Japanese Journal of Ichthyology
Vol. 23, No. 4 1977

魚類学雑誌
23巻4号 1977年

Spawning Behavior and Development of Eggs and Larvae of the Striped Fingerfish, *Monodactylus sebae*

Sumito Akatsu, Yoshimitsu Ogasawara, and Fujio Yasuda

(Received October 28, 1976)

Abstract After 15 months' rearing in brackish water (Cl: 2.82~3.75‰), *Monodactylus sebae* (Cuvier) spawned repeatedly. Spawning activity was observed from evening to mid-night. The interval of the spawning was five to 10 days, and the number of eggs fluctuated at a cycle from 18 to 28 days. The eggs were round, isolated and floating but sunk to the bottom in fresh water. They hatched out 20 hours after fertilization at 25°C. The optimum salinity for the development of eggs and larvae was 25% sea water (Cl: 4.59~4.64‰). The larvae were elongate in shape during the prelarval stage, and became higher from the 23rd day after hatching and on. The fin rays attained the specific numbers by the 33rd day.

Introduction

Monodactylus sebae occurs in inshore and estuarine waters of West Africa from Senegal to Congo (Wheeler, 1975). It is a common fish in its range, occasionally entering freshwaters. The fish is much more limited in range than its congener, *M. argenteus*, which is distributed widely in the Indo-Pacific from the Okinawa Islands through Australia and India to East Africa.

The spawning of *M. sebae* in captivity and its early development have been reported by Hegedus and Johnson (1968) and Wey (1971), but the details of its early life history and the physiological characters of eggs and larvae are not known. In the course of our rearing experiment of *M. sebae*, we were able to observe its spawning behavior and the development and salt tolerance of eggs and larvae.

Material and method

Ten young of *Monodactylus sebae* of about 3 cm in standard length imported from West Africa were transferred from Fuji Enterprise Co. Ltd. to our laboratory at Tokyo University of Fisheries.

The fish has been reared up to now in a round plastic tank of 0.5 ton in capacity with closed water circulation system, kept at 25~28°C in water temperature and Cl: 2.82~3.75‰ in salinity, fed with chopped clam. The fish grew to 100 mm in standard length in 15 months.

Eight of the ten individuals, three females and five males, were used for the present experiment. These individuals were housed in three containers: tank A and B, each 0.5 ton round plastic tank, and stocked with two males and a female; tank C, 150 *l* square plastic tank, with one male and one female. In each tank a siphon was installed so that eggs were automatically gathered into a fine-meshed net in the filter tank. When spawned the eggs were counted and those fertilized were transferred into 5 *l* glass jars and raised at a water temperature of about 25°C.

For the experiment of the salt tolerance of eggs and larvae, each 100 eggs were put in five 1 *l* beakers containing 0%, 25%, 50%, 75% and 100% sea water, respectively.

Fin-ray and scale counts in young were made on alizarin stained specimens.

Spawning behavior

Spawning activity was observed from evening to mid-night in tank A and B, the female first moved toward the tank wall and kept facing to the wall and moving her pectoral fins. The paired male stayed close behind the female. When the female trembled and twisted herself, with the dorsal and anal fins bent backward, the male got close to the female and pecked on her abdomen and anal fin, and then the pair started swimming side by side executing hairpin turns. Another male in the tank was not able to

