OBSERVATIONS ON THE REARING OF THE FISH SIGANUS GUTTATUS (BLOCH) (SIGANIDAE) IN BRACKISH WATER PONDS IN SOUTHERN NEGROS, PHILIPPINES

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A growth rate study was conducted on Siganus guttatus fry in two brackish water ponds from 29 November 1979 to 20 September 1980. A total of 342 acclimatized fish (3 batches) were released in Pond I and 190 in Pond II. In Pond I, the monthly increase was 7.46 g for the first batch, 5.58 g for the second batch and 6.20 g for the third batch. The fish in Pond II had the highest monthly increase of 13.58 g. Tolerance of this species to salinity, temperature and dissolved oxygen is discussed.

Siganids, represented by about 25 species in the Indian and western Pacific Oceans (Woodland and Allen, 1977), are highly esteemed food fishes in the Philippines which have recently been receiving widespread attention as potential candidates for mariculture (Lam, 1974; Popper and Gundermann, 1975; von Westernhagen and Rosenthal, 1976). Studies of the growth rates of siganids include those of S. canaliculatus and S. spinus in aerated aquaria (Laviña and Alcala, 1974); S. canaliculatus and S. spinus in sea cages (Horstman, 1975); S. canaliculatus and S. concatenata (S. guttatus) in the laboratory (von Westernhagen, 1975); S. canaliculatus, S. spinus and S. guttatus in the laboratory and sea cages (Carumbana and Luchavez, 1979b); S. canaliculatus, S. spinus and S. argenteus in Guam waters (Tsuda et al., 1974); S. rivulatus in tanks and sea cages (Ben-Tuvia et al., 1973); S. vermiculatus in dirt ponds (Lichatowich and Popper, 1975); S. guttatus in sea cages and fish pens (Tahil, 1978) and S. vermiculatus in nature and ponds (Gundermann et al., 1983).

This paper reports on the growth and tolerance of S. guttatus reared in brackish water ponds in Dumaguete, southern Negros, Philippines, with a view toward assessing the potential of this species for mariculture in ponds.

MATERIALS AND METHODS

The experiment was conducted in two ponds designated as I and II, located behind the Silliman University Marine Laboratory in Bantayan, Dumaguete. The ponds were adjacent to each other, with dimensions of 28 m long, 62 m wide and 30 m long, 30 m wide, respectively. The average depth of water in both ponds was about 39 cm. Sea water was supplied by the incoming tide (of at least 1.3 meters) through a small creek and a small canal leading to the ponds. The temperature of the water was monitored three times daily (morning, noon and afternoon) for two weeks each month during the observation period, using a mercury thermometer. Salinity was determined three times a week for two weeks every month using a refractometer, while the dissolved oxygen concentration of the sea water was determined twice every month using the Winkler method.

S. guttatus fry were collected using bamboo fish traps from the mangrove swamps in Sanlagan, South Bais Bay, Negros Oriental. Collection of fry was made four times, in November 1979 and in April, July and August 1980. Before being placed in the experimental ponds, all fish were acclimatized for a week in large concrete tanks. The first day, the tank held normal seawater. Each day following, fresh water was added to reduce the salinity from 34 ppt to the salinity of pond water at the rate of 2 ppt daily. Using a steel ruler and a "Harvard Trip Balance" the standard lengths (SL) and weights of a random sample of 25 fish from each group were taken. Their mean standard length and mean weight were recorded as initial measurement and weight.

A total of 342 acclimatized fish (three groups) were released in Pond I: Batch 1, 117 on 29 November 1979, with standard lengths ranging from 31 to 80 mm; Batch 2, 79 on 23 April 1980, with standard lengths ranging from 52 to 88 mm; and Batch 3, 146 on 5 July 1980, with standard lengths ranging from 23 to 55 mm. On 9 August 1980, 190 fish were stocked in Pond II; these had standard lengths ranging from 23 to 62 mm. The fish were always released in the ponds in the evening, when the temperature of the pond water was 32°C or lower.

The experimental fish in each pond were given only about 12 kg of green filamentous algae (Enteromorpha spp. and Rhizoclonium kerneri) daily. The algae was collected from a river mouth and fishpond nearby. Oftentimes, these foods were supplemented with young fresh leaves of "ipil-ipil" (Leucaena) and "kangkong" (Ipomoea reptans).

