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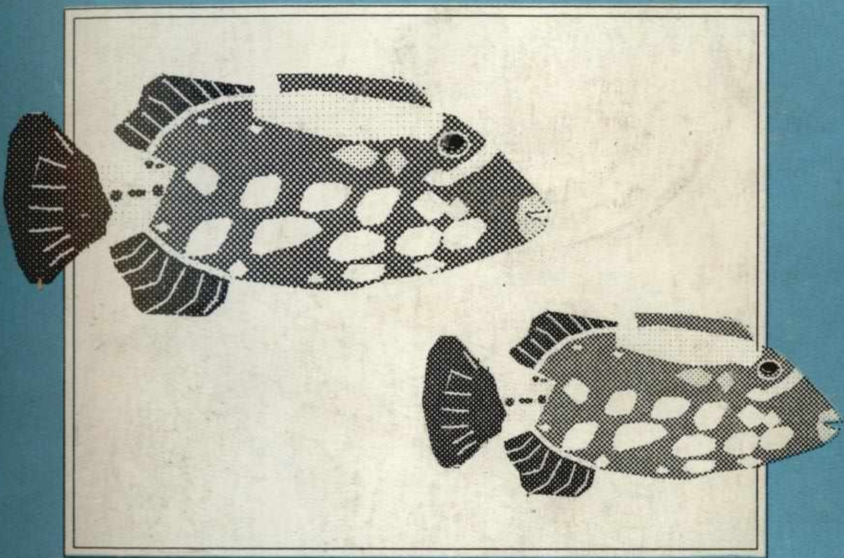

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The Culture of the Rabbitfish (*Siganus guttatus*) in Ponds and Wooden Tanks

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ABSTRACT

The growth of rabbitfish, *Siganus guttatus* (Block) was tested in earthen ponds and wooden tanks from May 1985 to February 1986 at Silliman University Marine Laboratory Compound in Bantayan, Dumaguete, Negros Occidental.

The fish reared in ponds subsisted mainly on filamentous green algae while those reared in tanks were given filamentous algae supplemented by mosquito larvae and commercial pelleted feed in the last two months of the study.

Results indicated that the fish reared in ponds for six months attained a mean length of 11.54 cm with mean weight of 38.06 g from an initial mean length of 2.59 cm and weight of 0.48 g Those reared in tanks grew to 12.66 cm and 65.19 g from 2.88 cm and 0.79 g in mean length and weight, respectively. The slow growth in ponds was due to a wide variation of sizes when initially stocked and environmental factors, like water depth, high water temperature, variable dissolved oxygen (0.85-6.42 ppm) and insufficient natural food.

Fish reared in tanks provided with sufficient food and water depth with frequent change showed a better growth.

Findings indicated the *Siganus guttatus* is a very promising species for aquaculture.

Keywords: rabbitfish, Siganus guttatus, growth

INTRODUCTION

The rabbitfish or siganid (*Siganus guttatus*) is one of the many species of the family *Siganidae* collected in coastal marine waters of the Philippines. It is considered an excellent food fish not only by the Filipinos but also by inhabitants of the eastern Mediterranean and the Indo-Pacific regions (Woodland and Allen, 1977; Lam, 1974). Various authors (Herre and Montalban, 1928; Fowler and Bean, 1929; De Beautifort and Chapman, 1951; and Lam (1974) reported the wide distribution of the family *Siganidae* in the Indo-Pacific waters. Woodland and Allen (1977) recognized about 21 species inhabiting the Indian Ocean and the Western Pacific Ocean. Herald (1966) counted 30 species and Woodland (unpublished checklist), Horstman (1975), Herre and Montalban (1928), and Burgan et al. (1979) stated that 14 or 15 species of siganids are found in the Philippines. Of these, 10 species were reported to have been collected in southeastern Negros areas and environs (Alcala, 1979).

