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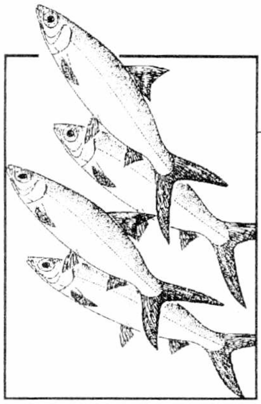

Milkfish broodstock development in the Philippines

By **Arnil C. Emata, PhD**
AQD Scientist

Milkfish aquaculture in the Philippines has up to now relied solely on fry collected along coastal areas. However, such dependence limits the expansion of the industry. Since its establishment in 1973, SEAFDEC Aquaculture Department has focused on the artificial propagation of milkfish or the culture of milkfish in its entire life cycle. To date, SEAFDEC / AQD has generated technologies for the mass production of fry in hatcheries to meet the requirements of the industry.

Most important in hatchery production of milkfish fry is the availability of eggs spawned by captive breeders or broodstock. These breeders are 5 years old or more and have been in cages or tanks under seawater conditions for these to attain sexual maturation and spawning. The capture of wild adults to be used as broodstock is disallowed due to the difficulty in capturing the *sabalo*, high mortality rates due to handling stress, and uncertainty of rematuration in captivity. Taiwan and Indonesia, countries that have rivaled the Philippines in the artificial propagation of milkfish since the '70s, may have gained an advantage because of the availability of captive breeders in private fishfarms. In Taiwan, for example, a fishfarmer raised milkfish for about nine years, carrying out his own breeding experiments by trial-and-error. When these breeders spawned naturally, eggs were given to hatcheries. After several years, Taiwan has filled up its requirement of milkfish fry from hatcheries and is now exporting fry to the Philippines. In Indonesia, because milkfish are not fully harvested in ponds, the leftover stock has grown to broodstock size. When this stock was bought by a government research institute, they spawned naturally after several months in captivity. The eggs were then given to small-scale private-owned hatcheries that produced milkfish fry. Today, several big-scale hatcheries have mushroomed, even maintaining their own milkfish broodstock.

One source of broodstock in the Philippines are the fish leftover from the defunct National Bangus Breeding Program (NBBP). Established in 1980, NBBP was implemented by the Department of Agriculture - Bureau of Fisheries and Aquatic Resources (DA-BFAR) with technical assistance from AQD and financial assistance from the International Development Research Centre (IDRC) of Canada for selected regional sites. NBBP was supposed to develop milkfish broodstock in regional sites nationwide but this effort was not sustained. With the broodstock lacking in maintenance especially on nutrition, DA opted to privatize the broodstock (about 305 in 5 sites, Table 1) in 1992 but even then only those reared by AQUASUR in Davao del Sur has so far produced adequate volume of eggs for hatchery operation. The obvious reasons for AQUASUR's success in milkfish breeding are good management practices, i.e., adequate financial and logistics support.

Several fishfarmers have rallied to the campaign of AQD for the establishment and development of captive breeders in ponds and tanks. There are about 4,000 broodstock in Luzon, about 1,580 in Visayas, and about 3,000 in Mindanao (Table 2). Presently, these breeders are near or at sexual maturity and would soon require spawning facilities with flow-through seawater to ensure successful spawning and egg production. Financial assistance to fulfill the huge initial capital outlay and operating expenses was promised by DA in one of the national meetings but so far none has been delivered. Unless the government considers milkfish broodstock development as a top priority, or provides every effort to realize the potential of the private-owned broodstock, the investment in time and resources of private fishfarmers will ultimately go to naught. What is even disappointing is that DA regional offices or farms have pushed for milkfish broodstock development by themselves rather than by the private sector. About 510 broodstock are maintained by the DA in Luzon, 3,700 in Visayas, and 98 in Mindanao (Table 3). Without clear, sustained financial support and direction, and close collaboration with fishfarmers who will later obtain eggs, fry, and fingerlings, this project could easily attain fail. It seems that the lessons from NBBP have not been learned.