The growth rate of the first batch of fish was determined for a sample of 25 fish harvested from Pond I on 28 May 1980. On 20 September 1980, the experiment was terminated when all experimental fish in the ponds died. The mean standard lengths and weights of the second and third batches of fish in Pond I and those in Pond II were taken from a random sample of 25 dead fish.

Their growth rates were computed.

RESULTS AND DISCUSSION

Growth rates.

Table 1 summarizes the data on growth of S. guttatus reared in the ponds. The fish in the first batch weighed 44.78 g after six months; those in the second batch 27.88 g after five months; and those in the third batch 12.31 g after two months. In Pond II, the fish weighed 13.58 g after one month. The mean monthly increase was 7.46 g for the first batch, 5.58 g for the second batch and 6.20 g for the third batch.

The first, second and third batches of fish had an almost uniform monthly growth rate. The fish in Pond II had the biggest growth rate, more than twice those in Pond I. These fish were younger than most of those in Pond I, as indicated by their initial size range of 23 to 62 mm. The lower growth rate of fish in Pond I was probably due to the smaller amount of food available per individual. As mentioned earlier, the same amount of food was placed in the two ponds, but Pond I had more fish (342) than Pond II (190).

The growth rates of S. guttatus in the ponds are much higher than those obtained by Tahil (1978), who reported an increase of only 18.09 g after six months (3.01 g/month) of rearing in sea cages and 19.0 g (3.1 g/month) in a fishpen, probably because his fish stocks were larger (initial mean standard lengths were 7.89 cm and 7.88 cm in the sea cage and fishpen, respectively). Carumbana and Luchavez (1979b) reported that S. guttatus reared in a sea cage for two months and given Enteromorpha spp. increased by 24.57 g in weight and 40.66 mm in standard length. The monthly growth increase was 12.21 g and 26.33 mm, much higher than the growth of fish in Pond I but comparable to that of the fish in Pond II.

Mortality and tolerance to physical factors.

The temperature and salinity of the water in the ponds during the experimental period from December 1979 to September 1980 fluctuated. Temperature varied from 27 to 43 °C, with March and September 1980 having the highest temperatures of 40 and 43 °C, respectively; salinity varied from 2 to 25 ppt, with March 1980 having the lowest salinity of 2 to 4 ppt. Dissolved oxygen concentration varied from 0.9 to 5 mg/l. It was also found that the pH of the experimental ponds varied from 7.6 to 8.0; the nitrite concentration was always below 0.1 mg/l (Carumbana and Luchavez, 1979b). Maximum temperatures of 38 to 40 °C in March 1980 and 38 to 43 °C in September 1980 were caused by prolonged sunny periods without rain. During this period, the water in the

Table 1. Growth rate of Siganus guttatus reared in brackish water ponds.

	POND NUMBER			
	I			II
	BATCH 1	BATCH 2	BATCH 3	
Number of fish stocked	117	79	146	190
Initial size range in SL (mm)	31-80	52-88	23-55	23-62
Initial mean SL (mm)*	45.92±12.76	67.16±10.04	36.0 ±10.0	39.08± 9.66
Initial mean weight (g)*	4.27± 3.93	11.02± 4.70	2.25± 1.84	2.57± 2.03
Mean SL (mm) at harvest*	110.84± 5.63	104.16± 2.63	71.64± 4.45	71.88± 6.57
Mean weight (g) at harvest*	49.05± 7.08	38.90± 5.92	14.56± 3.38	16.15± 4.07
Mean increase in weight (g) at harvest*	44.78± 3.15	27.88± 1.22	12.31± 1.54	13.58± 2.04
Mean monthly increase in weight (g)*	7.46± 0.53	5.58± 0.25	6.20± 0.77	13.58± 2.04
Number of fish sampled	25	25	25	25
Period of rearing (months)	6	5	2	1

*Figures following means are standard deviations.

ponds was shallow, only about 19 cm deep, because the low tides (neap tides) could not supply the ponds with sea water for almost two weeks. To keep the ponds from drying up, fresh water was added, resulting in the reduction of salinity to 2 ppt in March 1980.

Mortality of fish occurred twice during the experimental period. The first event was in March 1980, when 32 of 117 fish died in Pond I. The second happened in September 1980, when all experimental fish died in both ponds. At both times the maximum recorded water temperature varied from 38 to 43 °C. The high temperatures of the pond water combined with low salinity probably caused the death of the fish.

