The Commercial Production of Green Grouper Fingerlings, *Epinephelus malabaricus* and *Epinephelus suillus,* from Wild Caught Fry - An Industry Experience

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Abstract

Wild-caught fry of the green groupers, *Epinephelus malabaricus* and *E. suillus* ranging in standard lengths (SL) from 1.5 to 3.0 cm were bought from different fry dealers all over the Philippines. These were reared from 1.0 to 2.5 months in 10 to 40 m^3 (small) concrete tanks, in 240 m^3 (large) concrete nursery tanks with sandy bottom, in 10 m^3 hapa nets installed either in large nursery concrete tanks with sandy bottom or in 0.8 to 1.0 ha earthen ponds. The initial stocking density was 33-150/m^3. When the fingerlings reached 5 to 7 cm SL, these were harvested and stocked in cages. The wild fry were fed adult brine shrimps for the first few days and later, trash fish. Rearing water in small concrete tanks was changed daily while that in large nursery tanks and hapas was changed only when dissolved oxygen level was about 4 ppt or lower. Survival rates ranged from 3% to 64%. Although survival rates varied, rearing grouper fry in hapa nets installed in earthen ponds were found to be the most suitable for the commercial production of grouper fingerlings to a size suitable for stocking in cages. The large variation in survival rates is attributed mainly to the quality of wild fry bought from different fry dealers all over the country and the occurrence of diseases during the culture period. The problems encountered in the commercial production of fingerlings are discussed.

Introduction

Since 1988 when a lot of problems started to beset the prawn industry and when the price of prawn became very unstable going down to as low as P80/kg, the prawn farmers began to be interested in the production of other high valued species. The most economically important of these are the groupers of the genera *Cephalopolis* and *Epinephelus* because they command a high price in the market and

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the demand is great not only in the Philippines but in all Southeast Asian countries. Of the 19 *Cephalopolis* and 63 *Epinephelus* species identified by Randall (1987) for the Indo-Pacific Region, only six species of the genus *Epinephelus* are cultured in the Philippines either in ponds or cages (Kohno et al. 1988). Grouper farmers in the Philippines prefer to culture the green groupers, *E. malabaricus* and *E. suillus* because of the availability of their fingerlings throughout the year (Juario 1990). In addition, these grow fast and production to marketable size is economically feasible (Chua and Teng 1979, 1980).

Although there is a technology for culturing green groupers in ponds and cages, the hatchery and nursery technology for these species are wanting (Juario 1990, Quinitio and Toledo 1990). Consequently, when many prawn farmers turned to grouper culture, they had to face the very serious problem of erratic fingerling (SL = 7 to 8 cm or more) supply although these were available in different parts of the country year-round. Moreover, the fingerlings varied greatly in size and quality due to the absence of well developed capture, holding, packing, and transport technologies.

Throughout this paper, fingerlings refer to green grouper juveniles with SL of not less than 5 cm and are already suitable for stocking in cages while fry refer to those with SL of less than 5 cm but mostly with SL of 2 to 3 cm and are already metamorphosed. Grouper fry with SL of less than 2 cm are generally transparent while those with SL of more than 2 cm are dark and pigmented; the latter are commonly referred to as "black tinies" in contrast to the transparent ones.

The supply of smaller-size fry (SL = 2 to 3 cm), although seasonal and more localized, is reliable. These are available in a hundredfold greater than the bigger-sized fingerlings (SL = 7.5 cm or more) that are already suitable for stocking in cages.

To answer its need for greater numbers and more uniform-sized fingerlings for stocking in cages, the Atlas Prawn Corporation opted to buy large numbers of smaller sized transparent and black tinies (SL = 2 to 3 cm) and reared them to a size (SL = 5-7 cm or more) suitable for stocking in cages. This paper presents the method developed by the Atlas Corporation Staff for the commercial production of green grouper fingerlings from wild caught fry using the facilities that were originally constructed for prawn production.