The present annual milkfish production in the Philippines is about 170,000 metric tons. With a present population of 70 million, per capita milkfish consumption is about 2.42 kg per year. It has been projected that by year 2010, annual milkfish production should be 300,000 tons to support a population of 100 million with a per capita milkfish consumption of 3 kg per year. Assuming a harvest size of 250 g, total number of fish harvested is 1.2 billion. If the wild fry production is about 1.2 billion, another 1.2 billion should be sourced from the hatchery. With a cumulative survival rate of 10% from eggs to fry, about

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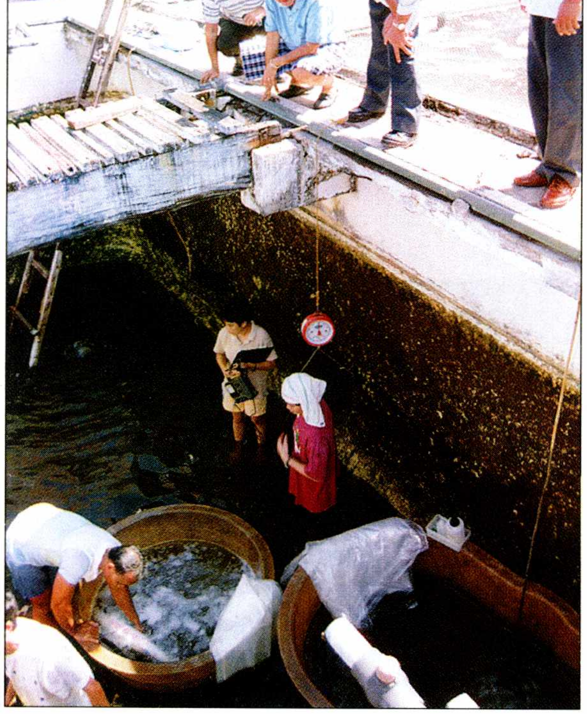
Dr. Emata is a reproductive physiologist on AQD's milkfish R&D team.



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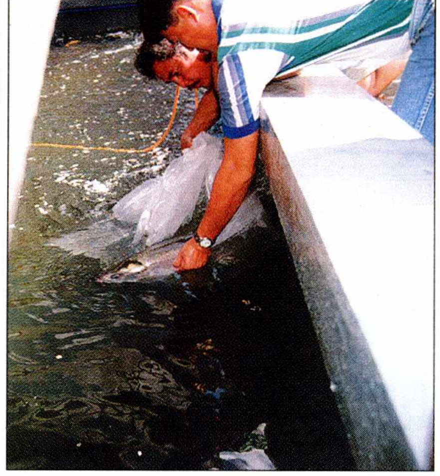

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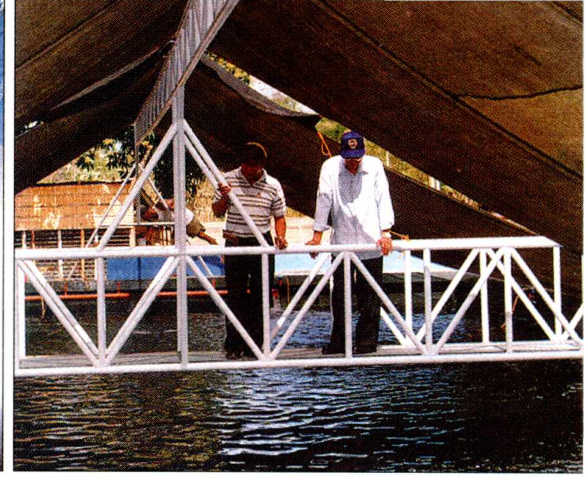

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AQD has built a new facility at its Tigbauan Main Station -- the Integrated Broodstock and Hatchery Pilot Demonstration Complex. Some milkfish broodstock were transferred from 50-ton tanks (A) to the new complex (B-C) last April 3.