Siganus guttatus can tolerate a fairly wide range of salinities (Carumbana and Luchavez, 1979a) under moderate temperatures. Juvenile S. guttatus have been found in river

mouths and tidal lagoons with salinities ranging from 2 to 20 ppt (Alcala, 1979) and adults are said to suffer no adverse effects when transferred from natural sea water to 5 ppt salinity (von Westernhagen and Rosenthal, 1976). Carumbana and Luchavez (1979a) also reported that S. guttatus can tolerate dissolved oxygen reduction to 0.70 mg/l at tempertaures of 28 to 29 °C. It is evident from these data that although S. guttatus is tolerant to large changes in salinity and of low dissolved oxygen concentration, this species easily succumbs to high temperatures (38 - 43°C).

CONCLUSION

The cultivation of S. guttatus in inland ponds may be feasible only if salinity and water temperatures are kept within the tolerance limits of the fish (28 - 32°C, 4 - 34 ppt) and if the rearing ponds are properly fertilized to allow abundant growth of algae serving as food for siganids. Providing shade and deep canals along the sides of rearing ponds may help ensure optimal water temperature and a steady supply of water.

ACKNOWLEDGEMENTS

The financial support of Filipinas Foundation, Inc. is gratefully acknowledged. The author also wishes to express her thanks to Dr. Angel C. Alcala for coordinating the project and editing this paper, to Esther Carumbana, Sally Alcazar, Zacharias Generoso and Teodulo Luchavez for their invaluable help, and to Miss Araceli Meñez, who kindly typed the manuscript.

LITERATURE CITED

Alcala, Angel C. 1979. Ecological notes on rabbitfishes (Family Siganidae) and certain economically important marine animals in southern Negros and environs, Philippines. Silliman Journal 26:115-133.

Ben-Tuvia, A., G. W. Kissil and D. Popper 1973. Experiments in rearing rabbitfishes (Siganus rivulatus) in sea water. Aquaculture 1:359-364.

Carumbana, E. E. and J. A. Luchavez 1979a. Oxygen consumption and short-term effects of reduction in salinity and dissolved oxygen concentration on Siganus canaliculatus, S. spinus and S. guttatus under laboratory conditions. Silliman Journal 26:172-186.

Carumbana, E. E. and J. A. Luchavez 1979b. A comparative study of the growth rates of Siganus canaliculatus, S. spinus and S. guttatus reared under laboratory and semi-natural conditions in southern Negros Oriental, Philippines. Silliman Journal 26:187-207.

Gundermann, N., D. M. Popper and T. Lichatowich 1983. Biology and life cycles of Siganus vermiculatus (Siganidae, Pisces). Pacific Science 37 (2):165-179.

Horstman, U. 1975. Some aspects of the mariculture of different siganid fishes in the Philippines. Phil. Scientist 12:5-20.

Lam, T. J. 1974. Siganids: their biology and mariculture potential. Aquaculture 3:325-354.

Laviña, E. M. and A. C. Alcala 1974. Ecological studies on Philippine siganid fishes in southern Negros, Philippines. Silliman Journal 21:191-210.

Lichatowich, T. and D. Popper 1975. Report on the growth of rabbitfish in fish ponds in Fiji. Aquaculture 5:211-212.

Popper, D. and N. Gundermann 1975. Some ecological and behavioral aspects of siganid populations in the Red Sea and Mediterranean coasts of Israel in relation to their suitability for aquaculture. Aquaculture 6:127-141.

Tahil, A. S. 1978. Experiments in rearing Siganus guttatus (Pisces: Osteichthyes, Siganidae) in a sea cage and fish pen in the Philippines. Phil. Sci. 15:50-66.

Tsuda, R. R., G. P. Bryan, W. J. Fitzgerald and W. J. Tobias 1974. Juvenile-adult rearing of Siganus (Pisces): Siganidae) in Guam. SPC Seventh Tech. Meet. Fish., Nuku´ Alofa, Tonga (July 15-19).

Von Westernhagen, H. and H. Rosenthal 1975. Rearing and spawning siganids (Pisces: Teleostei) in a closed seawater system. Helgolander wiss. Meeresunters 27:1-18.

_____ 1976. Some aspects of the suitability of various Philippine siganid species (Siganidae) for mariculture. Aquaculture 9:297-311.

Woodland, D. J. and G. R. Allen 1977. Siganus trispilus, a new species of Siganidae from the Eastern Indian Ocean. Copeia 1977:617-620.

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