Southeast Asian Fisheries Development Center **Aquaculture Department**

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Research and development at SEAFDEC/AQD

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Research and development at SEAFDEC/AQD

The mandate of academic institutions is basic research, or that which pursues knowledge for knowledge's sake. SEAFDEC/AQD is a research and development institution that caters to the aquaculture industry in the region, and hence should pursue applied research.

The technologies developed by SEAFDEC/AQD must take into consideration sustainable development of the region's aquatic resources. In doing so, a multidisciplinary approach is necessary. The natural scientists working with the social scientists and the fisherfolk open many venues for investigation of a problem viewed from different perspectives. The participation of fisherfolk in particular allows them access and understanding of the technologies developed, they who are the traditional users of aquatic resources and who are most affected when the environment is sacrificed for the sake of progress.

SEAFDEC/AQD must help make aquaculture sustainable.

- Dr. Efren Ed. C. Flores, Chief, SEAFDEC/AQD (1992-present)

AQD's 20 years of R & D

The SEAFDEC Aquaculture Department, established in 1973, has had 20 years of research and development. It has contributed substantially to the rapid expansion of the giant tiger shrimp industry in the Philippines, through technologies for broodstock development, hatchery and nursery operations, and pond culture, disease prevention and control in hatcheries and ponds, and in feed development for various life stages.

SEAFDEC/AQD made advances in milkfish culture. Existing grow-out technology was refined. Milkfish has been bred in captivity. The techniques developed in artificial propagation and seed production enabled the Philippine Government to launch a milkfish breeding program in the country in 1980-1992. Feeds were also developed for milkfish broodstock, larvae, and juveniles. Milkfish ecology was documented.

As with milkfish, spontaneous spawning of grouper, hormone-induced spawning of red snapper, and improved spawning, hatchery and nursery techniques for sea bass are expected to solve the problem of fry supply.

Tilapia research has shifted to genetics and to the nutritional requirements of fry and fingerlings. Carp and catfish research include induced spawning and seed production.

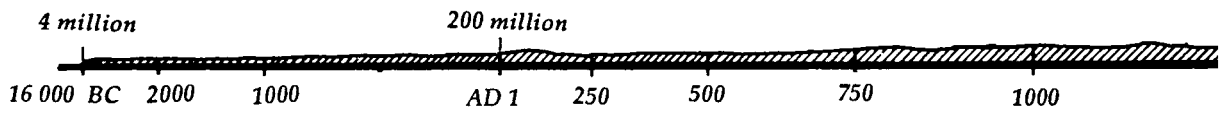
SEAFDEC/AQD's contributions to the development of the aquaculture industry in the region include the many bits and pieces of laboratory findings that filled up the knowledge gaps in:

- **small-scale hatchery technology for shrimps**
- **nursery and pond culture of shrimp and milkfish**
- **culture of oysters and mussels**
- **culture of tilapia**
- **pen culture of milkfish**
- **disease and pollution control**
- **feeds and feeding methods**
- **identification of seaweed species for culture**

As a result, the aquaculture industry has developed significantly and total production has increased.

The impact of aquaculture on the environment and the cost-effectiveness of developed technologies have recently been the concern of AQD. More studies are planned for ecologically sound aquaculture.

More precisely, SEAFDEC/AQD's transferable technologies — those that can be picked up by the private sector — are reflected in the training courses it has conducted on:



- shrimp hatchery and nursery operations
- marine fish hatchery (including milkfish and sea bass)
- fish health management
- fish nutrition
- brackishwater pond culture
- aquaculture management, methodology, and engineering
- sanitation and culture of tropical bivalves
- freshwater fish hatchery
- freshwater aquaculture
- culture of natural food organisms (including *Artemia* culture)

Or that which have been written up as manuals and pamphlets or produced as video programs, including:

- farming of tiger shrimp, sea bass, tilapia, and molluscs
- broodstock management for tiger shrimp, milkfish, and carps
- hatchery of tiger shrimp, sea bass, milkfish, and tilapia
- diseases and its control for tiger shrimp
- feeds and feeding tiger shrimp
- biology and taxonomy of siganids, milkfish, seaweeds, sea bass, and tiger shrimp
- culture and use of algae
- soil and water quality determination, feed analysis

