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State of Grouper (Lapu - Lapu) Culture in the Philippines

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The grouper, locally known as *lapu-lapu*, is a highly esteemed food fish in the Philippines. It represents about 2% of total fish catch in the country. The grouper is a preferred species by small-scale fishermen and is commonly caught by hook and line, gill-net, and bamboo fish trap. Recently, more attention has been given to grouper as a candidate for culture. Consequently, studies on grouper culture have been undertaken in several countries. In the Philippines, some private firms have ventured into grouper culture, although there are only few statistical data available. The existing culture method for grouper is usually based on the fish farmers' own experiences; more likely than not, it is without scientific bases. Although researchers in the Philippines have become more interested in grouper culture, no positive results have been obtained so far. To determine the direction of development of grouper culture in the Philippines, the present state of culture and the technical problems and constraints involved must first be described. Only then can research studies be identified to solve these problems or constraints.

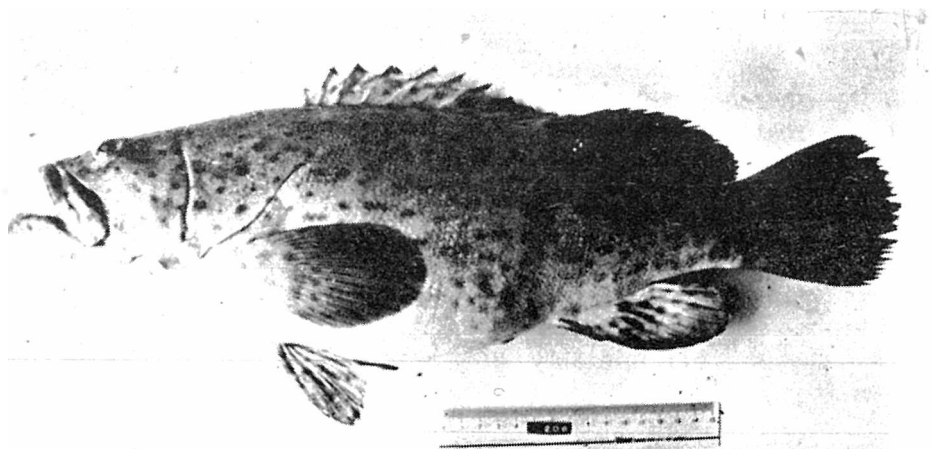
In this report, we aim to review the state-of-the-art of grouper

culture in the Philippines, present some technical problems encountered in grouper culture as well as propose research directions to be taken to address these problems.

Some studies on grouper culture techniques have been reported in the Philippines. After comparing the growth of four species (*Epinephelus merra*, *E. summana*, *Cephalopholis pachycentron*, and *Anypetodon leucogrammicus*) in one-year cage culture trials, *A. leucogrammicus* was recommended for culture (BFAR, 1981). A six-and-a-half months cage culture trial of *E. fuscoguttatus* and *E. macropilos* at different stocking rates based on body weight showed that higher stocking weights yielded higher

productivity (PCARRD, 1986). Manzano (1985) recommended a polyculture stocking rate of 15 000-20 000 tilapia and 1000 grouper per hectare (ha). Several findings on grouper pond culture techniques have been compiled by Elizalde and Marcial (1983).

In other countries, highest production was obtained when *E. salmoides* (?=*E. malabaricus*) fingerlings were stocked at 60 ind/m³ (Teng and Chua, 1978; Chua and Teng, 1979) or at 60 ind/m² for *E. tauvina* in cages (Sakares and Sukbanteang, 1985). Teng and Chua (1979) reported that, by providing artificial shelters in cages, one can increase stocking density for *E. salmoides* and production



Epinephelus malabaricus.

will be 230% more than in cages without shelters.