Before 1972, the importance of the siganid as a mariculture species was not recognized. However, Pillai (1962) reported that before 1960 the fish had been cultured, in a general case, with milkfish in small coastal ponds in the Philippines. It was only 1973, after the meeting of a Siganid Mariculture Group in Hawaii, that the culture of siganids gained attention and became the subject of many mariculture studies (Woodland and Allen, 1972). Years later, reports on various applied studies about the fish were made by different authors. Lam (1974), Popper and Gendermann (1975), Von Westerhagen and Rosenthal (1976) wrote about the species as a potential candidate for mariculture. Studies on growth rates of *S. canaliculatus, S. spinus, S. guttatus, S. argentus, S. reculatus,* and *S. vermiculatus* cultured in aerated aquaria, sea cages, tanks, ponds and fish pens were reported by Lam (1974), Popper and Gendermann (1975), Von Westerhagen and Rosenthal (1976), Lavina and Alcala (1974) Horstman (1975), Von Westerhagen (1975), Carumbana and Luchavez (1979), Ben-Tuvia et al. (1983), and Luchavez (1986).

Despite successful results of studies made, however, fish culturists in the country today are still reluctant to try using the siganid as a major crop in ponds. This is due to the lack of culture technology and information to guide them, particularly in selecting the most suitable species, which would give them the maximum benefit within a reasonable time and at reasonable expense.

This paper reports on the growth rate of *S. guttatus* reared in brackishwater ponds and in a wooden tank and the different factors that affect the cultured fish.

MATERIALS AND METHOD

Pond Culture

The study was conducted in one of the earthen ponds of Silliman University (SU) Marine Laboratory in Bantayan, Dumaguete, Negros Oriental. The pond was designated RP_2, containing an area of approximately 120 sq m. It was subdivided into three compartments of 40 sq m each, using a fine-mesh net supported by bamboo poles. The compartments were designated as RP_{2-a}, RP_{2-b}, and RP_{2-c}.

Water supply came from the sea during high tide, through a small creek at the southern part of the project site. The pond construction was defective in that the main water canal bottom was higher than the pond system. From this supply canal a small wooden gate served as the water inlet and outlet for the pond. When the water level in the pond was below 25 cm, water from RP_1, which was adjacent to the culture pond and always filled with water coming from the Marine Laboratory tanks and aquaria through a canal, would pass to the experimental pond through leakages in the dikes. Water conditions such as temperature, dissolved oxygen (DO) content, pH and salinity were monitored daily, morning and afternoon, using portable meters and a refractometer.

One month prior to fish stocking, the pond compartments were prepared and fertilized with chicken manure. Later, they were seeded with filamentous green algae. Similar treatments were given to the three pond replicates. The ponds were stocked with fish when about 50% of the pond surfaces was covered with filamentous green algae.

Due to the inadequacy of siganus fingerlings that could be collected at one time, three (3) batches of fish gathered on different dates and from different places were stocked simultaneously in the ponds on August 23, 1985.

RP_{2-a} was stocked with 120 siganid larvae with (TL) sizes ranging from 2.3 - 4.4 cm and with a mean weight of 0.84 grams. They were taken from the Zamboanguita sampling station on August 8, 1985. The larvae were conditioned for 15 days in a wooden tank at the BFAR/IDRC Laboratory. While being conditioned, the fish were fed with mosquito larvae and filamentous green algae (*Chaetomorpha spp.* and *Enteromorpha spp.*) attached on stones gathered from along the seashore.

The second batch of *S. guttatus* larvae stocked in RP_{2-b} and RP_{2-c} was brought from Polo, Tanjay, on August 23, 1985, or fifteen days after the arrival of the first batch. After sorting from the fish samples, the fry were directly stocked in the ponds without conditioning. Initial sizes (TL) of the fish ranged from 2.1 - 2.5 cm with a mean weight of 0.31 g.

During the first two months of culture no feed was given to the fish. The fish subsisted mainly on the natural food in the pond. On the third month and thereafter, 10 kg of filamentous green algae taken from a nearby pond were supplied weekly to each compartment. This was done because it was observed that the quantity of food available in the pond was minimal. Aside from the filamentous algae, no artificial feed was given throughout the culture period.