12 billion eggs are needed to produce 1.2 billion fry. The present fecundity estimate at AQD is 2 million eggs per female per season. Thus, to produce 12 billion eggs, 6,000 females must be maintained or 15,000 broodstock at a sex ratio of 1 female:1.5 male. The present number of cage- pond- and tank-reared broodstock in the Philippines is a step in the right direction. Additional number of breeders must be developed as broodstock egg productivity declines with age.

The breeding and hatchery fry production technologies at AQD are continuously being refined. For broodstock management, a sex ratio of 2 females to 3 males is sufficient for egg production. The broodstock are fed diets containing good quality fishmeal and vitamin mix. Land-based spawning facilities are provided with seawater turnover rates of up to 150% to maintain good water quality. In hatcheries, eggs are incubated and hatchlings are reared to fry stage in intensive or semi-intensive systems. In intensive systems, the larvae are reared in low-volume tanks (3- to 10-ton capacity) at high stocking rates (30,000 - 50,000 larvae per ton) supplied with live natural and artificial foods, with rearing water changed daily from 30-70%. In semi-intensive systems, larvae are stocked in high volume tanks (100-ton capacity or more) at low densities (1,000 - 3,000 larvae per ton), supplied with live natural or artificial foods, but with no water change.

AQD recommends that the private sector rear milkfish juveniles in brackishwater ponds for 3-4 years with only natural food for practical reasons. The government can provide soft loans for capital outlay, equipment, and/or operating expenses, or both to ease the financial burden of fishfarmers venturing into broodstock development. Eggs collected from natural spawns of the broodstock will supply the commercial hatchery operation. The harvested fry are immediately sold to fishfarmers or to fingerling producers who have intensive network of milkfish farmers.

Present evaluation of the biotechnical and economic viability of the breeding and hatchery technologies have revealed several areas that need to be addressed. The acceptance of fishfarmers for hatchery-produced fry has been very slow in spite of evidences to show that growth and survival

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TABLE 1 List of broodstock privatized by the Department of Agriculture.

Location	Rearing facility	Age (years)	No. of stocks	Owner
Alaminos, Pangasinan	Cage	15	35	Pacific Farms, Inc
Masinloc, Zambales	Cage	15	40	Good Fry Hatchery
Tabaco, Albay	Cage	10	50	3 H Corp.
	Cage	10	50	Minarco
	Cage	10	50	Greenwater
Calape, Bohol	Cage	15	30	Dobe International
Sta. Cruz, Davao del Sur	Cage	15	50	AQUASUR Dev. Corp.

TABLE 2 List of milkfish broodstock developed and maintained by the private sector.

Location	Rearing facility	Age (years)	No. of stocks	Owner
Magsaysay, Mindoro Occ.	Pond	4	4,000	JTV Farms
Roxas City, Capiz	Pond	6	190	Sabalo Multipurpose Coop.
San Joaquin, Iloilo	Tanks	5	200	Aloha Hatchery
Sagay, Negros Occ.	Pond	2-4	1,000	Marañon Farms
Pulupandan, Negros Occ.	Pond	6-7	190	Bayshore Aquaculture Inc.
Gen Santos City	Pond	5	3,000	Saranggani Agricultural Co. Inc.

AQD demonstrates ... from p 2

ter 5-7 months of culture using a 0.9 hectare grow-out pond. This is equivalent to 1,800 kg fish per hectare.

Survival rate was 80% and average body weight was about 450 grams per piece. Total feed consumption of grouper during the grow-out period amounted to 5,783 kilograms, or a feed conversion ratio of 3.82. The mean relative growth increment of grouper was 2.04 grams a day per fish.

Economics and costings for a one hectare pond at a stocking rate of 5,000 fish per ha will give an annual net income of ₱223,502.50 with 124% return on investment and a payback period of 0.81 year.

Prior to stocking in the grow-out ponds, grouper fry (~4g) were first held in netcages in the pond (nursery phase) for 30 days.