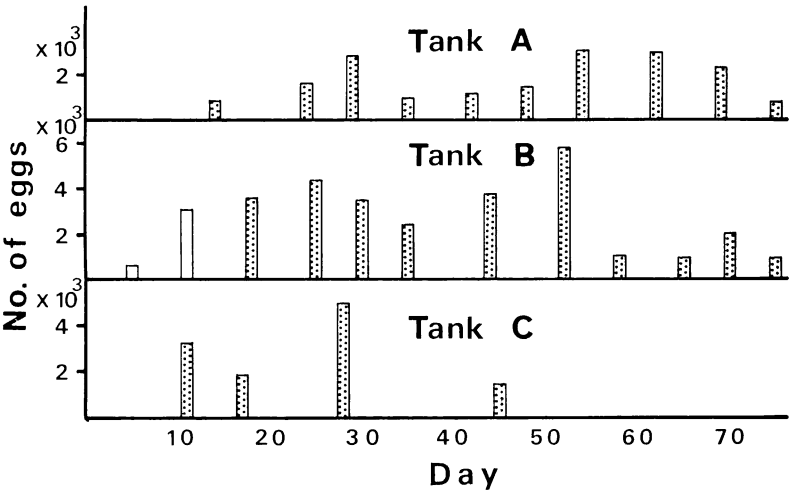

Fig. 1. Number of eggs spawned and interval of spawning. Shaded rectangle indicates ripe and fertilized eggs; hollow rectangle unripe eggs.

be associated with this pair. Spawning occurred during this vigorous swimming. The female and the two males were peaceful in the daytime, but the paired male became superior to another male with the incoming of night. In tank C, which is stocked with one female and one male, the action of the pair was not so passionate as in tanks A and B.

The number of eggs spawned and spawning interval in each tank are shown in Fig. 1.

Development of egg

The spawning occurred at a rather regular interval of five to 10 days, but the number of eggs varied from 825 to 5847, fluctuating at a cycle from 18 to 28 days (Fig. 1).

The eggs were round, isolated and floating, 0.64~0.69 mm in diameter (mean 0.67 mm). The perivitelline cavity was small. The yolk was colorless and transparent, with irregular bubble-shaped clefts. In the yolk there

Table 1. The development process of eggs of *M. sebae*. Water temperature: 25°C.

Time after fertilization		State of development	Drawing No. in Fig. 2
hr.	min.		
	0	Egg fertilized	A
	6	Blastodisc formed	
	11	2-cell stage	
	18	4-cell stage	
	33	8-cell stage	B
1	30	Morula stage	C
3	00	Blastula stage	D
4	30	Germ ring formed	E
5	30	About half of yolk covered by blastderm	F
7	00	Blastopore closed	G
9	00	Pigment cells appeared on yolk	H
10	00	5-myotome stage; optic vesicles Kupffer's vesicle and melanophores appeared	I
12	00	Erythrophores appeared	J
16	00	24-myotome stage; eye balls and auditory placodes appeared. Heart pulsing	K
20	00	Immediately before hatching	L