Only two samplings were made during the six-month culture period to avoid too much stress on the fish. The first sampling was on November 23, 1985 (after three months of culture) and the second was at harvest time. Twenty fish from each compartment were taken at random. The size (TL) and weight of each fish was recorded. At harvest, the total number of fish recovered was noted. Growth rates obtained in length and weight of the cultured fish were graphed and are presented in this paper.

Culture in a wooden tank

Twenty postlarvae of rabbitfish (*Siganus guttatus*) collected from Lutoban, Zamboanguita, on May 8, 1985, with sizes ranging from 2.5 - 3.2 cm, were stocked in a marine plywood tank, 8' x 4' x 2' at the BFAR/IDRC/SU Laboratory at the Silliman University Marine Laboratory Compound in Dumaguete, Negros Oriental. Aeration, using an electrically-run aerator, was applied. During the first month of culture, water depth was maintained at 30 cm. This was gradually increased to 45 cm in the succeeding months, until the end of the study. Water was partially changed daily during high tides. Water conditions (temperature, dissolved oxygen, pH and salinity) were monitored daily.

During the first month of culture the fish were fed with filamentous green algae (*Chaetomorpha* spp. and *Enteromorpha* spp.) taken from the fishpond and *Enteromorpha* growing on stones collected from along the shoreline. Approximately 2 kg of algae were put in the tank weekly. When mosquito larvae were available in the ponds, a small scoop was given to the fish every morning and afternoon.

In the fourth month of the culture period, commercial pelleted feed (Robina feed) was given every morning as supplementary food at 3% of the fish weight. Fecal matter and left-over feeds were siphoned out daily from the ponds.

The monthly growth rates were monitored by measuring all the fish individually. They are presented here in a graph. The overall monthly mean in weight, total length, and survival of the fish is presented in Table 1.

RESULTS

Growth rate in ponds

The growth rates of *Siganus guttatus* reared in ponds are presented in Figure 1. From a mean initial length (TL) of 2.59 cm and a mean weight of 0.48 g, the fish attained a mean length (TL) of 11.54 cm and a mean weight of 39.06 g after six months of culture. The growth was highest during the first three months, with a monthly mean of 2.3 cm in length (TL) and 7.33 g in weight. Slower growth was observed from the fourth to the sixth month, with only 0.68 cm increase in length and 5.77 g in weight.

The growth rate in terms of length during the first three months was a little less than the findings of Carumbana et al. (1979). She reared the same species in floating sea cages which gave a 2.63 cm increase in length (SL) per month. This could be due to the smaller fish used at the start of this study which had length ranging from 2.1 - 4.4 cm, against 4.71 - 8.78 cm used by Carumbana. Conditioning the fish prior to stocking in ponds could be another factor to consider.

Growth in weight obtained is comparable to that in the findings of Luchavez (1986) on a study of the same species, reared in brackishwater pond, which was 7.46 g per month. On the other hand, findings surpassed the growth rate obtained by Tahil (1978) on the same fish reared in a fishpond which gave only an average weight of 3.01 g per month.

Growth rate in wooden tanks

Figure 2 shows the mean monthly growth rate of *S. guttatus* reared in wooden tanks from May 8 to October 8, 1985. From an initial mean length (TL) of 2.88 cm and a mean weight of 0.79 g, the fish attained a mean length (TL) and a mean weight of 12.66 cm and 65.19 g, respectively, in five months' culture period. Growth rates were much higher than those obtained from the fish cultured in the pond.

The highest growth in length was obtained during the second and third months of culture (2.25 cm and 5.14 cm, respectively) but tended to slow down thereafter. Growth during the first month was quite slow. It gave only a mean length of 0.52 cm and a mean weight of 0.28 grams.

DISCUSSION

Results of the studies show that *Siganus guttatus* could be successfully grown in ponds and tanks.

Under natural conditions, post-larval fish stocked in ponds at a density of 3 fish per sq m and with sizes ranging from 2.1 -4.4 cm can attain weight from 25 - 59.9 g, depending upon the condition of the fingerlings at stocking. Growth rate was highest during the first three months of culture with a monthly mean length (TL) of 2.3 cm and a mean weight of 7.33 g. Slower growth in length started on the fourth month but growth in weight continued on an upward trend.