Some studies were conducted to determine the suitable amount of food and frequency of feeding for cage culture. On *E. tauvina*, Chua and Teng (1978) found that the feeding frequency of once in 2 days enhanced maximum intake and efficient food utilization. Sudradjat et al (1985) also observed that fish fed to satiation once every 2 days showed optimal growth and good feeding performance. For economical production of *E. salmoides*, fish should be fed 5% of body weight every 2 days (Chua and Teng, 1982).

REGIONS INVOLVED IN GROUPER CULTURE

Apart from the experimental culture of grouper, traditional grouper culture is practised in three areas in the Philippines, namely: Pangasinan, Manila, and

Panay Is. Cage culture of grouper is practised in Sual, Pangasinan. In the outskirts of Manila, in Obando, Bulacan (north of Manila), and in Kawit, Cavite (south of Manila) are two leading places of grouper culture. Pond culture of grouper is developed in Bulacan while both pond and cage culture are popular in Cavite. One private firm has cultured grouper in cages in Iloilo Strait, but the center of grouper culture on Panay Island is Roxas City. Several private firms are engaged in culturing grouper using both cage and pond in Roxas City and suburbs.

Experimental culture of grouper is conducted in other places to verify culture techniques developed by government institutions and universities. Cage culture trials have been conducted in Sual (Pangasinan) and Kawit (Cavite) by the Bureau of Fisheries and Aquatic Resources (BFAR, Region IV); Guian (Samar) by the Philippine

Council for Agriculture and Resources Research and Development (PCARRD); and Tacloban (Leyte) by BFAR, Region VIII. The polyculture of grouper and tilapia in ponds has been studied in Legaspi, (Albay) by Bicol University and a study on the effects of stocking density and feeding levels on growth of grouper in ponds was conducted in Leganes, Iloilo (Panay) by SEAFDEC AQD.

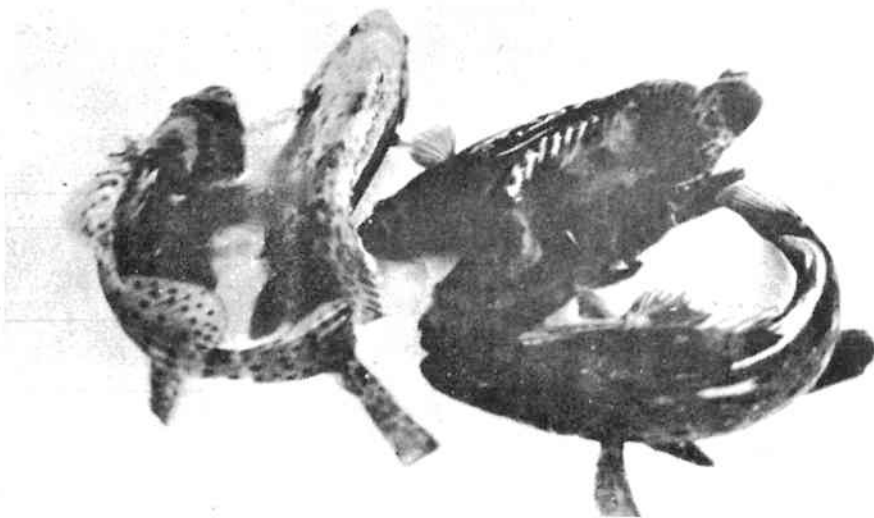
CULTURED SPECIES

The following six species have been cultured experimentally: *E. merra*, *E. summana*, *E. fuscoguttatus*, *E. macrospilos*, *C. pachycentron*, and *A. leucogrammicus*. The last two species are the common groupers sold in fish markets, but it is not known whether they are good aquaculture species candidates. It seems that *E. macrospilos* is not so common in the Philippines. Although the other three species of *Epinephelus* are commonly found in fish markets, we did not observe them being cultured in ponds or in cages by private firms.

The following six species of the genus *Epinephelus* are cultured in ponds or in cages of private firms:

E. malabaricus: This species ranks first in popularity and therefore is a desirable species for culture in ponds or in cages. Its fast growth rate makes it a good candidate for culture. Fingerling supply of this species from the wild is at present constant.