Accomplishments in seafarming

The species prioritized for seafarming and sea ranching research at AQD are grouper, milkfish, snapper, sea bass, mullet, rabbitfish, the marine shrimps, oysters and mussels, and seaweeds. Emphasis is on (1) the improvement of seed production and nursery culture techniques; (2) technology verification and refinement; and (3) practical feed development. The economics of culture systems and the socioeco-

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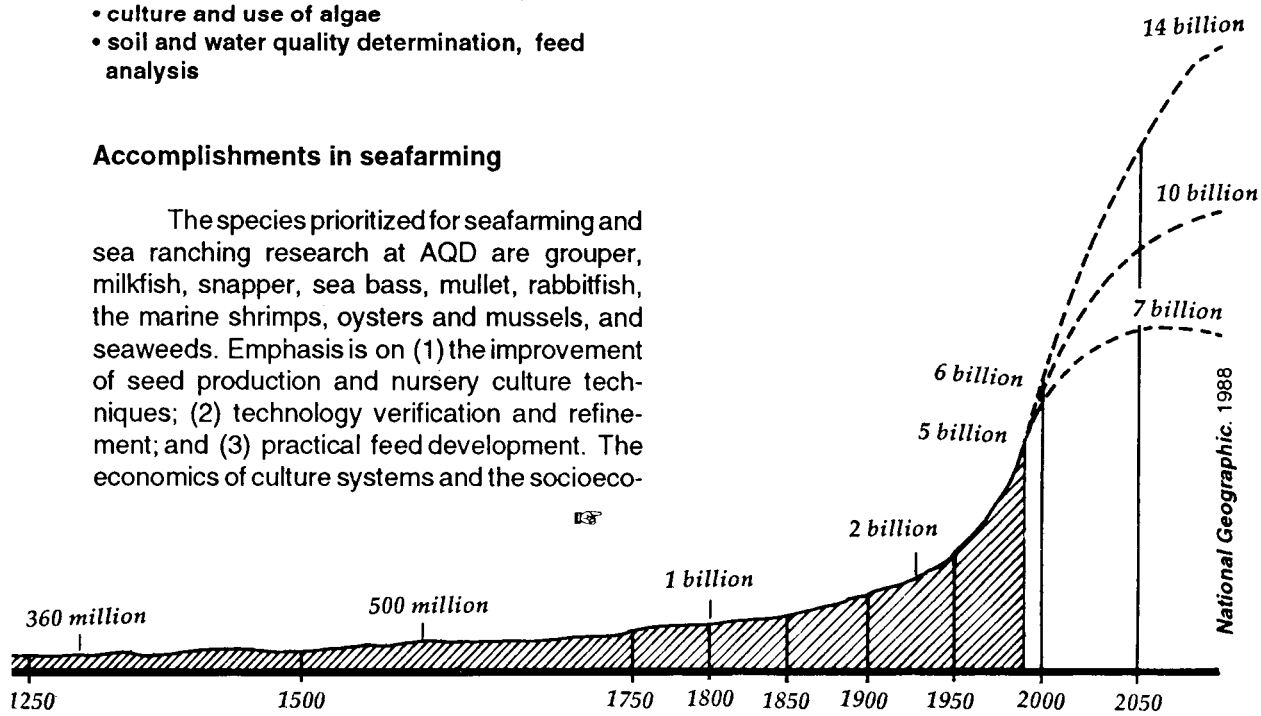
Too many mouths to feed

The 5 billion human beings alive today probably represent 6-7% of all who have lived in our species' 350 000 to 100 000 - year genealogy. As infant and childhood survival rates improve with public health, growing numbers reach childbearing age; life expectancies also increase. The doubling period for world population has shortened from centuries to mere decades. Three ranges (below) project the size of the future population — and the need for more and more food.

Fish is one of the cheapest protein sources for human consumption being studied in research institutions across the world. In the Philippines, institutions such as the SEAFDEC Aquaculture Department, the International Center for Living Aquatic Resources Management, the Department of Agriculture, and the University of the Philippines are involved in fisheries and aquaculture R & D, and are expected to find ways to produce more food for even just the country's 65 million people.



nomic status of coastal communities are also studied. Research on freshwater fishes now concentrate on genetic improvement, breeding, feed development, and the effects of aquaculture on the freshwater environment.