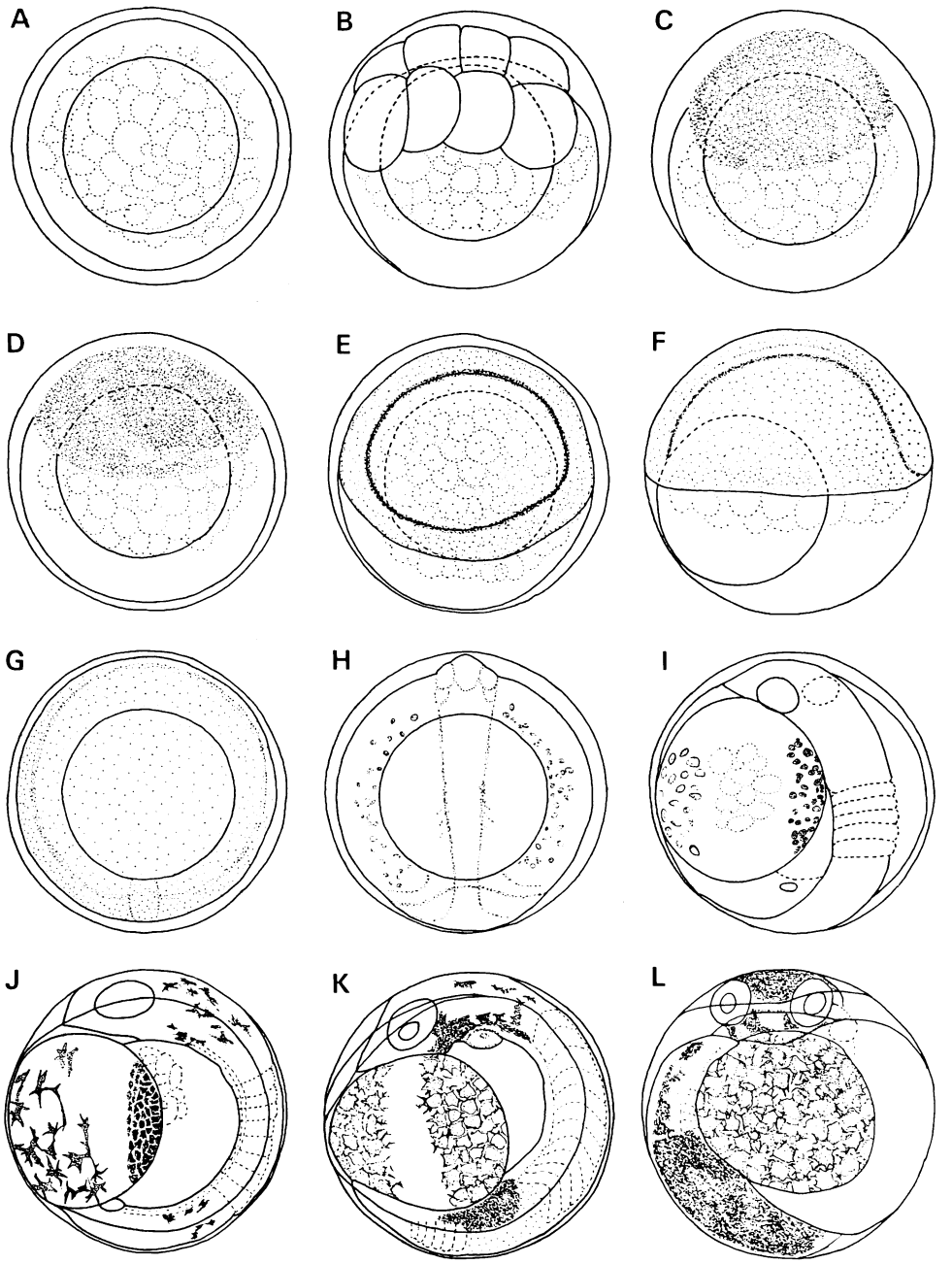

Fig. 2. Egg development of *M. sebae*. A: Egg fertilized, 0.67 mm in diameter. B: 8-cell stage, 33 min. C: Morula stage, 1 hr. 30 min. D: Blastula stage, 3 hrs. E: Germ ring formed, 4 hrs. 30 min. F: about half of yolk covered by blastderm, 5 hrs. 30 min. G: Blastopore closed, 7 hrs. H: Pigment cells appeared in yolk, 9 hrs. I: 5 myotome stage; optic vesicles kupffer's vesicle and melanophores appeared, 10 hrs. J: Erythrophores appeared, 12 hrs. K: 24 myotome stage; eye balls and auditory placodes appeared. Heart pulsing, 16 hrs. L: Immediately before hatching, 20 hrs.

was a colorless, transparent oil globule of 0.38 to 0.42 mm in diameter.

The process of the development of eggs are shown in Table 1 and Fig. 2. The pigment cells, which were first observed on the yolk nine hours after fertilization, moved to the surface of the oil globule and increased in both number and size with the development of eggs.

