Natural Spawning of Captive Milkfish in Taiwan

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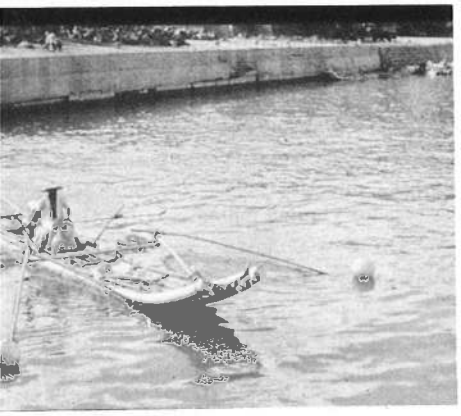
Milkfish culture in Southeast Asian countries, Indonesia, the Philippines and Taiwan in particular, has been an important food source for many years. Fry for stocking have always been collected exclusively from the wild and the fry supply has been dependent upon the natural yearly fluctuations of fry recruitment. The artificial propagation of this species under controlled conditions has been a controversial subject of research in several institutions over the last decade, for example, the Oceanic Institute in Hawaii, Aquaculture Department of the Southeast Asian Fisheries Development Center (SEAFDEC) in the Philippines and Tungkang Marine Laboratory of the Taiwan Fisheries Research Institute, Taiwan.



The old way of collecting milkfish fry is through the motorized raft. Photo courtesy of the Tainan Fish Culture Station, Taiwan.

In the private sector, Mr. Lieh-Tang Lin of Tung Shin Hatchery, Taiwan, has been engaged in propagating several species of finfish, including milkfish. He had been enthusiastically hoping since 1974 that milkfish fry would be produced someday in captivity. Through many years of effort, his goal has finally been realized. The captive milkfish broodstock which he has maintained in ponds for the last ten years began to spawn naturally without any exogenous hormone treatments on 8 April 1984. By the end of June, 52 spawnings had occurred within the same confinement. Lin has suddenly become the major milkfish fry supplier in Taiwan. It is anticipated that half of the fry demands will be produced from his hatchery this year.

Broodstock Maintenance and Husbandry

Since 1975, over 700 milkfish adults of both sexes have been maintained in dirt ponds measuring 750 m^2 and 1,500 m^2 each (30 m x 25 m or 30 m x 50 m). The depth of the ponds ranged between 1.3 m and 1.5 m (Fig. 1) and they were filled with filtered seawater

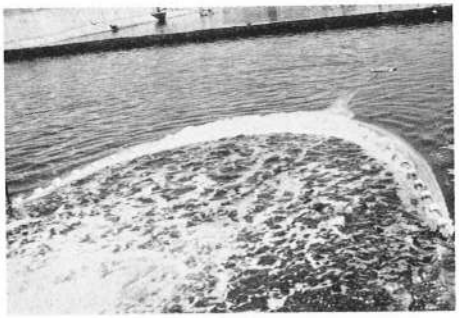


Fig. 1. Dirt pond in which milkfish adults were stocked. Seine-net is installed for egg collection.

which ranged between 29 ppt and 32 ppt salinity. The pond productivity was maintained by blue-green algae maintaining the transparency of at least 20 cm. The pond water was changed when the salinity dropped below 29 ppt or the transparency was less than the limit of 20 cm.

A mixture of rice bran, wheat flour, soybean meal and formulated eel feed was given to the broodstock at the rate of 5% biomass once a day. Occasionally, algae, yeast and vitamins E and B were also given. Ponds stocked with seabass *(Lates calcarifer)* and milkfish were given trash fish once a day in the afternoon. Paddle aerators were installed for aeration and water circulation in the ponds.

Induced Spawning Trials

In 1982 and 1983, ten females at the age of eight years or more (70-80 cm, 5-7 kg) were selected for induced spawning trials. Seven females responded to the hormone treatment and the artificial fertilization of mature oocytes was achieved. A single intramuscular injection of human chorionic gonadotropin (HCG) at the dose of 1.2-1.43 IU/g body weight was given. The mature oocytes were stripped 8-24 hours after the injection (Fig. 2). The total number of eggs stripped from each female ranged between 200 and 800 thousand with 10% to 60%

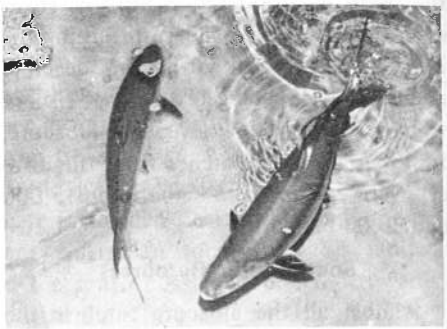


Fig. 2. Courtship behavior of milkfish in a holding tank.

fertilization. The best result in larval rearing survival was 42.76%. The average larval survival was 11.06% in 1982 and 36.9% in 1983.

Among these treated females, one responded exceptionally well and spawned 800,000 eggs naturally in a holding tank (Fig. 3), in which artificial fertilization took place. The hormone was administered at 1600 hr and a distention of the abdomen was observed 4-5 hours later.

Fig. 3. Artificial fertilization.

The female displayed vigorous swimming behavior and the paired males followed eagerly. The eggs were released naturally and fertilized 8 hours after the hormone treatment. Fertilization rate was 55%; hatching rate was 68.2%. Due to unfavorable water quality prevailing in the course of larval rearing, only 1,500 fry were produced from this trial.

Natural Spawning

On 6 October 1983, a natural spawning of milkfish was noticed in the course of a plankton collection in a 750-m^2 dirt pond, in which milkfish adults and seabass were stocked. Although few fertilized eggs were recovered, this incidental observation provided immeasurable encouragement to Mr. Lin, pursuing his long-awaited goal.