As a pilot study, an integrated sea-farming and sea ranching project has been set up in Malalison Island off western Panay. The project seeks to show the effectiveness of participatory research involving the fisherfolk in making aquaculture sustainable. To date, biological studies and test farming have been conducted. The results obtained in 1992-93 are given below. These results are unpublished and must not be cited without the authors' permission.

The Case of Malalison Island

Community-based management of fishery resources in Malalison Island was studied by Giselle Samonte. Low fish catch and poverty were identified by the Malalison residents as the priority issues that need to be addressed. Management techniques suggested by Malalison fishers include prohibitions on illegal fishing (muro-ami and dynamite), setting seasonal exploitation limits, public education on resource conservation, and alternative livelihood.

The traditional marine boundaries and territorial use rights in fisheries in Malalison Island were investigated by sociologist Susan Siar. Aside from Malalison fishers, traditional users of fishing grounds around Malalison come

World Aquaculture in the '90s

- **About 152 species of algae, fish, crustaceans, molluscs and other aquatic animals are under some form of culture.**
- **Production continues to be dominated by 20 countries (China is number one), and 12 of these are Asian (including the Philippines)**
- **The value of global production is about US$19 billion (capture fisheries is valued at US$73 billion).**
- **Production in the marine environment is almost entirely molluscs and algae, whereas freshwater production is almost entirely fish.**
- **Aquaculture, like agriculture, relies on a small number of crops like salmon and seaweeds for the greater part of its total production.**

Source: ***World Aquaculture*** Vol. 21 (No. 2), June 1990.

What is aquaculture?

AQUACULTURE is the farming of aquatic organisms -- fishes, molluscs, crustaceans and aquatic plants. Farming implies some form of intervention to enhance production -- regular stocking, feeding, protection from predators -- and individual or corporate ownership of the stock being farmed. Categories: inland aquaculture (or freshwater culture) and coastal aquaculture.

COASTAL AQUACULTURE means farming and harvest of stock in brackish or seawater including offshore activities, coastal ponds, and onshore tanks supplied with brackishwater or full-strength seawater. This includes species that spend part of their life cycle in freshwater.

Source: ***Regional Workshop on Fisheries Information and Statistics in Asia.*** Bangkok, Thailand, 8-12 Jan 1994. FAO/SEAFDEC.

from 12 of 16 coastal barangays of Culasi, including the nearby island of Batbatan. These fishing grounds possess the characteristics of open access, communal, and state property. There is no claim or ownership of specific fishing spots. Certain arrangements are observed for setting up gears. The accepted practice of "first come" determines allocation of fishing space for hook and line. Fishing nets are usually set about 50 meters apart.

The economic utilization of resources in Malalison Island was determined by Rene Agbayani. A village transect enumerating and depicting the location of water- and land-based resources was completed along with a survey of the income and expenses of 35 fishermen using different gears. The coastal resources are the main sources of income for 90% of the households. Land-based activities, that is, fish selling, net mending, and boat making, are also fishery-related. There are also households that raise pigs and chicken for market. Fishermen who use nets have the highest average annual income of P17 600. Those who use spears earn P12 900 a year; and hook and line, P5 040. The peak fishing season is April-May; incomes fall during the rest of the year.

Resource assessment in the waters around Malalison Island was conducted by Ronald Cheong in 1991. A total of 210 species of fish belonging to 29 families were identified. Labrids and pomacentrids were dominant in terms of species richness and abundance. Five species of seagrasses and 64 species of macrobenthic algae were identified (21 greens, 15 browns, and 28 reds). At the south side of the island, encrusting corals were dominant and live coral cover was poor (17%). At the north side of the island, non-*Acropora* branching corals were dominant, and live coral cover was in fair condition (35%).

Stock assessment of fish populations in Malalison Island was conducted by Edgar Amar. Some 494 fishing operations were recorded from February 1991 to January 1992. Mean catch per unit effort (CPUE, kilograms per man-hour) by gear type were: spear, 1.1; spear with compressor, 1.4; set gill net, 0.4; drive-in gill net, 2.4; drift gill net, 1.2; and hook and line, 0.7. The common species caught by the various gears were: surgeonfish and octopus by spear; fusiliers and surgeonfish by gill nets; and emperors, snappers and groupers by hook and line. The total catch by all gears was highest in July and October and lowest in November and December.

