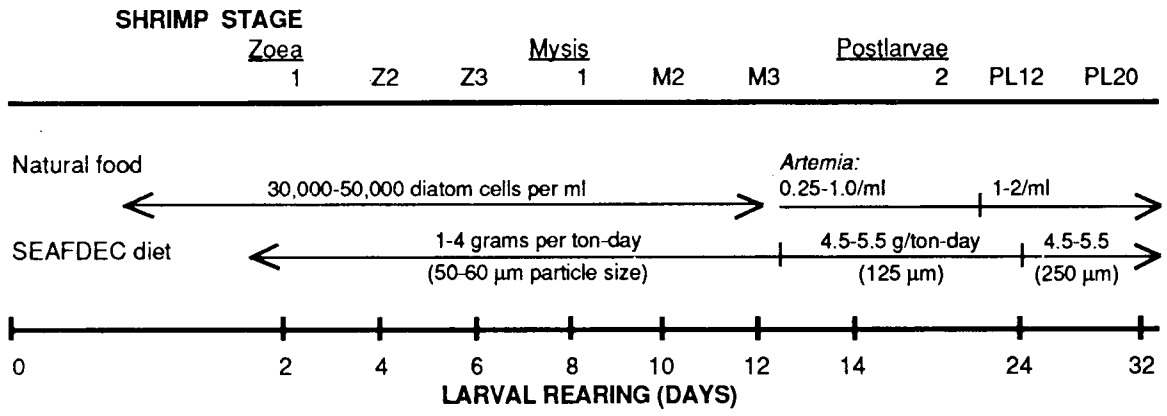
Artemia — 0.5-3 nauplii per ml | 5-10 nauplii/ml

5-10 instar II per ml

Live or frozen *Artemia* biomass; trashfish — *ad libitum*

0 5 10 15 20 25 30

Rearing period (days)



Feeding scheme for the tiger shrimp using a SEAFDEC/AQD formulated diet.

The feeding scheme has resulted to 85% survival during the zoea-mysis metamorphosis, 42% survival for mysis-postlarvae metamorphosis, and about 37% survival for PL18.

Reference: MN Bautista, F Parado-Estepa, OM Millamena, and EL Borlongan. 1991. *Large scale hatchery production of Penaeus monodon using natural food and artificial diets.* **The Israeli Journal of Aquaculture - Bamidgeh** 43 (4): 137-144.

Alternative live food for sea bass

The freshwater cladoceran *Moina macrocopa* (Strauss) can be used as partial or complete substitute for the more expensive *Artemia* in rearing the sea bass *Lates calcarifer* (Bloch) fry. *Artemia* is imported in the Philippines.

The current practice in hatcheries is to feed sea bass the marine rotifer *Brachionus* during the first 15 or 20 days, followed by brine shrimp *Artemia* until harvest. Other schemes include feeding *Moina* immediately after weaning from *Artemia* diets but prior to feeding minced fish. During this period, sea bass may be reared at lower salinities -- about 10 ppt -- to allow feeding of freshwater zooplankton. This will not be a problem because sea bass is catadromous; its postlarvae move upstream into freshwater lagoons for nursing after being spawned in inshore coasts.

Small-sized adults and neonates of *Moina* may be fed *ad libitum* to sea bass larvae less than 15-days old. *Moina* of whatever size may be given to older larvae. Sea bass fed *Moina* grow at about 9% per day; sea bass fed *Artemia* and grown at 32 ppt gain weight by about 12% per day.

Moina has a high nutritive value; it contains high levels of 20:5ω3 highly unsaturated fatty acid needed by most marine fish larvae.

Moina is also easy to propagate. Researchers at the University of the Philipines in the Visayas were able to culture *Moina* in tanks using the "sack" method. First, a 2 x 2 x 1.5 m tank with 1-m deep tap water is allowed to stand for two days. Then, 200 ppm hydrated chicken manure in a sack is suspended in the water. After five days, *Moina* can be harvested using a 800-1,000 µm mesh net. Large adults may be separated from nauplii and small adults using a 400-500 µm mesh.

Reference: AC Fermin. 1991. *Freshwater cladoceran Moina macrocopa (Strauss) as an alternative live food for rearing sea bass Lates calcarifer (Bloch) fry.* **Journal of Applied Ichthyology** 7:8-14.

Alternative live food for milkfish

Moina macrocopa may also be fed to the milkfish *Chanos chanos* fry. At a feeding density of 10-20 *Moina* per milliliter, 6-mm milkfish fry grow by about 4% per day. Survival is 60% over a 30-day rearing period. Fry fed *Brachionus* grow by about 3.5% per day with 50% survival.