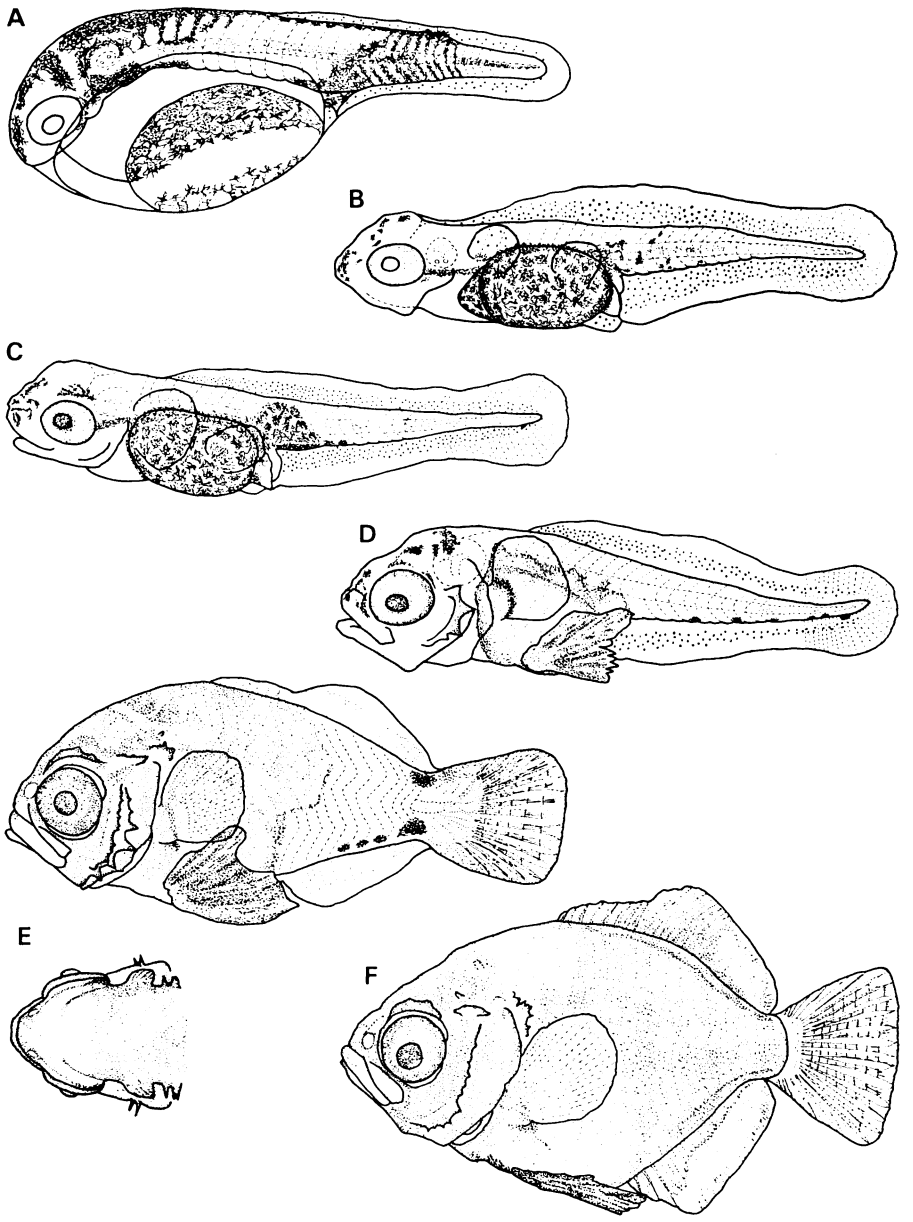

Fig. 3. Reared larvae, juveniles and young of *M. sebae*. A: prelarvae, immediately after hatching, 1.79 mm. B: Two days after hatching, 2.63 mm. C: Three days after hatching, 2.59 mm. D: 13 days after hatching, 30.9 mm. E: 23 days after hatching, 5.25 mm. F: 33 days after hatching, 8.92 mm all in mean total length.

Development of larvae

1) Prelarvae immediately after hatching, 1.79 mm in mean total length (Fig. 3, A). The yolk was ellipsoid with an oil globule at its posterior end. The anus opened slightly behind the 12th myotome. The vertical fin folds were provided with granular structure, and extended along and entire boarder of the body except the head and belly. The pectoral and pelvic fins were not formed. The mouth was not open. The eyes had on melanophores. The head and the anterior half of the tail were covered with numerous arborescent melano-and erythrophores. Erythrophores were observed on the surface of the oil globule, and melanophores on the other side of the globule. (Fig. 3, A). The larvae tended to float in surface layer. They began their first controlled swimming 30 to 60 minutes after hatching, mostly tending to swim to the bottom.

2) Two days after hatching, 2.63 mm in mean total length (Fig. 3, B). Pectoral fins were round in contour. Pelvic fins extended horizontally. The yolk sack reduced in size. The mouth was not open. Melanophores appeared in the eyes, and also covered whole part of the abdomen and a part of the yolk sac.