The work on resource assessment in Malalison was continued by Clarissa Marte in 1993. The coral species were identified. A manta tow survey around Malalison showed that live coral cover on fringing reefs varied from 19 to 69% with a mean of 35%. Reefs on the northeast side of the island were in better condition than those on the southwest side. The number of fish species and the abundance of fish populations varied with the coral cover. The comparatively low estimate of fish yield in Malalison reefs based on data from fish landing indicates an overfished condition.

The cage farming of siganids (*Siganus* spp.) in Malalison Island was studied by Edgar Amar as an alternative livelihood for coastal fisherfolk. Weekly sampling by dragged seine showed that juveniles less than 2 cm long appeared in seagrass flats in Malalison between the new moon and first quarter; numbers were

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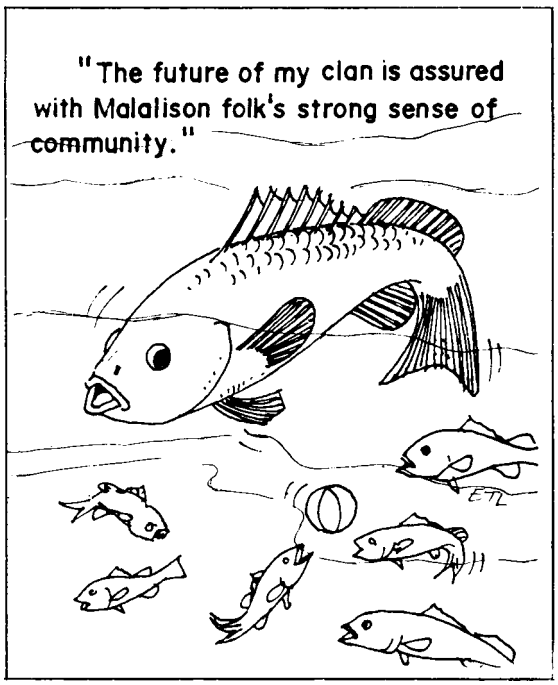


highest in June but very few in July. New schools of juveniles appeared in September and October but not in November. The dominant species were *S. spinus* and *S. canaliculatus.* Juvenile *S. guttatus* were not present in the seine samples, but a few 6 cm long were caught by gill nets. So, *S. guttatus* (about 7 grams) were obtained from an estuary in nearby Pandan town and transported to Malalison for cage farming. Stocked at 30 per cubic meter, the juveniles grew to 33 grams after 75 days. These were transferred to Igang for grow-out in cages. They grew to 202 grams after 120 days on a SEAFDEC formulated diet with 40% protein; feed conversion ratio was 1.3. A cost-return analysis showed a 10% return on investment. Feed was the major expense, about 60% of production cost. If a low-cost feed can be developed for juvenile *S. guttatus* (siganids are herbivorous in nature) and if two crops can be raised each year in a sheltered location, then cage farming of siganids may be profitable. But it is not a suitable alternative livelihood for Malalison fisherfolk.