Intensive pond preparations were made: pond renovation, pest removal and soil sterilization and enrichment. Next, 30 and 50 milkfish adults were stocked in the 750 m^2 and 1,500 m^2 ponds, respectively. The ages of these breeders were 10 and 11 years.

Finally, an unusual schooling behavior was noticed on 5 April 1984. Fish were moving vigorously along the edge of the pond and were not responsive to feeding. On the morning of 8 April, floating fertilized eggs were found which had developed to the many-celled stage. The eggs were collected by seine-net (Fig. 1): 0.5 million eggs were recovered. The spawning occurred around 3 a.m. and a fertilization rate of 55% was obtained. Hatching began at 9:30 a.m., 9 April and was completed by 3-4 p.m. the same day at a water temperature of 27-29°C and salinity of 34 ppt. A total of 210,000 larvae were hatched and were reared successfully through the fry stage in 22 days. A survival rate of 26.1% (54,800 fry) was obtained in this particular spawning.

Natural spawnings of these milkfish adults continued in the ponds and a total of 56 natural spawnings were recorded by the end of July. More than 57 million eggs were recovered at an average fertilization of 50-60%, with a high of 90% recorded.

A constant chasing courtship behavior was observed during the 2-3 days before spawning took place. Often the school of milkfish adults in the pond segregated into two or three smaller groups. The individuals within each group would interact with one another, displaying their own courtship behavior. Most spawnings occurred between midnight and 3 a.m. Synchronized egg development implied that only a single female among the group spawned each time. Sometimes spawning was also observed during midday. Spawnings were spread over the summer season in Taiwan, peaking during the months of May and June.

The incubation time of fertilized eggs varied with water temperature, 27-32 hours at 29°C and 20.5-22 hours at 31.5°C (Fig. 4).

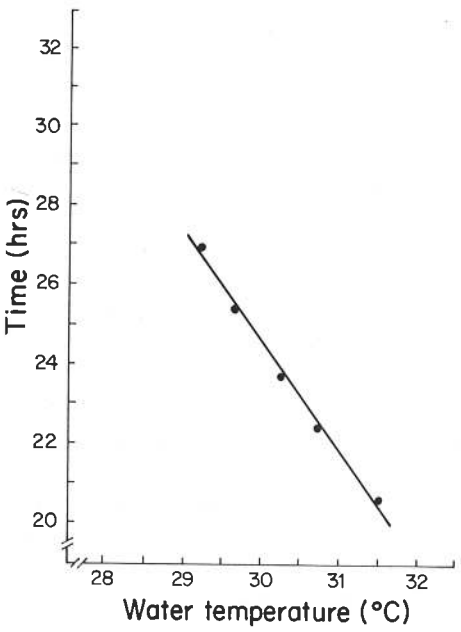


Fig. 4. The relationship between water temperature and time of commencement of hatching. (After Lin 1984)*

Algae *(Chlorella)* and rotifers were established in the hatchery before the larvae were stocked. Fertilized oyster eggs and egg yolk were given from 72 hours onward. In the later phase of larval rearing (10-22 days from hatching), *Chlorella*, rotifers and formulated eel feed were the major sources of larval food (Fig. 5).

Inadequacy of hatchery facilities available to Mr. Lin was a major constraint towards achieving better fry production this year. The hatched larvae were nursed either in the indoor hatchery (Fig. 6)

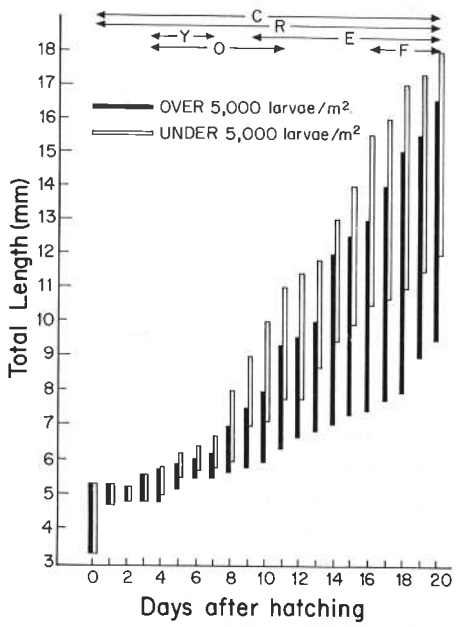


Fig. 5. The growth of milkfish larvae at two stocking densities showing feeding regime. C: *Chlorella;* R: rotifers; E: formulated eel feed; Y: egg yolk; O: fertilized oyster eggs; F: wheat flour. (After Lin 1984)*

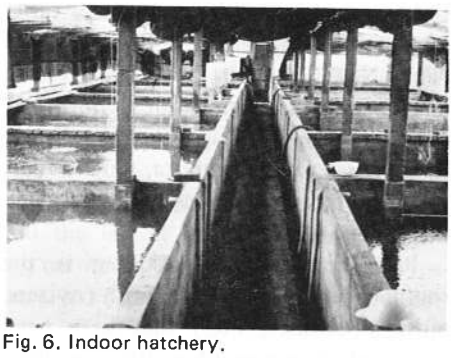


Fig. 6. Indoor hatchery.

or directly in the outdoor dirt ponds, in which the necessary larval food organisms were established prior to stocking. The survival of the larvae indoors ranged between 40 and 50%, and 10 and 20% in the outdoor ponds. From the 56 spawnings, a total of 20 million larvae hatched, from which 3 million fry were produced.

These pioneering accomplishments have been extremely satisfactory and point to the prospect of captive milkfish propagation for the industry in the years to come. ●

*Lin, L.T. 1984. Studies on the induced breeding of milkfish (*Chanos chanos* Forskal) reared in ponds. China Fisheries No. 378: 3-29.