Fry Source

Green grouper fry with standard lengths ranging from 2.0 to 3.0 cm were bought from different fry dealers all over the Philippines, hence, the fry used for each rearing run varied in quality. There were batches with active and uniform-sized fry, but there were also batches with stressed fish evidenced by dark body coloration, curled tails, emaciated appearance, presence of reddish spots at the caudal peduncle, and abnormal swimming behavior (e.g. whirling motion, staying on the surface, lethargic). Generally, transport mortality of "good fry" was less than 5% while that of "poor fry" ranged from 5% to 40%.

Rearing Facilities and Stocking

The rearing facilities used consisted of indoor 10 to 15 m^3 circular fiberglass tanks, indoor 40 m^3 (4 x 5 x 2 m deep) concrete, rectangular tanks, outdoor 240 (10 x 24 x 1 m) m^3 concrete, nursery tanks with sandy bottom, and 0.8 to 1.0 ha earthen ponds. Sixteen 10 m^3 (2 x 5 x 1 m deep) hapa nets were installed in the outdoor concrete nursery tanks and 200 hapa nets/0.8 ha in the earthen ponds. The fry were reared in hapa nets for ease in size-grading and feeding. The initial mesh size of the nets used was 0.3 cm. Nets with a mesh size of 0.5 cm was used when the SL of the fish was already about 3 cm.

The fry were stocked into the rearing facilities in batches as they come. Fry from plastic transport bags were slowly transferred to large circular plastic basins for acclimation to rearing water salinity and temperature. Acclimation lasted from 30 min to 2 h. As a rule of thumb, salinity and temperature acclimation were done at the rate of 1 ppt and 1 °C/30 min. The initial stocking densities were as follows: 150/m^3 in indoor fiberglass and concrete tanks, 33 and 84/m^3 in outdoor nursery tanks and in earthen ponds.

Feeds, Feeding And Water Management

During acclimation and from day 1 to 7, fry were fed live or newly thawed frozen adult brine shrimp. From day 5, the fish were gradually weaned to trash fish. From week 2 until harvest, the fish were fed solely with trash fish chopped to sizes suitable for their mouth. The fish were fed to satiation thrice daily for week 1 and twice daily thereafter.

The rearing water salinity ranged from 18 to 25 ppt. Water in indoor tanks was renewed daily while only from 30 to 50% of the water in the outdoor nursery and earthen ponds was changed when dissolved oxygen content fell to 4 ppt, when the secchi disk reading fell to 30 cm, or when the feeding and swimming behavior of the fish changed. Dissolved oxygen, temperature, transparency, and salinity of the rearing water were monitored twice daily.

Indoor and outdoor nursery tanks were provided with aeration while earthen ponds were provided with 1 paddlewheel per 0.8 ha pond. The paddlewheel operated from 1100 h to 1400 h to bring about even distribution of water temperature and to prevent drastic changes in salinity whenever it rained.

Stocking Assessment and Manipulation

Fish behavior was closely monitored daily during feeding. Dead fish were removed from tanks and hapa nets. Fish afflicted with disease but were considered to have good chances of survival were also removed and treated with antibiotics. When these recovered, these were returned to the rearing facilities. In general, a stock was transferred from one tank to another or from one hapa net to another, when they became anorexic, lethargic, or when there were signs of diseases, e.g. body lesions or when there was an overgrowth of filamentous green algae.

The fry were size-graded into small, medium, and large two weeks from stocking and weekly thereafter. Stainless steel sorters with three different mesh sizes were used for size-grading. Due to size-grading and mortality, the initial stocking densities were never maintained throughout the rearing period. The stocking density in each hapa net was always lower than the initial stocking.

Harvesting

Fingerlings cultured in tanks were harvested when these reached the size suitable for stocking in cages by draining the tanks. While draining, the fingerlings were gradually and carefully scooped out of the harvest nets attached to the drainage pipe. Harvesting fingerlings cultured in hapa nets was easier. The nets were lifted up and the fingerlings gradually and carefully scooped out while they were still under water.