E. amblycephalus and *E. tauvina*: Both species are considered to be



Mixed grouper fingerlings.

desirable for culture. We observed several of them being cultured in ponds and cages. Fingerling supply, however, is unreliable.

E. sexfasciatus and *E. megachir*: They appear to be the most abundant *Epinephelus* species in Philippine waters. We frequently observed both species being sold in fish markets, but it is hard to find them being cultured in ponds and cages.

E. bleekeri: That this species is commonly cultured in ponds and cages indicates that there is a sufficient fingerling supply. However, it has a poor reputation as a cultured species because of its slow growth rate.

FINGERLING SUPPLY

Grouper fingerlings are collected by small-scale fishermen. The main fishing gears they employ are hook and line, bamboo trap and dip-net. The size of fingerlings caught varies from 2-3 cm to more than 10 cm in total length (TL). The peak season of fingerling supply is the latter half of the summer season (February-June). During the rest of the year, the fingerling supply cannot meet the demand.

The fishermen sell fingerlings they collect to dealers or directly to pond/cage operators. The dealers own small ponds or cages where they stock the fingerlings before selling them to pond or cage operators. The pond/cage design of fingerling dealers is roughly in accordance with that of pond/cage operators described below, but the facilities are more simple, on a

smaller scale, and constructed close to their residence. The fingerling dealers stock the fingerlings depending on the fishermen's catch. There is no definite standard on how to stock the fingerlings, including the stocking density and period. There is no provision for water management, and water exchange is left to take its natural course. The amount of food given is insufficient. Even if the dealers stock fingerlings in cages or ponds for a short period, they are still confronted with the problems of disease and cannibalism.

CULTURE TECHNIQUES

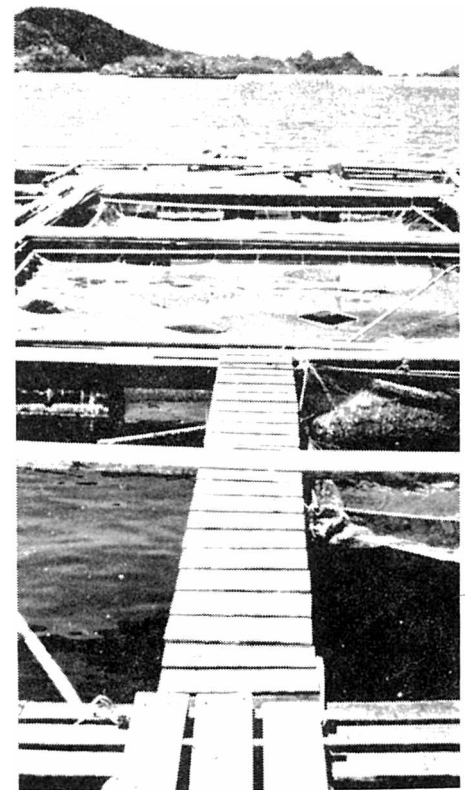
Site selection and facilities

Cage culture. To avoid damage caused by rough seas, grouper cages are set up in calm waters, e.g., in a bay, behind an island or in a river close to the sea. Cage site is usually accessible, a caretaker's house is built beside the cage. Water depth in the site is at least 3 m, but the technique of cage construction (see below) restricts the maximum depth to about 5 m. In addition to topographical considerations, the difficulty of water management compels one to select the site deliberately. Cages are set up in sites where water is unpolluted, good water exchange is possible, and no great fluctuations of temperature, salinity and pH occur.

Bamboo and coconut trunks are used for constructing cage frames. Coconut trunks are commonly employed for vertical prop, while bamboo is used for horizontal frame. Size of cage is usually 3 x 3 m. Two types of cages have been observed:

(1) Floating net cage: Four coconut posts are vertically fixed to the bottom. A square frame, with one side consisting of two bamboo poles, is placed horizontally. The vertically oriented coconut posts are loosely connected to the bamboo frame, thus it is movable. The net is fastened to the horizontal bamboo frame, and its bottom corners are linked to the vertical props of coconut posts. The cage is kept afloat by plastic drum, styrofoam float, or bamboo. This type of cage is advantageous in relatively deep water and in water with wide range of tide.

