Japanese Journal of Ichthyology
Vol. 35, No. 1 1988

魚類学雑誌
35巻1号 1988年

Development of the Cottid Fish, *Pseudoblennius percoides*, Reared in the Laboratory, with Brief Descriptions of Juvenile *P. marmoratus* and *P. zonostigma*

Seishi Kimura, Kingo Tsumoto and Koichiro Mori

(Received February 23, 1987)

Abstract Embryonic, larval and juvenile development of the cottid fish, *Pseudoblennius percoides* were described on the basis of a series of laboratory-reared specimens. The eggs were demersal, adhesive, almost spherical in shape, measuring 1.66–1.82 mm in diameter, and with numerous various-sized oil globules. Neighboring eggs adhered to each other to form an egg mass. Hatching occurred between 13 and 16 days after spawning at a water temperature of 15.4 to 16.5°C. Newly hatched larvae measured from 6.5 to 7.3 mm, averaging 6.9 mm TL, and possessed 40 myomeres. Absorption of the yolk was completed at about 7.5 mm TL. Flexion of the notochord started and finished at about 10 mm TL and about 14 mm TL, respectively. Aggregate numbers of all fin rays were completed at over 16 mm TL, when the larvae reached the juvenile stage. The pigment pattern became the same as that of adults in juveniles longer than 25 mm TL. Lateral lines were completed at over 44 mm TL, when the juveniles attained to the young stage. The early stages of this species were clearly distinguished from those of *P. cottoides*, and the juveniles of four *Pseudoblennius* species, i.e. *P. percoides*, *P. cottoides*, *P. marmoratus* and *P. zonostigma*, could be identified mainly by their pigment patterns.

Pseudoblennius percoides Günther is a common marine cottid fish inhabiting *Zostera marina* or *Sargassum* beds in shallow waters along the coast of southern Japan. Only a little is known about the embryonic development and the hatched larvae of this species (Fujita, 1957). We described the eggs, larvae and juveniles of *P. cottoides* (Richardson) from a series of reared specimens in the previous paper (Kimura et al., 1987). In this report embryonic, larval and juvenile development of *P. percoides* were described in the same way as in the previous paper, and those of the congeneric species were compared with each other.

Materials and methods

Four females (158.4–168.8 mm in total length (TL)) were caught by angling at the mouth of Ago Bay, Mie Prefecture (lat. 34°16′45″N, long. 136° 46′30″E) in November, 1985. The rearing methods of the parental fish, eggs, larvae and juveniles were the same as in the previous paper (Kimura et al., 1987) except the incubating temperature which ranged from 15.4 to 16.5°C. The preservation and measurements of the specimens also followed the methods of the previous paper.

Results and discussion

Spawning. The females spawned fertilized eggs, proving that they had already copulated before our collection. Fertilization took place entosomatically maybe just before spawning. Spawning occurred continuously from November 20 to 30, 1985.

Embryonic development. The eggs were demersal, adhesive, and almost spherical in shape, measuring 1.66–1.82 mm in diameter (Fig. 1A). Neighboring eggs adhered to each other to form an egg mass. The chorion was colorless and transparent. The yolk was pale yellowish green or pale bluish green in color. There were numerous and various-sized oil globules in the yolk just after spawning. The perivitelline space was narrow.

Embryonic development of the eggs was as follows: The blastodisc began to elevate at 2 h after spawning. 2-cell stage at 5 h 40 min, 4-cell stage at 7 h 45 min (Fig. 1B), 8-cell stage at 9 h, blastula stage in 1 d, gastrula stage in 2 d after spawning. Two days and five hours after spawning, half of the yolk was covered by blastoderm and the embryonal body appeared (Fig. 1C).