The growth rate attained in ponds could have been higher had the fish used in the study come from the same age group or were collected at the same time. As observed, fish used in replicate RP_{2-a} which were collected 15 days earlier, conditioned and acclimatized in tanks for two weeks prior to stocking, were bigger at harvest. From length ranges of 2.3 - 4.4 cm, the fish at harvest attained 10.3 - 15.3 cm in length and weights from 30.3 - 62.7 g, respectively. In other replicates (RP_{2-b} and RP_{2-c}) where the post larval fish stocked were newly collected from the wild and were smaller in size, lengths (TL) ranged from 2.1 - 2.6 cm; growth was slower. The fish grew to 8.5 12.4 cm in length and 21.2 - 44.5 g in weight. Table 1 shows the differences in growth rates of *S. guttatus* reared in the ponds, collected on different dates and subjected to the different conditions at the start of the study.

Based on the study undertaken, generally it could be stated that factors which could be considered important in the culture of the siganus are:

Larval conditioning

Conditioning of newly collected larvae for a week or two in tanks is necessary before stocking the fish in the rearing ponds. The conditioning period will allow the young fish to adapt themselves to the new environment and to recover from the stress and trauma during collection and transportation.

During the conditioning period, the fish could be trained to take other feed, entirely different from the food they used to take while in the natural environment. Fish growth is minimal during this period, but tends to be enhanced thereafter.

Fish larvae conditioned in tanks were found to grow faster when stocked in ponds, as shown by the larvae used in replicate RP_{2-a} of the study.

The need for conditioning the fish is highly evident as shown by the slow growth rate obtained during the first month of culture. As shown in Figure 2, the mean monthly increase in weight of the fish was only 1.076 g in the first month, against 14.7 g, 25.02 g, 38.96 g and 65.19 g in the second, third, fourth and fifth months, respectively. This observation was also clearly shown by the smaller-sized fish from replicates RP_{2-b} and RP_{2-c} in pond culture during the sampling period. In replicate RP_{2-a} (where fingerlings stocked were conditioned and had sizes ranging from 2.5 - 4.4 cm), the fish at harvest were bigger in size, from

10.3 - 15.3 cm in length (TL) and from 30.3 - 62.7 g in weight, with fish weighing above 40 g dominating. In replicates RP_{2-b} and RP_{2-c}, where the fish stocked were newly collected from the wild and had sizes (TL) ranging from 2.11 - 2.5 cm, smaller fish were harvested. The size range at harvest was 8.5 - 12.4 cm in length and 21.2 - 44.5 g in weight, with most fish weighing from 30 to 40 g each.

Environmental factors (water depth and characteristics)

The high growth rate obtained from fish reared in the tank can be attributed to the controlled environmental conditions. Water freshening was observed daily by pumping in fresh seawater during high tide. Temperature was maintained at 25°C to 28°C and salinity at 33 ppt. Dissolved oxygen was always maintained above 5 ppm by continuous aeration and pH was maintained at 6 to 6.2 by siphoning out fecal matter daily.

In pond culture, however, the slow growth rate of the fish could be due to the uncontrolled conditions in the environment. The shallow water level, most of the time ranging from 19.76 - 34.7 cm, cannot be considered an ideal depth for fish culture. The average depth of the water in the ponds was 29.78 cm throughout the study period. Water management could not be done effectively due to deteriorating dikes and gates. Seepage from adjacent fishponds was uncontrollable because the soil in the area is sandy. The pond bottom which is lower in relation to the water supply canal bottom makes water freshening very difficult. Stagnation of bottom water in the pond occurred. Letting in water was done whenever high tide warranted but letting out stagnant water in the pond, particularly at the lower portion, could not be effected. This caused the build-up of hydrogen-sulfide, characterized by the foul odor of the muddy bottom during harvest.