(2) Settled net cage: The design of this cage is similar to the



Floating cages for grouper and other finfish broodstock at Igang Substation, SEAFDEC AQD.

floating cage, but the horizontal bamboo frame, with one side consisting of one bamboo, is fixed with the vertical prop of coconut posts. The bottom corners of the net are anchored to the substratum. This type of cage is set up in calm waters.

Pond culture. The basic construction of the grouper pond is similar to milkfish/prawn ponds; the latter can be converted for grouper use. However, a site with salinity of more than 10 parts per thousand (ppt) is preferred. Adequate supply of good water quality is needed for grouper culture. The required water depth of the pond is 0.8 m, although a depth of 1.0-1.5 m is more ideal. Several small ponds of more than 0.3 ha are used if different-sized grouper are stocked, otherwise subdivision into small compartments, as in a milkfish pond, is not needed. Eradication of predators is not necessary, because groupers are carnivorous and they feed voraciously on fish which are considered predators and pests in milkfish ponds. To keep the water unpolluted, frequent water exchange is done by tidal fluctuation. Good water management is found to be important for a successful culture of grouper in ponds.

Stocking density

Fingerlings for stocking are purchased from fingerling dealers or directly from fishermen. Initial stocking density is about 1000 fingerlings/cage (about 37 fingerlings/m³) or 2000-6000/ha of pond for a fingerling size of about 10 cm total length (TL). Because of difficulty in collecting enough uni-

form-sized fingerlings, the actual stocking density varies. There is no schedule when to stock fingerlings; stocking depends largely on availability of the fingerlings. Fingerlings are re-stocked into two cages as they grow; hence, stocking density decreases to about 500 fingerlings/cage.

In pond culture, separate compartments are useful for stocking different-sized groups. It is possible to thin out the stock as the fish grow. The exact timing of thinning out the fingerlings is not exactly known and is largely based on the experience of the operators.

Feeding

Grouper is a carnivorous and voracious fish taking live fish and crustaceans as food. However, it is easy to acclimatize the grouper to feed on trash fish. Any kind of trash fish available can be used as food for grouper. Feeding frequency is usually twice daily at about 10% of total fish body weight per day. The feeding scheme depends largely on the experience of the operators. One method usually employed is to feed them until they stop to take trash fish and to feed them several times per day. Tilapia fry is available as food for groupers in ponds, but the amount of tilapia fed to groupers depends on the experience of the operators.

Marketable size and rearing period

Marketable size of high demand ranges from 0.5 to 1.0 kg. Groupers weighing more than 1.0 kg fetch much lower price. The

rearing period is determined by the initial fish size at stocking. Marketable size groupers are attained after 4 to 6 months of rearing if initial TL is 10 cm, while it takes 8 to 10 months after stocking for 3-5 cm TL fingerlings. A survival rate of more than 90% is obtainable in usual operations, and the mortalities are limited to wounded fish when they are caught, pre-stocked by fingerling dealers, or transported. Mass mortality seldom occurs in cages probably because of adequate water exchange, although it sometimes occurs in ponds. Poor water management in ponds may induce diseases in grouper, resulting in mass mortality.

Harvesting and marketing

As in stocking, there is no definite schedule of harvesting. Marketable size groupers weighing more than 0.5 kg are harvested by dipnet in cages and by lift net or cast net in ponds. The local market, i.e., within the farm vicinity, is limited for the cultured grouper, thus operators usually want to sell them in Manila where grouper is sold directly to restaurants or to the market. Wholesale price is higher for live than dead grouper. Grouper is transported live in oxygenated plastic bag, at 5-10 groupers in 8-10 liters of water. Ice is used to lower the metabolism of grouper during transport. More than 90% survive after land and air transport.

