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Indonesia is new SEAFDEC Member

With Indonesia as 8th member, SEAFDEC strengthens its presence in Southeast Asia as it keeps in step with the growth of the fishery industry

The Indonesian government has been officially advised of its admission to SEAFDEC and has been asked to accomplish the instrument of accession for submission to the SEAFDEC Secretariat.

This was announced at the Twenty-ninth Meeting of the Council of the Southeast Asian Fisheries Development Center in Hanoi, Viet Nam on 4-7 March 1997. Indonesia is the eighth member of the official SEAFDEC family. Cambodia has also expressed interest to join SEAFDEC. This expansion has been facilitated by
...to page 10



A hatchery rearing method for the mangrove red snapper

In an AQD paper published in the *Israeli Journal of Aquaculture-Bamidgeh* the growth and survival of the red snapper larvae were studied at different feeding densities and frequencies using the live food *Brachionus*, *Artemia*, and minced trash fish

In 1992, AQD reported the successful spawning of the mangrove red snapper *Lutjanus argentimaculatus* at its Tigbauan Main Station. Since then,

reliable spawning and hatchery techniques have been one of the many research thrusts of AQD. Identified as a high value food fish in Hong Kong,
...to page 2

Inside

Read our ANNOUNCEMENT on page 12 on the merging of our two publications

Use of chemicals in aquaculture, a requested reprint 6

SEAFDEC/AQD News 8

New AQD Proceedings 12

AQD research publications 12

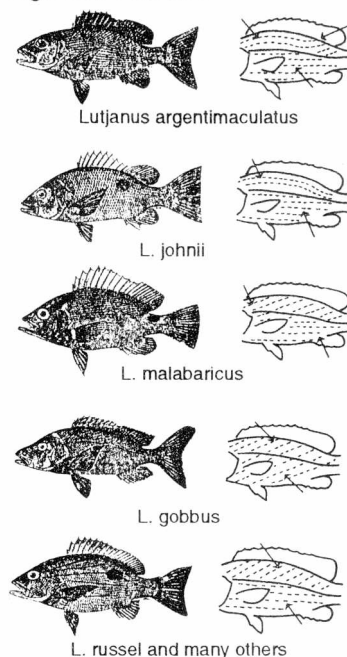
Singapore, and Taiwan, and to some extent Hawaii and the US west coast, the snapper industry needs to address a number of problems before it can meet these demands. These are unreliable seed supply, trial-and-error rearing techniques, limited information on market requirements, and uncompetitive packaging methods.

Market information is not as widespread perhaps because production has not advanced. The Food and Agriculture Organization of the United Nations reported a world aquaculture production to be 18,388 metric tons in 1993 from Hong Kong, Singapore, Malaysia, Brunei Darussalam, Nigeria, and other Asian countries. *Infish International* says that as of 22 April 1997, prices of red snapper (all in US\$) in Singapore are 4.40-4.80/kg for whole, chilled; primary wholesale in New York, USA is 2.75-3.50/lb, chilled, fillet, eviscerated; in Miami, USA it is 2.35-4.55/lb whole, gutted, chilled; in Tokyo, Japan it is 7.93-18.26/kg whole, shatterpack; and in France it is 4.70-5.20/lb fillet, skin-on, individually quick frozen (IQF). These markets are good

prospects year round provided importers are assured of reliable and regular shipments.

The red snapper, *Lutjanus argentimaculatus* (Forsskal, 1775), is distributed in the Indo-West Pacific from Samoa and the Line Islands to East Africa, and from Australia northward to Ryukyu Island, Japan. It is a marine species also occurring in brackish estuaries and the lower reaches of freshwater streams. The red snapper migrates offshore to deeper reef areas, sometimes penetrating to depths in excess of 100 meters. The head profile is straight or slightly convex. The young and adult have pairs of strong canines on the upper jaw. Another identification key to the species in the Lutjanids is the arrangement of the scale rows. In *L. argentimaculatus*, the scale rows above the lateral line run parallel to the dorsal profile over most of their length and rise obliquely under the soft part of the dorsal fin which is in contrast to those of the other lutjanids (right). The red snapper grows to 80-120 centimeters long. In recent years, coastal net cage culture has been developing using wild

juveniles to meet the demand for live and high class fishes.



These illustration and part description are from Biology and Culture of the Red Snapper, *Lutjanus argentimaculatus* by Masanori Doi and Tanin Singhagriwan. 1993. The Eastern Marine Fisheries Development Center, Department of Fisheries, Ministry of Agriculture and Cooperatives, Thailand.

Snappers are highly valued food fish in tropical and subtropical countries. In Thailand, snappers are cultured in floating net cages and ponds as alternate to sea bass and shrimps. It is necessary to develop a seed production technology for the snappers in anticipation of an increased demand for juveniles.