Milkfish broodstock ... from p 8

of hatchery-produced fry are similar to that of wild-caught fry. Thus, hatchery operators face difficulties in marketing fry despite the fact that they can deliver large numbers of fry. Furthermore, fry produced from the hatcheries should be harvested within 21 to 24 days from hatching, and without buyers, rearing fry for several more days will entail additional operating expenses as well as decreased survival. This further cuts revenue. What may be needed is for the industry to evolve into specialized components such as broodstock development and management for egg production, hatchery operation, and fingerling production. Cohesiveness of these enterprises (such as contract growing schemes) will ensure the continuous artificial propagation of milkfish and the sustainable growth of milkfish aquaculture in the country.

TABLE 3 List of broodstock maintained by the Department of Agriculture.

Location	Rearing facility	Age (years)	No. of stocks
Puerto Princesa, Palawan	Cage	10	20
	Cage	7	120
	Cage	4	140
Naujan, Mindoro Oriental	Pond	2	230
New Washington, Aklan	Pond	2	3,000
Calape, Bohol	Pond	3	200
Bais City, Negros Oriental	Pond	7-8	500
Baliangao, Misamis Occ	Cage	10-12	98

AQD journal publications ... from p 4

Toledo JD, SN Golez, M Doi, RS Bravo, and S Hara. 1996. Preliminary studies on the rearing of the red-spotted grouper *Epinephelus coioides* larvae using copepod nauplii as initial food. UPV J. Nat. Sci. 1: 119-129 ---

One day old red-spotted grouper (*Epinephelus coioides*) larvae from SEAFDEC/AQD, Iloilo, were packed at 3,300 ind/L and transported to Dagupan, Pangasinan for larval rearing. Transport time was about 10 hours. More than 90% of the larvae were active after transport. These were reared in two 7-ton tanks (Tanks 1 and 2) using *Acartia nauplii* and rotifers as initial food and in one 10-ton tank (Tank 3) provided with rotifers only. Feeding incidence at the onset of feeding (Day 3) was higher (90 - 95%) in Tanks 1 and 2 than in Tank 3 (85%). All larvae sampled from Days 4-10 in Tanks 1 and 2 had food in the gut while feeding incidence in Tank 3 was variable (75 - 100%). Larvae in Tanks 1 and 2 showed consistently higher food electivity for *Acartia nauplii* than rotifers. Higher survival rates were observed on Day 13 in tanks provided with copepod nauplii (16 - 18%) than with rotifers only (2%). Average total length on Day 13 was higher in copepod-fed larvae (4.5+0.5 mm) than larvae fed with rotifers only (3.0+0.3 mm). All larvae fed with rotifers alone died on Day 15. A total of 675 larvae were harvested on Day 45 from Tanks 1 and 2. These results indicate the feasibility of transporting one day old *E. coioides* larvae for at least 10 h and of using copepod nauplii as food for the first feeding *E. coioides* larvae.

Rabanal SF, R Azanza, **A Hurtado-Ponce.** 1997. Laboratory Manipulation of *Gracilariopsis bailinae* Zhang et Xia (Gracilariales, Rhodophyta). Botanica Marina 40 (6): 547-556 ---

Carpospore germination, carposporeling development and tetraspore formation were investigated in *Gracilariopsis bailinae* Zhang et Xia by manipulating photoperiod, photon flux density, temperature, salinity and nutrients. Laboratory-generated sporelings attained mean growth rate from 4.05 to 10.31% d(-1) during the first week of incubation. Duncan's multiple range test (DMRT) showed that growth rates were significantly different ($P < 0.05$) between the treatment combinations and between weekly intervals. The optimal condition for growth of sporelings, irrespective of culture age, was attained at treatment combinations of 26 degrees C,11:<(13)over bar> (h. L:(D) over bar) photoperiod, 100 mu Em(-2)s(-1) photon flux density (PFD), 25 mu M NH4Cl: 2.5 mu M K2HPO4 and 25 parts per thousand salinity followed by a treatment combination of 26 degrees C, 11:<(13)over

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