The water in the pond was shallow, hence, water temperature was high. It rose from 27.3 C in the morning to as high as 40°C at noontime, during the rearing period. The highest temperature (39.3 - 40 C) was experienced during the months of September and October. During warm days the pond water was also warm and the fish were observed to stay most of the time near the pond bottom and in shady areas. Seventeen fish died during those warm days: 5 from RP_{2-a}, 7 from RP_{2-b}, and 5 from RP_{2-c}. The mortality was presumably caused by high temperature and low dissolved oxygen of the pond water. For the whole duration of the study, dissolved oxygen varied from 0.85 - 6.42 ppm; hydrogen ion (pH) from 6.98 to 7.6; salinity from 17 - 35 ppt. The lowest oxygen reading was recorded at noontime. The inflow of low salinity water from the adjacent pond (RP_1) coming from the Marine Laboratory aquaria could have maintained a low salinity reading even when water temperature was high. As reported by

Luchavez (1987), salinity in the same pond during the past years rose to over 40 ppt during summer months. Along with these environmental factors, Alcala (1979), Carumbana and Luchavez (1979), reported that although juvenile *S. guttatus* are tolerant to salinities ranging from 2 ppt to 20 ppt, the species easily succumbs to high water temperature at 38ºC to 43ºC.

Availability of food supply

Availability of food is a very important factor in fish production. Its function is growth. This is clearly exemplified by the growth of siganus reared in the tank during this study, Growth rate was much higher than those reared in ponds. This was because filamentous green algae, (*Chaetomorpha* spp. and *Enteromorpha* spp.) were supplied weekly to the fish. They were also given live mosquito larvae, whenever available, supplemented with commercial pelleted feed during the last month of rearing.

The insufficient natural food growing in the fishpond (after the third month) could have caused the slow growth rate of the fish. It was observed that at this point of culture, the filamentous algae in the pond began to disappear, probably due to overgrazing by the fish. As a supplement, 10 kg of algae were then supplied once a week until the end of the study. The algae given, however, were fully consumed before another ration was given.

The percentage of survival was based on the number of fish recovered at harvest on March 14, 1986. This cannot be accurate as total drainage of the pond was not possible. The siganid has the tendency to burrow in the mud and it is possible that some fish were not recovered.

Another cause of low recovery could be the escape of some fish to the adjacent compartments through holes and leakages in the dikes. As mentioned earlier, oftentimes when the water level in the experimental ponds (RP_2) was low, water passed from RP_1, which was always filled with water coming from the Silliman University Laboratory. The fish could easily go from one pond to another.

Despite the problems of fish recovery, however, the averages of survival of 79.5% and 90% from the pond and tank, respectively, were obtained. In the pond culture, survival was highest in $RP_{2\text{-}a}$ with 92%. In $RP_{2\text{-}b}$ and $RP_{2\text{-}c}$, survival rates were 77.5% and 69.17%, respectively. Survival was highest in ponds stocked with fish which were conditioned prior to stocking.

CONCLUSION

Siganus guttatus is a promising species for aquaculture. It could be cultivated in ponds and in wooden tanks with optimum growth attained in five to six months. As reported by other authors, it was successfully reared in cages and pens. In ponds, optimum physico-chemical water parameter requirements should be maintained through proper water management.

The fish has a low food chain, feeding voraciously on filamentous algae. But it would take artificial feeds in confinement.

Post-larval and juvenile fish in schools are abundantly found in mangrove swamps and mouths of rivers along the shoreline. Hence, larvae supply is not a problem. They are hardy and resistant to stress from handling and transportation.

A good market demand for the cultured fish is another important point to consider. Rabbitfish is always in great demand in local markets.