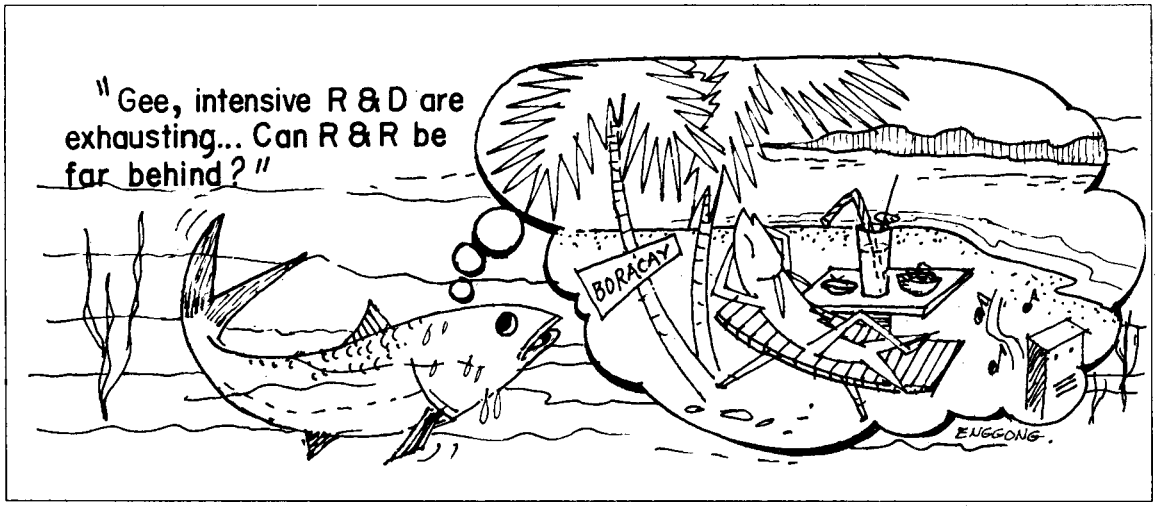
Cultivation of the seaweed *Kappaphycus alvarezii* with the grouper *Epinephelus* sp. was initiated by Anicia Hurtado-Ponce in Malalison Island. In one experiment, the seaweed was grown on horizontal lines, vertical lines, or clusters. The % weight increase per day varied significantly by culture technique, but production was not different. In another run, the seaweed was grown for six months on a bamboo raft with or without an enclosing net cage with juvenile groupers. Highest growth and production of seaweed were recorded in March-April and a total of 406-454 kg was harvested. About 24 kg of grouper (97%) survived, each 170 gram on average.

Case studies on women in fishing and oyster farming were made by Susana Siar, focusing on women in Malalison Island and Binaobawan, Capiz. Based on whole-village interviews and time allocation charts, women work longer hours than men each day. In Malalison, women work 4 hours at home and 6 hours in income-generating activities. Men spend 2 hours in house work and 7 hours in fishing and other livelihood. In Binaobawan, women work 4 hours at home and 5 hours in buy and sell activities; men spend one hour in house work and 5 hours in fishing and other livelihood.

Snappers for Sea Ranching

Territorial reef fishes such as snappers are being considered for sea ranching trials in Malalison. First, a sufficient seed supply must be assured. Thus, breeding and rearing studies were conducted.

A broodstock of the mangrove red snapper is being developed by Arnil Emata for purposes of seed production for seafarming and sea ranching. Snappers caught from the wild were



kept in a floating net cage or a concrete tank. They were sexually mature in May-October 1992. In August, mature females and spermiating males were injected 50 micrograms LHRHa or 1 500 IU hCG per kilogram body weight. About 1.2 million eggs were spawned 27-36 hours after injection. Fish that spawned rematured 4-5 weeks later. In 1993, the snapper broodstock in cages were sexually mature from March to November, but the tank-reared ones only from May to October. Among broodstock in a 5 x 5 x 3 meter deep cage, 1 kg males and 2.5 kg females were already sexually mature. Single injections of 1 500 IU hCG per kilogram body weight resulted in spawning 32-40 hours later. About 0.5-2.2 million eggs were collected from different females.

Larval rearing techniques for the mangrove red snapper are being developed by Marietta Duray. Snapper larvae only 2.3 mm long started feeding on rotifers on day 2. All larvae 3 mm long were feeding by day 7 and rotifer intakes increased as the larvae grew. On day 22, snapper larvae 6.3 mm long started feeding on *Artemia* nauplii. In one experiment, snapper larvae were reared for the first two weeks on either rotifers alone or rotifers supplemented with two microparticulate diets. Larvae fed rotifers with FRIPPAK were bigger than those fed rotifers alone or rotifers with Nosan R-1. Survival was not significantly different among the treatments.

Another experiment by Marietta Duray determined the appropriate density of *Artemia* nauplii for rearing three-week old snapper larvae to day 35. Survival was as high as 81% but not different among treatments. Another set of three-week old snapper larvae were fed 2 nauplii per ml

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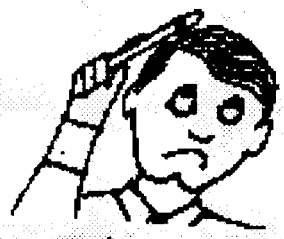

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Back issues of *Aqua Farm News*

