KEMENTERIAN
KELAUTAN DAN
PERIKANAN

PRODUKSI BENIH IKAN KAKAP MERAH BAKAU/ MANGROVE JACK

(Lutjanus argentimaculatus)

KEMENTERIAN KELAUTAN DAN PERIKANAN
DIREKTORAT JENDERAL PERIKANAN BUDI DAYA
BALAI PERIKANAN BUDIDAYA AIR PAYAU SITUBONDO

BUDIDAYA IKAN KAKAP MERAH BAKAU/*MANGROVE JACK*
(*Lutjanus argentimaculatus)*
DI BALAI PERIKANAN BUDIDAYA AIR PAYAU (BPBAP) SITUBONDO

A. Pengenalan Ikan Kakap Merah Bakau

Ikan Mangrove jack atau *Mangrove red snapper* dikenal sebagai ikan kakap merah bakau, banyak dijual sebagai ikan konsumsi maupun ikan hias karena corak tubuhnya yang cukup menarik. Harga jual untuk ikan kakap merah bakau sebagai ikan hias dibanderol dengan nilai Rp.5.000,- sampai Rp.6.000,- per sentimeter, sedangkan untuk ukuran konsumsi mencapai Rp.75.000,- sampai Rp 100.000,- per kilogram. Namun sampai saat ini ketersediaan ikan kakap merah bakau dipasaran masih berasal dari tangkapan alam. BPBAP Situbondo sebagai Unit Pelaksana Teknis dari Direktorat Jenderal Perikanan Budidaya, Kementerian Kelautan dan Perikanan mencoba merintis budidaya ikan kakap merah bakau sejak tahun 2021.

B. Pemeliharaan Induk dan Calon Induk di BPBAP Situbondo

Sejumlah 82 ekor calon induk dengan berat rata-rata 0,8 Kg telah didomestikasi pada Bulan Mei Tahun 2021. Calon induk dipelihara dan diberikan pakan yang mengandung protein tinggi dan kadar lemak rendah seperti ikan layang, selar/kembung dan cumi cumi dengan prosentase pakan 3-5% bobot biomass setiap 2 hari sekali. Secara periodik setiap satu kali dalam semingu dilakukan pemberian multivitamin dan vitamin E yang berguna untuk memacu perkembangan gonad. Pada bulan September 2023 induk tersebut telah berhasil memijah untuk pertama kali (ukuran induk mencapai 3-4 Kg). Sejak saat itu kegiatan pembenihan mulai dirintis dengan mengadopsi teknik pembenihan ikan kakap putih yang telah dikuasai. Benih ikan kakap merah bakau telah mampu dihasilkan pada bulan Januari 2023. Saat ini stok induk yang ada di BPBAP Situbondo sebanyak 50 ekor yang siap pijah. Untuk generasi berikutnya telah disiapkan calon induk sebanyak 65 ekor dengan berat 0,8 Kg.

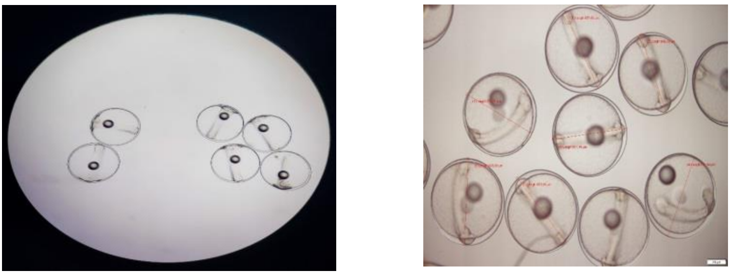
C. Teknik Pemijahan dan koleksi telur

Sampai saat ini pemijahan ikan kakap merah bakau masih dilakukan secara alami, dimana induk jantan dan betina sebanyak 50 ekor dengan rasio 1:1 digabung dalam satu wadah berupa bak sirkular berdiameter 10 m dan kedalaman 3 m. Telur hasil pemijahan yang bersifat mengapung akan keluar dari bak induk dan tertampung dalam satu wadah berupa kolektor telur yang telah disiapkan. Frekuensi pemijahan berlangsung antara 2-7 hari per bulan dengan jumlah telur berkisar antara 200.000 - 2.000.000 butir untuk setiap pemijahan mulai September 2023.