3) Three days after hatching, 2.59 mm in mean total length (Fig. 3, C). The yolk was absorbed, while the oil globule remained. The mouth opened at the lower corner of the snout. The gill slits were open. Two or three melanophores were present on the median ventral line. Hypural rudiment appeared.

4) 13 days after hatching, 3.09 mm in mean total length (Fig. 3, D). The body became higher. Vertebrae in the anteriormost part of the body was recurved downward and those in the posteriormost portion was recurved upward. The hypural rudiment became larger. The pectorals and pelvics began to develop. Five spines were formed on the margin of the preopercle. Melanophores on the median ventral line increased to 4 to 7 in number.

5) 23 days after hatching, 5.25 mm in mean total length (Fig. 3, E). The body became much higher. The dorsal and anal fins were separated from the caudal fin. 7 or 8 spines were observed in the dorsal fin, and 2 or 3 in the anal. Several segments were found in the caudal fin rays. Hypurals were observed. 10 or 11 spines were present on the striae in the anterior part of the preopercle and 5 or 6 on the posterior margin of the bone. Projecting serratures were formed on the supraorbital, on the preopercle and on the upper part of the opercle. These bones became covered by the skin when the fish attained about 20 mm in total length.

Melanophores increased in number and covered the body before the anus. A pair of large melanophores appeared on the upper and lower sides of the caudal peduncle. The time of the formation of these melanophores coincided with that of the completion of the caudal fin. Myotomes were well developed, and the fish started swimming actively. Nostrils were formed.

6) 33 days after hatching, 8.92 mm in mean total length (Fig. 3, F). Body depth was about 48 percent of total length. The fin-rays attained the specific number: D. XIII, 33; A. III, 35; P. I, 5. Melanophores were observed on all over the body except the fins. The preoperclar spines reduced in size but increased in number. Scales appeared on the anterior part of the pelvic fin.

The growth of larvae indicated by the total length is shown in Fig. 4 together with

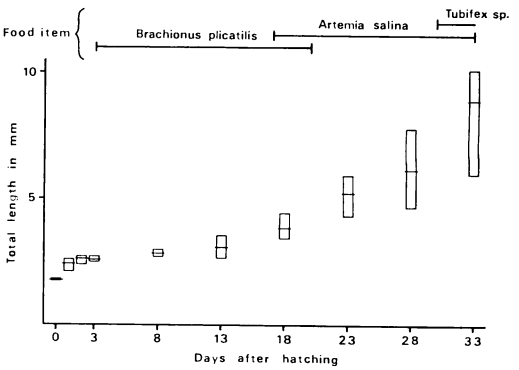

Fig. 4. The growth of larvae in total length and food items. Hollow rectangle indicates range, horizontal bar mean. Horizontal line refers to the duration of feeding with each food item.

food items given to the larvae.

Influence of salinity on the development of eggs and on the growth of larvae

The salt tolerance of eggs and larvae expressed in the survival rate are shown in Figs. 5 and 6, and the rate of hatching and of abnormal larvae is shown in Table 2.

In the experiment started with eggs of the morula stage, all of the eggs survived up to 24 hours after the start of the experiment, and all hatched out excepting for those in 100% sea water section (Fig. 5). However,

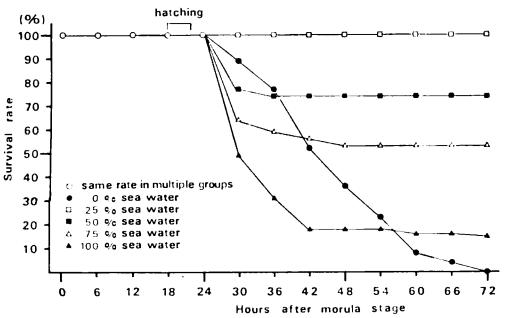

Fig. 5. Survival rate of eggs and larvae of *M. sebae* in different salinity sections. Eggs were introduced into each salinity section at the morula stage. Number of eggs used is 99 in 0% section, 97 in 50% section and 100 in all other sections. It is noted that some eggs are not yet hatched out by the end of this period.