Production Experience

The survival rates of eleven production runs ranged from 3% to 64% (Table 1). Grouper fry reared in indoor tanks had the lowest survival while those reared in an outdoor tank had the highest. One can not make, however, any definite conclusion regarding survival rates in different rearing facilities since the production runs were not designed for this purpose.

The time needed for green grouper fry to reach 5-7 cm SL was longest among fry reared in indoor tanks at a stocking density of 150 fry/m^3 and shortest among fry reared in outdoor tanks at a stocking density of 33 fry/m^3 (Table 2).

Table 1. Survival rates of green groupers reared in indoor and outdoor concrete tanks, and hapas in earthen. Batches of fry delivered to the farm on the same day were considered one production run.

Production run no.	Date	Rearing facilities	Volume (m^3)	Total no. of fish stocked	Initial stocking density (pcs/m^3)	Survival rate (%)
1	Nov-Dec '87	Outdoor tank	240	7,920	33	64
2	Feb-Mar '88	Outdoor tank	240	20,160	84	34
3	Jan-Feb '90	Indoor tank	40	500,000	150	3
4	Sep-Nov '90	Indoor tank	10	11,000	100	3
5	Sep-Oct '91	Hapas in outdoor tank	10	11,000	100	35
6	Oct-Nov'91	Hapas in outdoor tank	10	11,000	100	33
7	Feb-Mar '92	Hapas in outdoor tank	10	11,000	100	18
8	Aug-Sep '92	Hapas in ponds	10	280,000	100	15
9	Oct-Nov '92	Hapas in ponds	10	25,000	100	27
10	Nov-Dec '92	Hapas in ponds	10	196,000	100	35
11	Dec-Jan '93	Hapas in ponds	10	400,000	100	32

The great difference in survival rates is attributed mainly to the variability in quality of fry that were delivered to the farm. This in turn was greatly affected by the method employed in collecting, holding, packing, and transporting the fry. More often than not, the fry used in each production run, did not come from the same source although they came from one dealer. Some batches of fry had to be held in a station or site by fry dealers for 2-3 days, at times longer, before they were delivered to the farm. Holding fry for 2-3 days in a collection site will greatly affect survival rates, if the collector or dealer does not know how to handle and feed them.

A bad batch of fry will always have high transport mortality, ranging from more than 5% to 40% or greater and will show signs of disease like anorexia, white spots on the body, lethargic swimming, body lesions and low food consumption within a week after delivery to the farm. Massive mortality occurs within the first week of rearing. Emaciated fry always indicate that the fry had been held for a long time in a collecting site without feeding.

Table 2. Time needed to rear grouper fry to 5-7 cm in standard length.

Production run no.	Rearing facilities	Volume (m^3)	Total no. of fish stocked	Initial stocking density (pcs/m^3)	Duration (in mos)
1	Outdoor tank	240	8,000	33	1.5
2	Outdoor tank	240	20,200	84	1.5
3	Indoor tank	40	500,000	150	2.5
4	Indoor tank	10	11,000	100	2.0
5	Hapas in outdoor tank		11,000	100	2.0
6	Hapas in outdoor tank	10	10,000	100	1.5
7	Hapas in outdoor tank	10	11,000	100	2.0
8	Hapas in pond	10	280,000	100	2.0
9	Hapas in pond	10	25,000	100	2.0
10	Hapas in pond	10	196,000	100	2.0
11	Hapas in pond	10	400,000	100	2.0

A good batch of fry have low transport mortality, usually 5% or less. No massive mortality occurs during the first week of rearing. Instead mortality gradually increases during the first and second week of rearing but gradually decreases thereafter.

Another factor that could have contributed to mortality is size-grading. Grouper fry tend to be cannibalistic especially at the earlier stages although our experience show that they are less cannibalistic than sea bass fry. It would be worthwhile to determine whether survival rates will significantly increase if weekly size-grading is omitted because size-grading injure some fish in the process, is time-consuming and labor-intensive.