A B

Gambar 1. Denah bak induk kakap merah bakau (A) dan bak kolektor telur (B)

Telur kakap merah bakau yang telah dibuahi berbentuk bulat, transparan dan bersifat pelagis, berdiameter 0,74 - 0,81 mm. Memiliki ruang previtaline sempit, korion bening, kuning telur homogen dan tidak tersegmentasi, serta terdapat gumpalan minyak (*Oil globule*) tunggal (diameter 0,14 - 0,16 mm) pada kutub vegetal. Telur menetas pada suhu 25,8-28,7 ^{O}C dalam waktu 16-22 jam setelah pembuahan. Larva yang baru menetas berukuran panjang total 1,62 - 1,94 mm. Larvanya memiliki kantung kuning telur yang memanjang dari belakang ke arah moncongnya. Kantung kuning telur terserap seluruhnya 66-90 jam setelah menetas, saat mulut dan mata mulai terbuka (Leu, Chen and Fang, 2003).



Gambar 2. Telur Ikan Kakap Merah Bakau dalam kolektor Telur di Bak Pemijahan BPBAP Situbondo

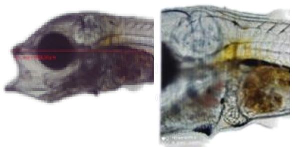
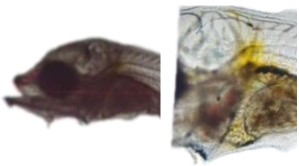
D. Pemeliharaan Larva Ikan Kakap Merah Bakau di BPBAP Situbondo

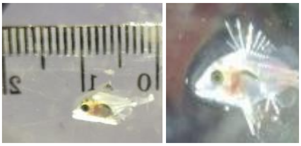
Telur yang telah dibuahi ditebar dalam bak yang berisi air laut dengan padat tebar 15-20 butir per liter. Derajat penetasan dihitung sehari setelah penebaran. Nilai *hatching rate* berkisar antara 33,0-92,0%. Seperti pada larva ikan laut umumnya, Pakan rotifera *Brachionus rotundiformis* (10-20 ind/ml) sebagai pakan hidup diberikan pada usia dua hari beserta penambahan Chlorella

(100.000-500.000 sel/ml) sebagai pakan untuk rotifer. Rotifer yang digunakan merupakan tipe SS (*super small*) yang memiliki ukuran paling kecil (Wullur, 2017). Pemberian pakan tipe SS berlangsung hingga umur 8 hari, selanjutnya diberikan ukuran yang lebih besar. Pakan cair diberikan dengan dosis 0,5 ppm mulai D6-D15. Pakan buatan protein tinggi (48%) diberikan pada D10 dimulai dari ukuran yang paling kecil berbentuk *powder*. Sedangkan artemia diberikan pada umur 18 hari setelah menetas.

Perkembangan larva kakap merah bakau terlihat kuning telur memanjang dari belakang ke depan pada larva yang baru menetas. Saat larva berusia 6 hari terlihat adanya 2 bintik hitam. Pada usia 15 hari anus teramati mulai memendek. Anus memendek secara sempurna pada umur 20 hari pemeliharaan. Pada saat itu pula duri sirip punggung dan perut mulai memanjang dan mampu mengembang dengan sempurna. Saat usia 34 hari telah tampak corak garis kehitaman namun belum terlalu jelas. Corak garis hitam dan putih dibagian sisi tubuhnya telah jelas terlihat pada usia 39 hari dan sudah tidak kanibal.