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Table 1. **Growth rate of Siganus guttatus reared in ponds for six months**

	Ponds			
	$RP_{2\text{-}a}$	$RP_{2\text{-}b}$	$RP_{2\text{-}c}$	Average
No. of fish stocked	120	120	120	
Initial length (TL, cm)	3.05 ± 0.72	2.36 ± 0.10	2.38 ± 0.09	2.59 ±0.30
Initial wt (g)	0.84 ± 0.69	0.33 ± 0.07	0.29 ± 0.04	0.48 ± 0.27
Mean at harvest:				
TL length (cm)	12.44 ± 1.85	11.05 ± 0.96	11.14 ± 0.98	11.54 ± 1.26
Wt (g)	44.44 ± 12.43	35.29 ± 6.77	37.46 ± 7.01	39.06 ± 8.74
Mean increase (6 mo.)				
TL length (cm)	9.39 ± 1.13	8.69 ± 0.86	8.76 ± 0.89	8.95 ± 0.96
Wt (g)	43.60 ± 11.74	34.96 ± 6.70	37.17 ± 6.97	38.58 ± 8.47
Monthly increase:				
Wt (g)	7.27 ± 1.96	5.83 ± 1.11	6.19 ± 1.16	6.43 ± 1.41
length (TL, cm)	1.56 ± 0.19	1.45 ± 0.14	1.46 ± 0.15	1.49 ± 0.16
Survival (%)	92.5	72.5	69.17	78.05

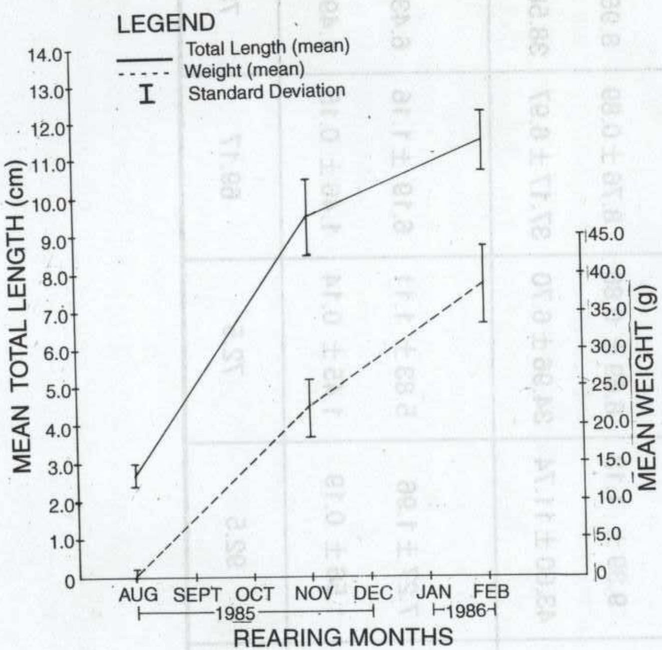

Figure 1. **Growth rate of *Siganus guttatus* reared in ponds (Random samples of 25 fish from each pond)**

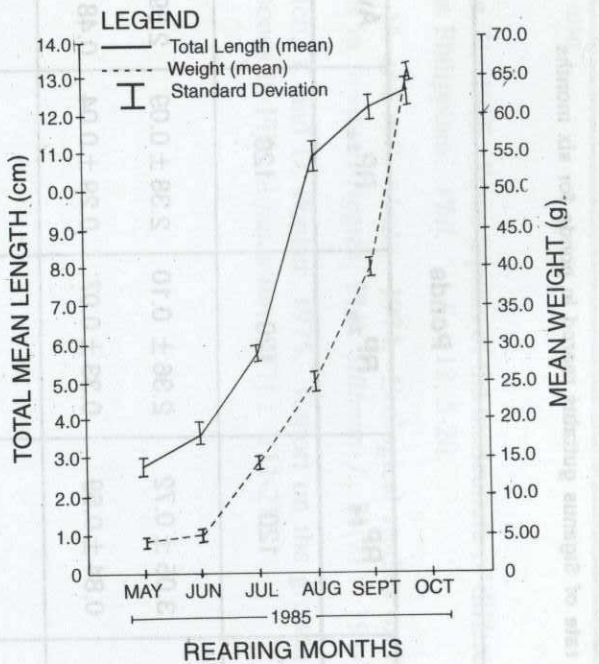

Figure 2. **Growth rate of *Siganus guttatus* reared in tanks**