

LARVICULTURE OF MARINE FISHES AT SEAFDEC/AQD

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The recent glut in the world market for shrimp dealt a heavy blow to the aquaculture industry. It is thus apparent that fish farmers should not depend on only a single species for culture. The popularity and market demand for grouper, sea bass, and snapper make them obvious choices as alternative culture species. On the other hand, milkfish and rabbitfish are cheaper sources of protein and they already contribute substantially to fish production from aquaculture--56.2% from milkfish for example (Rabanal 1988). However, culture and production of marine fishes are hindered by the unpredictable and seasonal seed supply. Research on larviculture at SEAFDEC/AQD are geared towards hatchery production of fry to augment supply from the wild.

Status

There are five marine fish species being cultured at AQD, namely: grouper (*Epinephelus suillns*), sea bass (*Lates calcarifer*), milkfish (*Chanos chanos*), rabbitfish (*Siganus guttatus*), and most recently the snapper (*Lutjanus argenti-maculatus*). Although larviculture of milkfish was first tried in 1977, it was only after spontaneous spawning occurred that larval rearing techniques rapidly developed. At present, this hatchery technology (Gapasin and Marte 1990) is verified in selected private hatcheries in Antique, Capiz, and Iloilo of Panay Island with very promising results. The seed production technique for sea bass developed in Thailand has been modified to suit local conditions. This in turn has already been adopted by some private hatcheries. Although larval rearing techniques for the rabbitfish are available, these techniques have yet to be tried in commercial scale. Larviculture of grouper and snapper are still under experimentation.

Larviculture

Spawning. Naturally spawned eggs are commonly used in larval rearing trials. These come from mature fish induced to spawn by hormonal injection or pellet implantation. *E. suillus* spawn from 1600 to 1800 H within four days before or after the last quarter moon phase (Toledo et al. 1990). Sea bass usually

spawn in the evening (Garcia 1988) between 1900 and 2300 H four days before or after the first quarter moon and within five days before or three days after the last quarter (Toledo et al. 1991).

Egg collection and transport. Except for the rabbitfish whose eggs are adhesive and demersal, the pelagic eggs of other species are collected by manual seining or by draining the water in the tank into an egg concentrator seine. SEAFDEC/AQD has designed a manually operated "egg sweeper" for milkfish (Garcia et al. 1988). For *S. guttatus*, an egg collector or a substrate is placed at the bottom of the tank prior to spawning. This substrate can be transferred to incubation or rearing tanks.

Eggs are transported from Igang Marine Substation to the hatchery at Tigbauan Main Station in double-layered oxygenated plastic bags inside *pandan* bags. Packing densities vary from 90,000 to 300,000 in 8-10 l of water depending on the species.

Incubation. Eggs are incubated in 400- or 500-l tanks or directly stocked in 3- or 5-t larval rearing tanks at stocking densities ranging from 100 to 400 egg/l. Dead eggs are removed and incubation water is partially changed by allowing the water to flow through for no less than 30 min. Moderate aeration is provided to each tank. Incubation period is about 17-18 h for the grouper, 12-17 h for sea bass, 26-32 h for milkfish, 18-20 h for rabbitfish, and 17-18 h for the red snapper.

Larval rearing

Food and feeding

Rotifers are still essential in the initial stage of rearing the various marine fish larvae because of their size and ease of culture. Most marine fish larvae are fed rotifers on day 2 at 10-15 rotifers/ml. Newly hatched brine shrimp nauplii are usually given on day 15 starting at ≤ 1 ind/ml. This rate is gradually increased as larvae grow. Gradual weaning from one prey type to another is practiced (Fig. 1-3).

Growth and survival are significantly better if sea bass larvae are given ≥ 6 ind/ml *Artemia* nauplii four times a day (Duray 1990). To optimize the use of *Artemia* on sea bass larvae, mouth width development is monitored. Dhert et al. (1990) suggested the use of newly hatched San Francisco Bay type of *Artemia* (430 μm) from days 8 to 10, Great Salt Lake *Artemia* (500 μm) from day 11 and onwards. HUFA-enriched Great Salt Lake metanauplii (800 μm) can be given starting day 14. Metamorphosis has been enhanced with the use of HUFA enrichment, and larvae, in turn, show strong resistance to salinity stress.