Attempts to rear other species of snappers had limited success. Larval rearing of the mangrove red snapper, *L. argentimaculatus*, using *Brachionus*, *Artemia*, *Moina* and minced fish as food had low and variable survival rates as shown by some studies abroad. Early attempts to rear red snapper larvae at

the SEAFDEC Aquaculture Department were not successful.

This paper by M.N. Duray, L.G. Alpasan, and C.B. Estudillo, published in the *Israeli Journal of Aquaculture-Bamidgeh* 48(3), 123-132, 1996 describes the results of later work at the SEAFDEC AQD to develop a hatchery rearing method for the mangrove red snapper. The effects of small-sized *Brachionus* and *Artemia* nauplii at different feeding frequency and density on the growth and survival of the red snapper larvae are highlighted.

Spawning and incubation

Fertilized eggs were obtained from hormone-treated broodstock (3.6-4.3

kg) in cages at Igang, Guimaras Island. The fish were induced to spawn with a single injection of luteinizing hormone-releasing hormone analog (LHRHa) at 100 µg/kg body weight. After injection, a male-female pair was placed in a hapa net cage and allowed to spawn naturally. The hapa net was slowly raised to gather the eggs which were then scooped out.

The eggs were transported to the Tigbauan Main Station hatchery in oxygenated double plastic bags at about 300,000 eggs in 10-l sea water. Each bag of eggs was incubated in 400-l circular fiberglass tanks with water at 35 ppt salinity and 26-27°C and constant aeration. Egg samples were

collected with a PVC pipe from five sections of the tank. The fertilization rate was 95%, and 62% (± 14.8) were viable eggs. Aeration was stopped for a few minutes, dead eggs were allowed to settle and then siphoned out. Fresh sea water was allowed to flow through for 15 min. Hatching occurred 16 hours after fertilization with a mean hatching rate of 57.5% (± 6.2) and 65.2% (± 12.4) viable larvae.

Culture of natural food

The green alga, *Chlorella virginica*, was cultured in 27 t circular concrete tanks. When the algal population reached a density of at least 10×10^6 cells/ml, *Brachionus* (S-type, local Sapien, Capiz strain) were placed into the tanks at 20-50 individuals per ml. After 5-6 days, when the density was ≥ 120 per ml, the *Brachionus* was harvested using a 42 μ m mesh plankton bag. Some of the harvested *Brachionus* was screened through 90 μ m plankton netting material and used in the first feeding experiment.

Larval rearing

Newly hatched larvae were reared indoors in six 3 t conico-circular concrete tanks and six 500-l fiberglass tanks for 21-24 days at a stocking density of 30 larvae/l. The water temperature was 25.5-28.7°C, the dissolved oxygen was 5.6-6.9 ppm and the salinity was 35 ppt. Twenty larvae were collected from the 3-ton tanks every three days for length measurement. For gut content analysis, 10 larvae were sampled an hour after the addition of the food, daily until day 15, and every three days till day 35. Larvae from the 500-l tanks were harvested on day 21 and restocked in 200-l tanks for feeding experiments. Those reared in 3 t tanks were harvested on day 24 and restocked at 1-3 larvae/l in nine 3 t tanks until day 55. Larvae were sampled every three

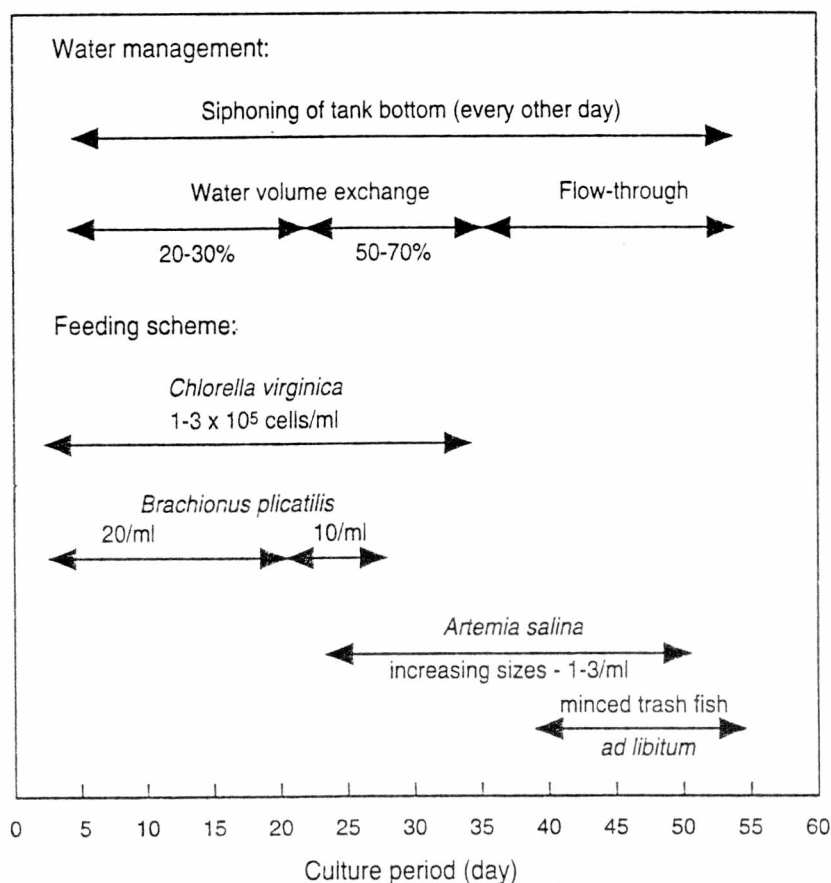
days until day 35 and every five days thereafter.