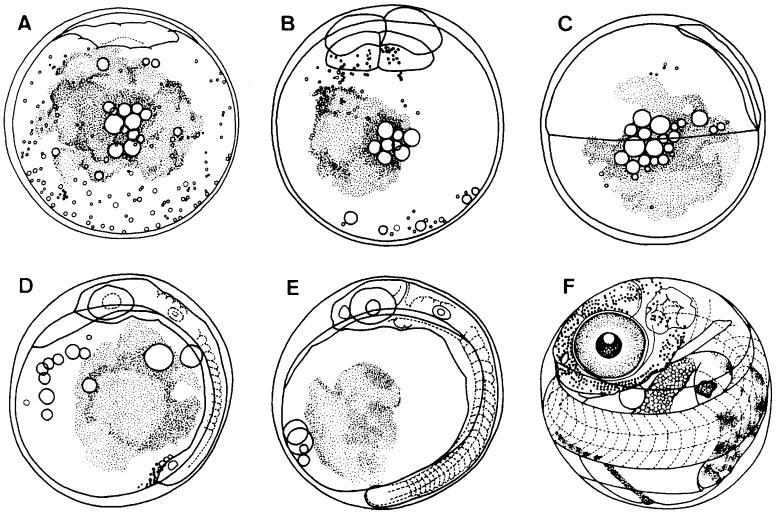

Fig. 1. Development of eggs of *Pseudoblennius percoides*. A, fertilized egg newly spawned; B, 4-cell stage, 7 h 45 min after spawning; C, formation of embryo, 2 d 5 h; D, formation of auditory vesicles, 3 d 12 h; E, 26-myomere stage, 5 d; F, just before hatching, 13 d.

Three days after spawning, the balstopore was closed, optic and Kupffer's vesicles appeared, and six myomeres were present. Auditory vesicles, optic lenses, and 13 myomeres were observed in 3 d 12 h after spawning (Fig. 1D). Four days after spawning, 18 myomeres were observed and Kupffer's vesicle disappeared. Five days after spawning, the myomeres increased in number to 26, the heart pulsated, and the embryonal body moved intermittently (Fig. 1E). The eyes became blackish in color in 6 d, and the pectoral fins formed in 7 d after spawning. Nine days after spawning, the mouth was open, numerous hatching glands were present on the head, and melanophores were located on the dorsal surface of the yolk, on the yolk beneath the pectoral base, and along the ventral contour of the tail. Ten days after spawning, xanthophores appeared on the top of the head, at the auditory capsule, on the dorsal surface of the yolk, and along the spinal chord anterior to the anus. Hatching occurred between 13 and 16 days after spawning.

During embryonic development, the oil globules decreased in number, and became a single droplet about 7 days after spawning. The perivitelline circulation was observed before hatching. Fujita (1957) described that the yolk became pale in color with embryonic development, but in our experiment color change of the yolk did not occur.

Yolk-sac larvae. The newly hatched larvae measured 6.5 to 7.3 mm, averaging 6.9 mm TL, and contained a large amount of yolk with a single oil globule (Fig. 2A). The head length (HL) and pre-anal length (PAL) were 17% and 39% of TL, respectively. Eye diameter (ED) was 53% of HL. The alimentary canal was already convoluted. Melanophores were distributed on the top of the head (0–1 cell), on the nape (0–1), on the dorsal surface of the visceral cavity (9–15), at the anterior tip of the yolk (1–3), and along the ventral contour of the tail (22–31). Xanthophores were present on the top of the head, at the auditory capsule, on the dorsal surface of the visceral cavity, and along the spinal chord. The larvae possessed 9+31=40 myomeres. The larvae swam actively in the surface layer of the rearing tank, and showed strong phototaxis.

Preflexion larvae. Absorption of the yolk was completed when the larvae attained to about 7.5 mm TL (Fig. 2B). HL and PAL were 20% and 40% of TL, respectively. ED was 40% of HL. All the larvae possessed the melanophores on the top of the head and on the nape. The snout elongated, and the larvae began to feed on the rotifers. In larvae of about 8 mm TL, a series of melanophores was present along the spinal chord posterior to the anus. When the larvae grew to over 8.5 mm TL, xanthophores were located along both dorsal and ventral sides of the notochord, and the rudiment of the caudal fin appeared