In milkfish, a combination of microparticulate feed and rotifer can result in significantly bigger larvae than those solely fed rotifer or microparticulate feed (Marte and Duray 1991). Likewise, a significant increase in growth and survival of the larvae is observed when larvae are fed HUFA-enriched rotifers compared to *Chlorella*-fed ones (Duray, unpubl.). This result is similar for those larvae given microparticulate feed and rotifer. Milkfish are also observed to be more robust and to have slightly higher survival rates when reared in open outdoor tanks. The verification runs in private hatcheries use open outdoor tanks in rearing milkfish larvae.

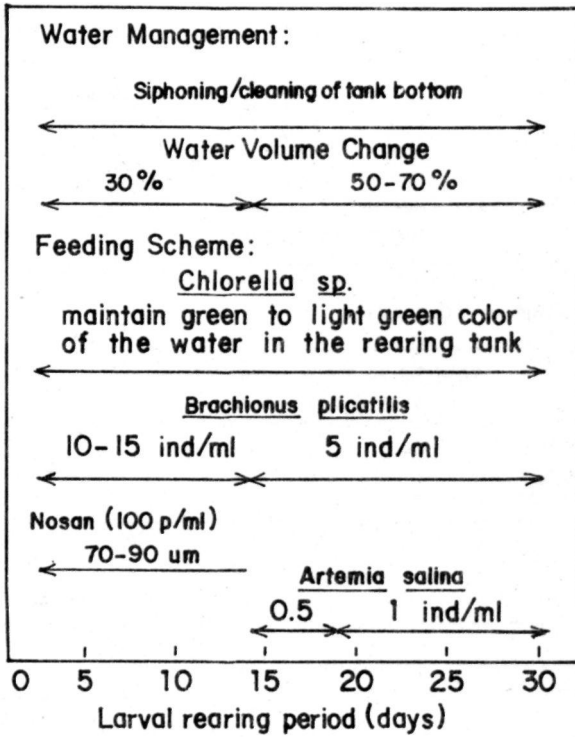


Fig. 1. Water management and feeding scheme for rearing milkfish larvae (Juario and Duray in Marte 1988; Marte and Duray 1991).

Since both siganid and grouper larvae have small mouths, screened rotifer ($< 90 \mu\text{m}$) can be used during initial feeding in the absence of SS-rotifer strain. If *Artemia* is fed starting day 21 rather than day 14, mortality for grouper larvae is lower.

Water management

Compared to other species, siganid and grouper larvae are reared initially in static water system for 5 to 7 days; otherwise, partial water changes from 30-50% during the rotifer feeding days and 50-75% on brine shrimp feeding period are followed. Larviculture of milkfish in open outdoor tanks requires greater volume of water to be changed; if not feasible, a flowthrough system is allowed for 1-2 h until the water becomes clear of diatom bloom.

Stocking rate

The initial stocking density used for most of these fish species is 30 larvae/1. For grouper, a stocking rate of 10-20 larvae/1 is optimum. For sea bass, from an initial stocking rate of 30 larvae/1, the density is reduced by half every ten days. Grading of the stock is done before restocking sea bass in freshly cleaned tanks.

Diseases and their control

Common disease problems encountered in the hatchery are related to viral or bacterial infection. Vibriosis associated with the appearance of red spots