TECHNICAL PROBLEMS

As mentioned above, the present techniques used by the private



Harvesting grouper with a dip-net.

sector in culturing grouper is largely empirical. Although some have been successful, many technical problems still exist. We point out these problems to form the basis of future research on this species.

The most serious constraint to increased grouper production is insufficient fingerling supply, leading to unstable stocking schedules and inexact stocking densities during the culture phase. Ways to solve this problem are to develop grouper broodstock and techniques for the mass production of grouper fry. At present, however, there is no existing hatchery for grouper in the Philippines. Some institutions and even the private sector in other countries have tried to produce grouper fry but only in experimental scale or in limited quantities. Accordingly, fry supply relies on nature which should be utilized with utmost care. The present fishing gears used by fishermen are unfit for collecting fingerlings. Fingerlings are easily and seriously injured by hook and line. Other gears like bamboo traps and dip-

nets are inefficient.

Facilities owned by fingerling dealers are inappropriate for stocking fingerlings even for a short period. Under present stocking conditions in these facilities, good water management is difficult to achieve. Insufficient feed is another problem. Site selection may also be another problem.

There is no information on appropriate stocking density in ponds available at present. If sufficient fingerlings are available, private farmers use a stocking density of about 37 fingerlings/m³ in cages and 2000-6000 fingerlings per ha in ponds.

The amount of food and frequency of feeding is important in grouper culture from the viewpoint of production cost. Operators depend solely on their experience at present. An appropriate method for feeding grouper cultured in ponds and in cages needs to be investigated. Water management is one of the most important prob-

lems in grouper pond culture. Water exchange in ponds relying largely on tidal fluctuation is difficult.

Harvesting does not follow a definite schedule since the time of harvest depends on the demand of buyers. Consequently, the period of rearing marketable-sized grouper is not well defined. Also, information on the supply and demand of the grouper market is scarce. ●

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Isolation and Identification of Pseudomonas fluorescens from Hatchery-Reared Tilapia fry (Oreochromis niloticus Linnaeus)

R.C. Duremdez and G.D. Lio-Po

Bacterial infections caused by *Pseudomonas* sp. are widely reported among cultured aquatic organisms. In the Philippines, initial report of *Pseudomonas* sp. infections occurred among hatchery-reared tilapia fry, *Oreochromis niloticus* Linnaeus. Undue stress due to crowding and handling enhanced the development of the disease. The causative agent was identified as *Pseudomonas fluorescens*.

Pseudomonas fluorescens is a Gram-negative, rod-shaped bacterial species with flagellar filaments for active motility. It produces greenish to yellowish diffusible pigments

on selective agar medium such as Pseudosem Agar. Growth and viability of this bacterium is maintained in optimum freshwater conditions for more than 150 days while viability in brackishwater situations is limited to 50 days only. Sea-water medium is not tolerated by this bacterium. This species is thus able to survive and thrive only in freshwater and brackishwater fish culture systems under optimum temperature (25°-30°C).

Ps. fluorescens has been frequently reported to occur predominantly in the tissues and internal organs of healthy and diseased freshwater fishes such as *Oreochromis niloticus*. The rearing water, likewise, contained predominantly the same genus of the bacteria.

Since this bacterial species appears almost always in an aquatic environment, it is likely to infect the fish under adverse environmental conditions. Undue exposure of the cultured fish to stress brought about by sudden environmental changes and poor rearing conditions such as overcrowding can cause deterioration of water quality parameters. This condition triggers increased bacterial load in the water and eventually weaken the fish. Evidence also shows that most outbreaks of infectious diseases are associated with stress. Such situations coupled with the ability of *Pseudomonas* to thrive longer in an aquatic environment may explain occurrences of *Pseudomonas* infections in aquaculture systems. ●

R.C. Duremdez is a Research Associate while G.D. Lio-Po is a Scientist of SEAFDEC Aquaculture Department.

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