The water management and feeding scheme is shown below. Starting on day 3, the rearing water was partially exchanged daily with fresh filtered sea water to maintain good water quality. Debris, feces, and dead fish were siphoned off the tank bottom every other day. Tanks were mildly aerated throughout the rearing period.

Brachionus plicatilis were introduced on day 2 and maintained at a density of 20/ml until day 21, together with the

addition of newly hatched *Artemia* nauplii. On day 25, the *Artemia* nauplii were replaced by HUFA-enriched (highly unsaturated fatty acid-enriched) instar II *Artemia* to day 30. Enrichment was for 12 hours using self-emulsifying lipid concentrate SELCO (Artemia Systems). *Chlorella* was added daily at $1-3 \times 10^5$ cells/ml as food for the *Brachionus* and as a water conditioner. Increasing sizes of *Artemia* were given at 1-3/ml every day until day 50. On day 40, larvae were gradually weaned to minced fish.

...to page 4



Water management and feeding scheme during larvae rearing of the mangrove red snapper.

Previous larval rearing attempts

Early attempts to rear larval red snapper to metamorphosis had limited success with survival rates ranging from zero to 43.4% on days 15 or 21. In 1993, Doi and Singhgraiwan reported a negative correlation between initial stocking density and number of harvested fry. The high mortality during the first week of this experiment agree with the observation of Doi and others. This was attributed to the poor feeding habits of red snapper larvae. Compared with rabbitfish, milkfish, and grouper, it was observed that the red snapper consumed almost all their inherent nutritional source at the onset of feeding compared to the former three species. Thus, red snapper larvae are more vulnerable to starvation during this critical feeding period. Low larvae survival could also be due to larvae quality, attributable to the broodstock, as reflected by the percentage of viable eggs and larvae reported above.

Cannibalism

Cannibalism is probably one of the causes of low survival during the second phase of rearing. Missing fish in the tanks were assumed to have been cannibalized when no dead fish were siphoned out. Size differences were observed. Sorting should have been done to minimize cannibalism as behavioral factors contribute to cannibalism among fish larvae.

Previous trials of red snapper rearing included feeding of small crustaceans (copepods) and *Moina*, different or mixed phytoplankton species, as well as earlier introduction of *Artemia* nauplii. Larvae survival rates attained in 3 t tanks in this study with *Brachionus* only for 21 days were comparable with those obtained by other researchers who used copepod and *Brachionus* together. Phytoplankton in rearing tanks improved growth and survival of



Researchers at AQD working on red snapper seed production: Considered a high value food fish in tropical and subtropical countries, a seed production technology for snappers must be developed to address the demand for its juveniles for stocking.

many marine fish larvae. Larvae benefit nutritionally either from a change in the composition of *Brachionus* or from partially digested algae in the guts of *Brachionus*.

Use of *Brachionus*

Although *Brachionus* are considered to be the most suitable food organisms for fish larvae, their size is critical for the survival of these small-mouthed larvae. The mouth width of first-feeding red snapper is about 191-200 μm yet the larvae prefer much smaller prey (<105 μm). Prey size selection was also observed in sea bass, rabbitfish and milkfish larvae. Larvae of these three species had prey sizes which were about 20-80% of their mouth width. For anchovy larvae, it had a 76% prey width to mouth width ratio and observed that the prey were eaten "end first." Duray and Kohno in 1990 believed that the size threshold of prey ingested by the

larvae is not only a function of larvae length or mouth width but to some extent is also affected by the density of food available. Although *Brachionus* was screened using 90 μm plankton netting material, *Brachionus* in the gut during the first 14 days of culture ranged from 62 to 166 μm , indicating that excess *Brachionus* in the tank grew or multiplied and were ingested by the larvae the following day. The same observation was reported by other researchers. In the absence of super-small (SS) strain *Brachionus*, screening of S-*Brachionus* cultures (Sapian strain) at SEAFDEC/AQD was necessary. Using screened *Brachionus*, survival of red snapper improved at day 14, similar to the results of other researchers. However, Doi and his companions in 1991 found no beneficial effect of screened *Brachionus* for grouper larvae but obtained good survival with SS-*Brachionus*. Growth of

the larvae was not enhanced using screened *Brachionus* until day 14.