Umur	Gambar	Keterangan
D1		Panjang 3043,80 µm Kuning telur memanjang dari belakang kedepan Belum diberikan pakan
D6		Panjang 3127,86 µm Secara manual terlihat ada 2 bintik hitam Pakan rotifer SS Type, Pakan

		cair 0,5 ppm
D7		Panjang 3276,13 µm Pakan rotifer SS Type sampai D8 Pakan cair 0,5 ppm
D10		Panjang 3936,26 µm Pakan rotifer, pakan cair dan rotofier
D11		Panjang 4250,56 µm Pakan rotifer, pakan cair dan rotofier
D15		Panjang 4033,34µm Anus mulai memendek
D20		Panjang 5589,74µm Sirip punggung dan sirip renang mulai memanjang dan terlihat mekar

D26		Panjang 1,2 cm Pakan rotifer, dan rotofier
D34		Panjang 1,2- 2,5 cm Mulai terlihat corak garis-garis tetapi masih belum jelas
D39		Panjang 1,7-3 cm Corak garis-garis semakin jelas Berwarna hitam putih, Sirip mulai terbentuk, Sudah tidak kanibal

Sumber : Sriwahyuningsih, 2024 (*unpublish)*

Gambar 3. Perkembangan Larva Kakap Merah Bakau

Benih kakap merah bakau ukuran 3-5 cm telah mampu dihasilkan dengan masa pemeliharaan sekitar 60-80 hari. Penampakan tubuhnya sangat menarik dengan corak garis hitam dan putih sehingga kecantikan ikan ini menjadikannya masuk dalam kategori jenis ikan hias pada ukuran benih (<10 cm). Ketika usia dewasa, ikan ini juga termasuk dalam kategori ikan konsumsi. Kecepatan renangnya teramati lebih gesit dibandingkan ikan kakap putih terutama saat pemberian pakan.

Nilai sintasan yang diperoleh pada masa pembenihan berkisar antara 0,11-2,77%. Rendahnya nilai sintasan ini disebabkan tingkat kematian yang terjadi pada masa kritis yaitu usia 3-5 hari saat transisi pemanfaatan pakan endogenus ke pakan exogenous. Titik kritis berikutnya terjadi pada hari ke 18-20 saat kemunculan duri sirip punggung yang memanjang (Bonlipatanon, 1998 dan Emata et.al., 1994). Uji coba yang dilakukan pada tiga hatchery di BPBAP Situbondo sampai dengan saat ini telah menghasilkan benih berukuran 3-10 cm sebanyak 5.751 ekor dalam 2 siklus yang berbeda. Sedangkan pemeliharaan benih hingga ukuran konsumsi masih berjalan sampai saat ini.

Selama pemeliharaan benih ikan kakap merah bakau menuju ukuran konsumsi, benih diberi pakan berupa pakan komersil yang ukurannya disesuaikan dengan bukaan mulutnya. Pemeliharaan benih menggunakan sistem air mengalir dan pembersihan/sipon dasar bak pemeliharan dilakukan tiap hari. Benih ikan kakap merah bakau dapat dipelihara dalam bak dengan media air tawar, payau, maupun air laut. Saat ini di BPBAP Situbondo sedang dilakukan uji coba pemeliharaan benih ikan kakap merah bakau dengan salinitas yang berbeda, yaitu pemeliharaan benih dengan air tawar dan pemeliharaan benih dengan air asin/laut. Benih ikan kakap merah bakau berukuran 7-8 cm dipelihara dengan media air tawar dan ukuran 6-7 cm dipelihara dengan media air laut, dengan pakan yang diberikan adalah pakan segar/rucah

A.

B.

C.

Gambar 4. Benih Ikan Kakap Merah Bakau di Hatchery BPBAP Situbondo
A. (Ukuran 4-5 cm)
B. dan C. (Ukuran 6-7 cm)

Pemasaran benih untuk saat ini masih di sekitar Situbondo dengan harga Rp.1.000/cm. Akan tetapi karena ikan kakap merah bakau bisa dipelihara di air tawar beberapa pedagang menjualnya sebagai ikan hias dan dengan harga yang relatif tinggi yaitu Rp.5000 - 6000/cm meskipun segmen untuk ikan hias sangat kecil. Sementara untuk harga konsumsi ikan kakap merah bakau (minimal 500 gram) dipasaran berkisar Rp.75.000 - 100.000/Kg.