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- Artificial reefs, Sept-Oct 1991
- Seaweeds, Nov-Dec 1991
- Ornamental fishes, Jan-Feb 1992
- Mud crab, Mar-Apr 1992
- Farming the grouper, May-June 1992
- Mollusc culture, Jul-Aug 1992
- Snappers, Nov-Dec 1992
- Milkfish breeding, Mar-Apr 1993
- Tilapia culture, May-June 1993
- Policing fisheries, Jul-Oct 1993

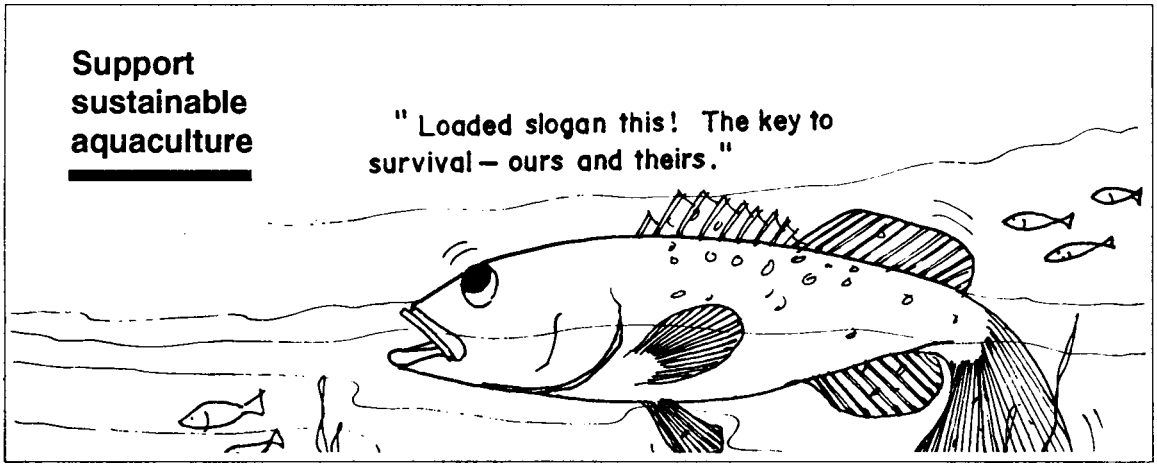
either 1, 2 or 4 times daily. Survival on day 35 was much better among larvae fed 4 times a day than among those fed once or twice daily. Rearing snapper larvae is easier than rearing grouper larvae.

The Case of Molluscs

Technical and socioeconomic assessment of oyster and mussel culture in Binaobawan, Pilar, Capiz and Lakaran, Dumangas, Iloilo was conducted by Wenresti Gallardo and Susana Siar. Rapid rural appraisal was used to understand the physical layout of the two villages and the livelihood and socioeconomic situation of the villagers, particularly the oyster and mussel farmers. Fishing is the major source of livelihood in both villages. In Binaobawan, 77% of the villagers are engaged in oyster and mussel farming. Oysters are cultured by the bottom method and mussels by the platform method. Production of oysters in Binaobawan could be increased by adapting the method used in Lakaran. In Lakaran, all residents are engaged in oyster farming by the rack hanging line method. Culture of green mussel (*Perna viridis*) and brown mussel (*Modiolus metcalfei*) is being developed in Lakaran with the active participation of the oyster farmers.

A survey of the kapis (*Placuna placenta*) fishery in the Philippines was conducted by Wenresti Gallardo. There are 27 remaining kapis beds, six of which are now the major sources. Kapis stocks are declining and many beds are already depleted due to excessive gathering, siltation, trawling, and pollution. Kapis shells support an open access fishery; anybody can gather shells by handpicking in shallow areas, compressor diving in deeper areas, and dredging. To prevent further depletion of this resource, several measures are recommended: establishment of sanctuaries, ban on trawling and other destructive fishing, enforcement of existing regulations, community-based fishery management, and further research on seed production, restocking, and transplantation.

The reproductive biology of the abalone *Haliotis asinina* is being studied by Emmanuel Capinpin. Monthly field sampling was conducted in Panagatan Cays (between Antique and Palawan) in November 1993-February 1994. Ninety-five specimens with shell lengths of 4-10 cm have been collected. A modified gonad bulk index was calculated, then gonads were preserved and processed for histological observations.

Future direction

In the next decade and beyond, SEAFDEC/AQD will continue research on economically important species in Southeast Asia. The Department aims to develop sustainable aquaculture.