Although survival rates of grouper reared in hapa nets installed in earthen ponds do not greatly differ from each other (Table 1), there are two important problems to be solved - the overgrowth of filamentous green algae and diseases. The unconsumed feed coupled with the feces of the fry easily promote the growth of filamentous green algae. We do not know whether the overgrowth of the filamentous green algae also contributed significantly to the fry mortality. Filamentous green algae were removed every time the fry were size-graded to prevent overgrowth. In addition, because hapa nets were installed in very large ponds, it was difficult to treat fry afflicted with diseases in situ. Consequently, it was difficult to prevent the spread of diseases although diseased fish when spotted were immediately isolated and treated with antibiotics in fiberglass tanks.

It is relatively easy to obtain survival rates of 30% or more when rearing grouper fry to stocking size in hapa nets installed in earthen ponds. However, we can not state whether the survival rates are acceptable because to date, there are no reports on commercial production of green grouper fingerlings from wild fry. At present a study under controlled conditions showed that massive, and sometimes total mortality occurs during the first two weeks of rearing when wild caught green grouper fry (black tinies) are reared to stocking size (Serrano pers. comm.). This is attributed mainly to the quality of fry delivered to the experimental site. In addition, the survival rates of hatchery-bred groupers reared to metamorphosis are low ranging from 0.14 to 10% (Leis 1987, Fukuhara 1989, Lim 1990). Apparently, larval rearing is the most difficult operation in the production of green grouper fry (Duray pers. comm.). A survival rate of at least 30%, however, was found to be economically feasible if the fingerlings produced are reared to marketable size.

Although our production runs were not designed to demonstrate the effect of stocking density on growth and survival, there are indications from our results that higher stocking density resulted in lower survival rate and slower growth rate. Our present practice of using a stocking density of about 100/m is based primarily on these preliminary results.

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References

Chua TE, Teng SK. 1979. Relative growth and production of the estuary grouper, *Epinephelus salmoides* Maxwell reared in floating net-cages. Mar. Biol. 54:363-374.

Chua TE, Teng SK. 1980. Economic production of estuary grouper, *Epinephelus salmoides* Maxwell, reared in floating net cages. Aquaculture 20:187-228.

Fukuhara O. 1989. A review of the culture of grouper in Japan. Bull. Nansei Reg. Fish. Res. Lab., 22:47-57.

Juario JV. 1991. Status of finfish mariculture in the Philippines. p.27-36. In: Advances in Finfish and Shellfish Mariculture. Guerrero RD, Garcia MP Jr. (Eds.). Proceedings of the First Philippine-French Technical Workshop on Advances in Finfish and Shellfish Mariculture, 24-26 October 1990, Los Baños, Laguna, Philippines, PCAMRD and French Embassy in the Philippines.

Kohno H, Duray M, Juario JV. 1988. State of grouper (Lapu-lapu) culture in the Philippines. SEAFDEC Asian Aquaculture 10:4-9.

Leis JM. 1987. Review of the early life history of tropical groupers (Serranidae) and snappers (Lutjanidae). p. 189-237. In: Tropical Snapper and Grouper: Biology and Fisheries Management. Polovina JJ, Ralston S, (Eds.). Westview Press, Inc., Boulder, Colorado.

Lim LC, Chao TM, Khoo LT. 1990. Observations on the breeding of brown-marbled grouper *Epinephelus fuscoguttatus* (Forskal). Singapore J. Pri. Ind. 18:66-84.

Quinitio GF, Toledo JD. 1991. Mariculture techniques for *Epinephelus* sp. in the Philippines. p. 94-106. In: Advances in Finfish and Shellfish Mariculture. Guerrero RD, Garcia MP Jr., (Eds.). Proceedings of the First Philippine-French Technical Workshop on Advances in Finfish and Shellfish Mariculture, 24-26 October 1990, Los Baños, Laguna, Philippines, PCAMRD and French Embassy in the Philippines.

Randall JE. 1987. A preliminary synopsis of the groupers (Perciformes, Serranidae, Epinephelinae) of the Indo-Pacific Region. p. 89-188. In: Tropical Snappers and Groupers: Biology and Fisheries Management. Polovina JJ, Ralston S, (Eds.). Westview Press, Inc., Boulder, Colorado.