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SEAFDEC Asian Aquaculture

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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

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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,

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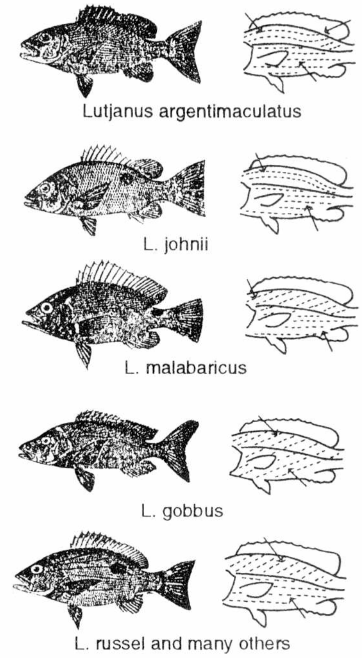
Singapore, and Taiwan, and to some extent Hawaii and the US west coast, the snapper industry needs to address a number of problems before it can meet these demands. These are unreliable seed supply, trial-and-error rearing techniques, limited information on market requirements, and uncompetitive packaging 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. *Infofish 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 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 Singhagraiwan. 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 $10x10^6$ cells/ml, *Brachionus* (S-type, local Sapian, 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 µm mesh plankton bag. Some of the harvested *Brachionus* was screened through 90 µm 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 $1\text{-}3 \times 10^5$ 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.

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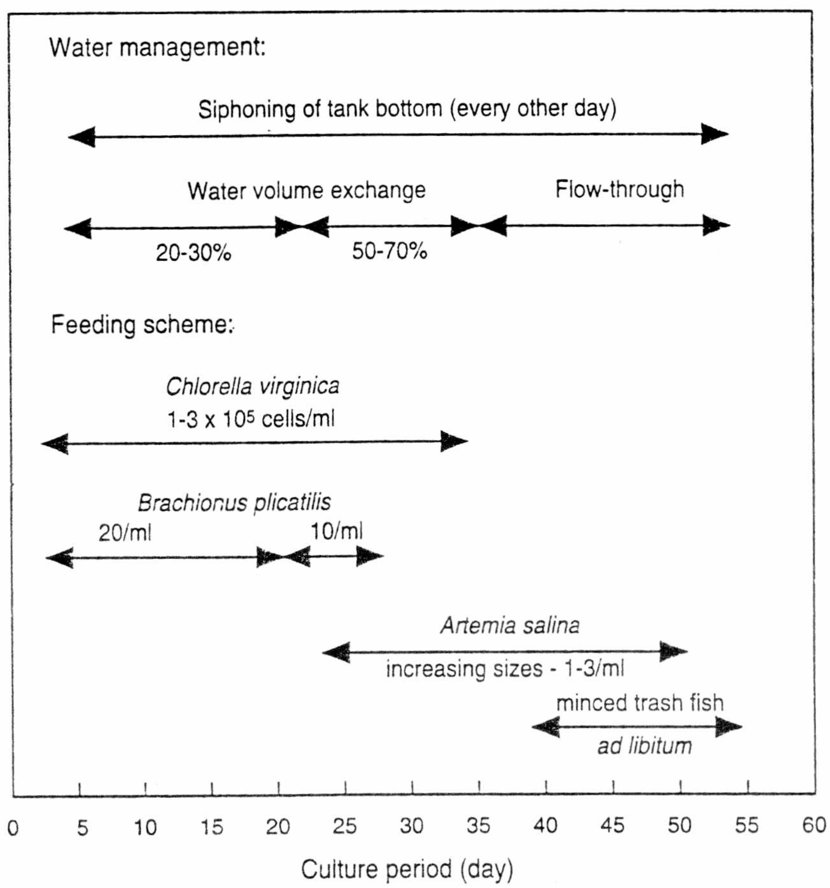

Water management and feeding scheme during larvae rearing of the mangrove red snapper.

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 Singhagraiwan 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.

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.

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 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 appropraté 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 aquisilviculture 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.