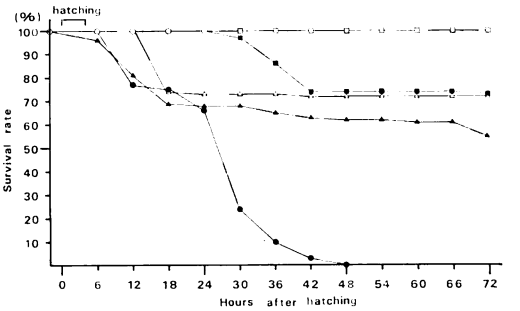

Fig. 6. Survival rate of larvae of *M. sebae* in different salinity section. Eggs were transferred into each salinity section immediately before hatching. Number of eggs used is 100 for each section.

influence of unsuitable salinity was exhibited in the high rate of abnormality (Table 2). In 0% and 100% sections, newly hatched larvae tended to die abruptly, and those in 0% section were totally died by 72 hours after the start of the experiment. Twenty-five % section showed the best survial (survival rate, 100%), and 50% section comes next (survival rate, ca. 70%).

In another experiment started with eggs immediately before hatching, the death of larvae was not so quickened as in the foregoing experiment. Again in this experiment 25% section yielded the highest survival rate (100%), and 0% section the lowest, all larvae being died by 48 hours after the start of the

Table 2. Rate of hatching and of abnormal larvae of *Monodactylus sebae* in different salinity sections.

	Salinity (% sea water)	0	25	50	75	100
I	Rate of hatching (%)	100*	100	100**	100	89
	Rate of abnormal larvae (%)	32	3	21	80	82
II	Rate of hatching	100	100	100	100	100
	Rate of abnormal larvae	0	0	3	4	15

Notes: N=100. *Initial number of egg 99. **Initial number 97.
I, eggs were kept in each salinity section from morula stage.
II, eggs were kept in each salinity section from immediately before hatching.

experiment (Fig. 6). The occurrence of abnormal larvae was of much lower rate than in the foregoing experiment (Table 2).

Comparison of the results of the first and second experiments indicates that the quickened death of larvae in the first is attributable to the influence of unsuitable salinity during egg stage. It also shows that 25% sea water (Cl: 4.59～4.64‰) is optimum to the development of eggs and larvae, that larvae cannot survive in freshwater, and that pure sea water is not favourable environment for the larvae either.

Though there is no observation of where *M. sebae* spawn in their natural habitat, these results should probably indicate that the fish spawns in brackish water, or otherwise it spawns in freshwater and eggs flow down into brackish water.

Acknowledgments

The authors wish to express their sincere thanks to the staff of Fuji Enterprise Co. Ltd., who provided live specimens of *M. sebae* for the study. We also thank Dr. Yasuhiko Taki, Tokyo University of Agriculture, for his useful advice and critical reading of the manuscript.

Literature cited

Hegedus, A. M. and A. C. Johnson. 1968. Reproduction and early development in *Monodactylus sebae*. Drum Croaker (Wash)., 68 (3): 19～23, 2 figs.

Wheeler, A. 1975. Fishes of the world, an illustrated dictionary. Macmillan Pub. Co., New York, xiv+366 pp., 501 color pls.

Wey, W. 1971. Lots of monos. Anchor, 5: 67～73, 4 figs.

(Tokyo University of Fisheries, 4-5-7, Konan, Minato-ku, Tokyo 108, Japan).

ヒメツバメウオ科 *Monodactylus sebae* の初期発生と産卵習性

赤津　澄人・小笠原　義光・安田　富士郎

Monodactylus sebae (Cuvier) の産卵には泳ぎ回れる充分な広さが必要で，産卵行動は夕方から夜間にかけて行われ，5～10 日ごとに産卵し，18～28 日目に産卵の山が現れた．卵は分離浮遊性であり，水温約 25°C で約 20 時間でフ化した．卵および前期仔魚の飼育には 25% 海水 (Cl: 4.59～4.64‰) が適しており，卵発生は他の硬骨魚類と大きな差はなかった．フ化後 33 日目には体高は高くなり黒色素が体全体を蔽い，各鰭条はほぼ定数に達していた．

(108 東京都港区港南 4-5-7 東京水産大学)