Although a higher rate of *Brachionus* feeding was observed as larvae grew, it could not quantitatively sustain growth. Sequencing of small and then bigger *Brachionus* during the first two weeks of rearing should be done since this feeding regime has been found to be effective in rearing gilthead seabream larvae. On the other hand, Duray (unpublished) obtained better growth and survival of red snapper larvae fed *Brachionus* supplemented with artificial diets than those fed only *Brachionus* during the first 14 days of culture.

Artemia feeding

Like *Brachionus*, *Artemia* is important in rearing marine fish larvae. Earlier workers used *Artemia* nauplii starting on day 10 or 15. In the present study, very few day 15 larvae ingested *Artemia* nauplii. To improve utilization and save costs, feeding with *Artemia* started when larvae were ≥ 6.0 mm, around day 21. Perhaps the other workers used a brand of *Artemia* that produced smaller nauplii than that used in this study, or their larvae were larger on day 15, such that earlier feeding with *Artemia* was feasible. *Artemia* is believed to contain certain metamorphosis-enhancing substances. Metamorphosis is a sensitive, difficult stage of larvae development. If metamorphosis can be accelerated through manipulation of the nutrient value of the larval food, like *Artemia*, survival might be improved and the hatchery operation might be shortened.

Growth of snapper larvae increased with the *Artemia* feeding level. Survival was inversely related to the feeding level, suggesting that *Artemia* is not very suitable for red snapper larvae, or that high *Artemia* density adversely affects water quality as has been reported in other fish larvae. But since at present, *Artemia* nauplii can be

supplied consistently and at the appropriate density for mass fry production, it is still being used in hatcheries. The nutritive value of *Artemia* may be enhanced by feeding them a high HUFA diet prior to feeding them to the larvae. Otherwise the live food has to be supplemented by an artificial diet. Although HUFA-enriched instar II *Artemia* were given for six days, the duration of the enriched *Artemia* feeding should be determined for effective utilization. On-grown *Artemia*, known to contain a high level of protein, may also need to be enriched with high HUFA to meet the larval requirement for n-3 fatty acids.

Feeding frequency

Feeding larvae with *Artemia* at 2/ml once a day produced longer and heavier larvae but, in terms of survival, four times a day produced the best result. Frequent feeding led to more efficient utilization of feed, better feed conversion, and reduced variation in water quality. However, because of higher larvae density in the tank at four times a day feeding, larval growth was affected. Snapper larvae may be fed a higher daily ration of *Artemia* (2-3/ml) if the ration is given in smaller amounts several times a day.

Experimental results showed that snapper larvae survived better in bigger (3 t conico-circular concrete) tanks. Survival improved with the use of small *Brachionus* during the first two weeks of culture. Increasing the *Artemia* feeding level and frequency (2/3 ml at four times a day) promises to improve growth and survival to harvest. Enriching on-grown *Artemia* with high HUFA feed before feeding them to snapper larvae should be done in the future.

NETWORKING

AQD in a consortium for community-based resource management

Making sure of sustainability

The much needed shot-in-the-arm for the development of rural based community resource management has been strengthened with the signing of a Memorandum of Understanding among leading institutions concerned with marine resources management. AQD Chief Rolando R. Platon signed on 8 January 1997 a Memorandum of Understanding between SEAFDEC, the International Center for Living Aquatic Resources Management (ICLARM), the SEAMEO Regional Center for Graduate study and Research in Agriculture (SEARCA), and the Tambuyong Development Center (TDC), a local NGO concerned with the protection of marine resources and welfare of local communities.

The agreement will assist in the improvement of coastal resources and quality of life of coastal residents. AQD will spearhead the dissemination and transfer of appropriate aquaculture technologies to Palawan-based institutions. The first activity is an aquasilviculture activity to demonstrate crab fattening in mangrove swamps while preserving the mangroves.

Other signatories to the agreement were: Dr. Meryl Williams, Director-general of ICLARM, Dr. Percy Sajise, Director of SEARCA, and Prof. Carlito Añonuevo, Executive Director of TDC.

It is envisioned that if the pilot project is successful in Palawan, a similar co-management scheme will be done in Viet Nam.