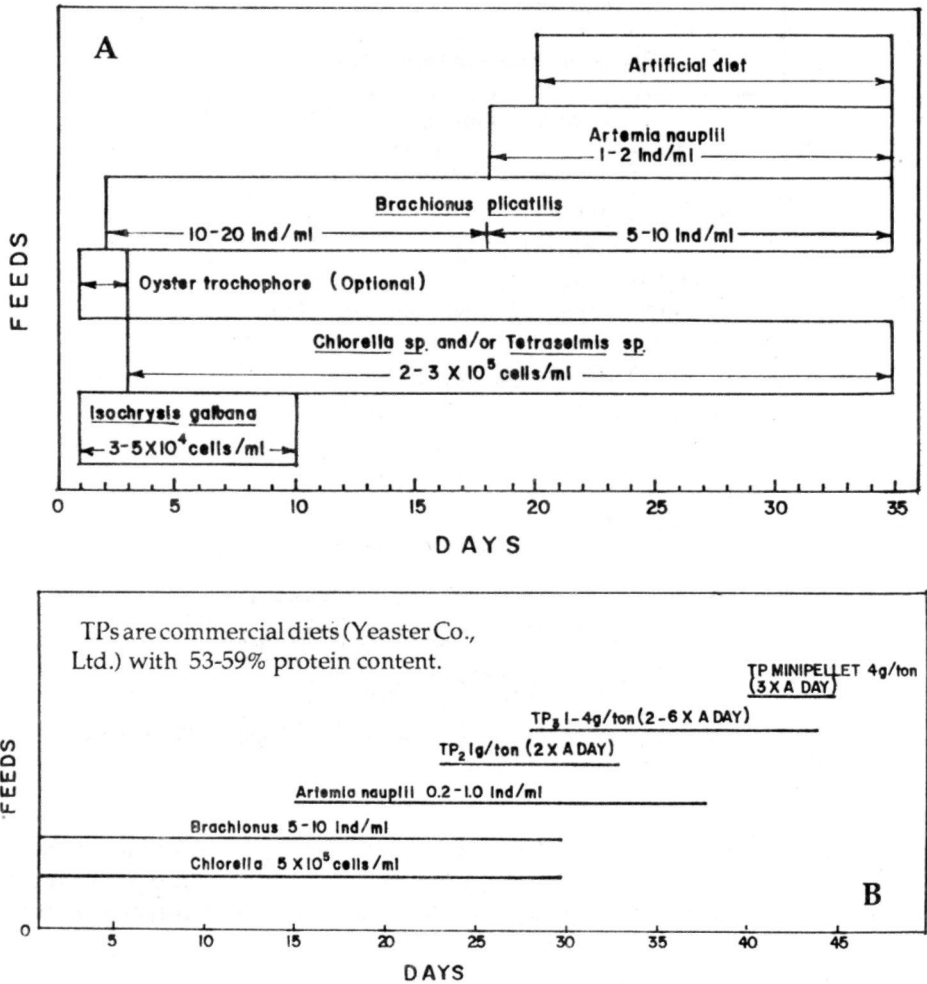


Fig. 2. *Siganus guttatus*: feeding schedule for larvae. A, after Juario et al. 1985; B, illustrated based on data in Hara et al. 1986.

in the tank bottom and sides is common. Application of freshwater directly to the infected area effectively controls the infection after two to three days (Duray and Juario 1988).

Swimbladder stress syndrome (SBSS), often mistaken as gas bubble disease, is observed. This is due to environmental stress. High stocking density accompanied by high levels of ammonia-nitrogen and other stress-inducing factors may contribute to SBSS occurrence. Some preventive measures include the maintenance of good water quality, adequate nutrition, and reduction of other environmental stress like low dissolved oxygen, extreme temperatures, and build-up of wastes.