Freezing surplus zooplankton permits short term storage in anticipation of high hatchery demand. It can also ensure against failures in live cultures. But, feeding frozen *Moina* to milkfish fry

reduces growth (0.5% per day) and decreases survival (32%). Fry fed frozen *Brachionus* grow and survive better (3.5% per day; 50% survival).

Reference: CT Villegas and GL Lumasag. 1991. *Biological evaluation of frozen zooplankton as food for milkfish (Chanos chanos) fry.* **Journal of Applied Ichthyology** 7: 65-71.

Multi-step method of producing microalgae and its economics

The use of phytoplankton as food for shrimp larvae is a basic component of hatchery operations. Microalgal species widely used in the Philippines include *Skeletonema costatum, Chaetoceros calcitrans, Chlorella* sp., and *Tetraselmis* sp. Of these, *Chaetoceros* was the highest produced in volume at SEAFDEC/AQD.

Chaetoceros culture is simple and can be easily adopted by hatchery operators. Culture starts with a pure inoculum of 50,000 cells per milliliter. The starter culture is aerated moderately, illuminated continuously, and maintained at 18-27°. *Chaetoceros* is grown in batches using successively larger containers. A cell density of 2.65 x 10^6 cells per ml would be obtained from a final 4-day culture. The flow chart of *Chaetoceros* production at SEAFDEC/AQD is shown below.

To produce the microalgae, about ₱145,000 is needed for equipment and other materials. This amount is incurred as initial investment in the hatchery. Producing *Chaetoceros* using the multi-step method would cost ₱715.50 per ton. This includes the cost of the algae enrichment F-medium (₱378 per liter) and TMRL (₱63/l).

Reference: GPB Samonte, CC Espegadera, RD Caturao. *Economics of microalgae (Chaetoceros calcitrans) production using the multi-step method in the Philippines.* **Aquaculture** 112: 39-45.

Other larval rearing studies at SEAFDEC/AQD

Progress on the larval rearing of fishes artificially spawned at SEAFDEC/AQD have been made. Among these are the grouper *Epinephelus suillus*, the red snapper *Lutjanus argentimaculatus*, the native catfish *Clarias macrocephalus*, and the bighead carp *Aristichthys nobilis*.

CULTURE CONDITIONS	TYPES OF ALGAL CULTURES							
	PRIMARY STOCK CULTURES		SECONDARY STOCK CULTURES		LARGE-SCALE CULTURES			
CULTURE CONTAINER (Volume)	TEST TUBE		ERLENMEYER FLASK (100 ml.)	DEXTROSE BOTTLE (1 liter)	GALLON JARS (3 liters)	CARBOYS (GLASS/PLASTIC) (10-20 liters)	VINYL TANKS (200 liters)	FIBERGLASS TANK (1 ton)
	AGAR SLANT (20 ml.)	BROTH (20 ml.)						
AERATION/ AGITATION	none	manual shaking	manual shaking	aerated	aerated	aerated	aerated	aerated
ILLUMINATION	1-2 units 40 watt Fluorescent Lamps (DAYLIGHT TYPE)					1/2-3 units Fluorescent lamps/sunlight	4-6 units Fluorescent lamps/sunlight	sunlight (ambient)
TEMPERATURE	18-22°C	18-22°C	18-22°C	25-27°C	25-27°C	28-30°C	28-30°C	ambient
VOLUME OF INOCULUM	1 loopful	1 drop-1 ml.	1-10 mL	20-50 mL	100-200 ml.	1-3 liters	20-50 liters	200-500 liters
GRADE OF CHEMICALS	ANALYZED REAGENT GRADE					TECHNICAL GRADE		AGRICULTURAL FERTILIZERS
CULTURE MEDIA	MODIFIED F MEDIUM				F MEDIUM	TMRL (Technical)	TMRL (Technical)	16-20-0 * Urea 46 21-0-0
WATER TREATMENT	AUTOCLAVED			BOILED (20 minutes)		FILTERED (MICROFILTER)		SAND FILTERED
STERILIZATION OF CULTURE VESSELS	AUTOCLAVED			OVEN-DRYING	OVEN-DRYING	10% HCl DISINFECTION (24-48 hours)		
CULTURE PERIOD	7-10 days		5-7 days	1-4 days	1-4 days	1-4 days	1-4 days	1-4 days

* Dosage: 16-20-0 (12-15 g/ton)
Urea 46 (12-15 g/ton)
21-0-0 (100 g/ton)

Flow chart of the microalgae *Chaetoceros calcitrans* production at SEAFDEC/AQD.