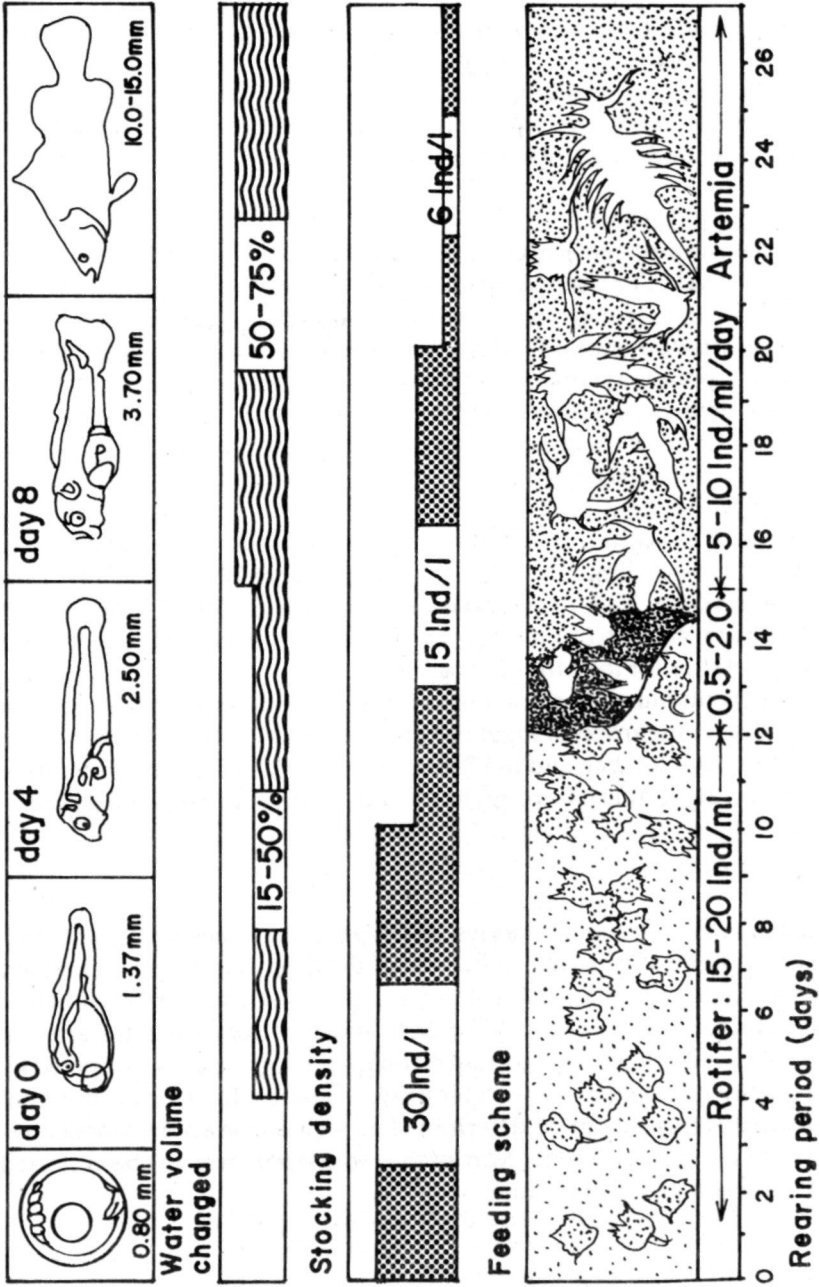


Fig. 3. Larval rearing of sea bass (After Parazo et al. 1990).

Live food production. Intensive larviculture of marine fish species depends on adequate supply of rotifers grown on microalgae. Most large-scale algal production are unialgal semi-continuous or batch culture. Both methods are used at SEAFDEC/AQD although the latter is more common. Of the three species (*Chlorella* sp., *Tetraselmis chuii*, and *Isochrysis galbana*) grown in the hatchery, *Chlorella* is preferred in spite of its low n-3 fatty acid profile. *Chlorella* is easier to mass produce compared to the other two.

Chlorella production

For *Chlorella* propagation in large-scale, a ratio of 4:1 filtered seawater and algal starter is used. Commercial fertilizer mix (100 g of 21-0-0; 20 g of 16-20-0; and 20 g of 46-0-0/t of seawater) is applied and strong aeration is provided. Peak bloom is attained within 4-5 days. At this time, a portion is transferred to another tank to serve as a starter and to the rest, rotifers are inoculated. "Culture crashes" sometimes occur either due to the failure of the algae to multiply or due to algal death. Color of the algae and pH of the culture are often the guides to the condition of the algal culture.

Rotifer production

When *Chlorella* culture peaks, rotifers are added at densities ranging from 10 to 50 ind/ml depending on availability. A density of 120-200 rotifers/ml is reached within 4 days. They are then harvested and concentrated using a 48- μ m plankton net bag, then fed to larvae. From the harvested stock, a portion is reserved as a starter for the other *Chlorella* tank.

Diatom contamination sometimes occurs. If contamination is severe, the culture is usually discarded. If algal culture "crashes," rotifers are harvested using a 63- μ m plankton bag and fed Baker's yeast at 0.5-1.0 g/million rotifers. Rotifers are fed algae at least overnight prior to feeding them to the larvae.

Production constraints

For milkfish, extraneous species (shrimps, other fishes) that come with the eggs are difficult to separate, and, most of the time, they compete for food or prey on milkfish larvae. For *S. guttatus* fry, a lot of work has to be done before artificial propagation can be carried out routinely. Survival rates are still variable. Development of larval rearing techniques for grouper is hampered by poor egg quality resulting in low hatching rates. Suitable food for the different developmental stages has to be determined as well as the environmental requirements of the larvae. Larviculture of the red snapper has just been started so a great deal still needs to be done.

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