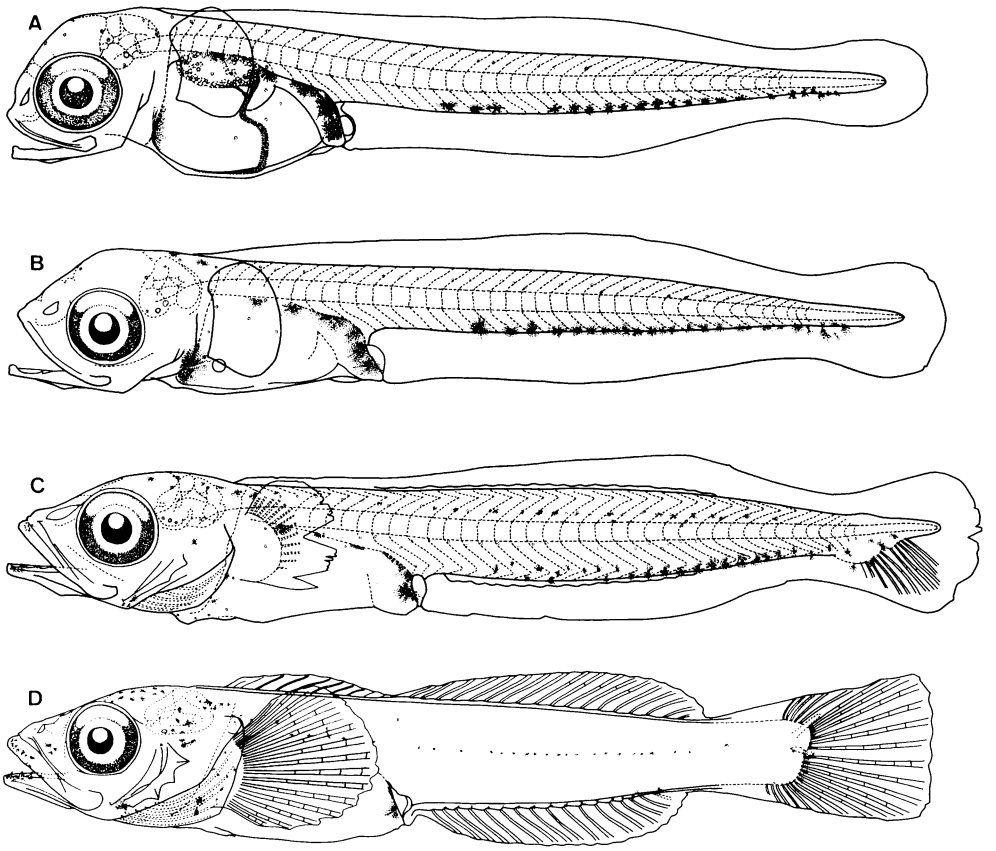

Fig. 2. Development of larvae of *Pseudoblennius percoides*. A, yolk-sac larva newly hatched, 6.9 mm TL; B, preflexion larva, 7.6 mm TL; C, flexion larva, 10.4 mm TL; D, postflexion larva, 15.3 mm TL, entosomatic melanophores were omitted. Scales indicate 1 mm.

ventrally at the posterior tip of the notochord. In larvae of about 9 mm TL, melanophores were located at the posterior end of the angular, at the pectoral base, and along the entire length of the spinal chord. Both jaws became strong, and the food preference changed from rotifers to planktonic crustaceans.

Flexion larvae. The notochord started to flex when larvae attained to about 10 mm TL (Fig. 2C). HL and PAL were 23% and 43% of TL, respectively. ED was 34% of HL. The pectoral rays appeared. Pelvic buds and segmentation of the caudal rays were observed. Two preopercular spines were present. Melanophores newly appeared at the anterior tips of both jaws and on the opercle. In larvae of about 11 mm TL, the dorsal and anal soft rays were observed. In a larva of 12.4 mm TL, the dorsal spines appeared. The larvae began to feed intensively on larval *Sebastiscus marmoratus*.

Postflexion larvae. Flexion of the notochord was completed when the larvae attained to about 14 mm TL (Fig. 2D). HL, PAL and the depth of caudal peduncle (CPD) were 25%, 42% and 6.6% of TL, respectively. ED was 30% of HL. Though the dorsal and anal fins were still connected to the caudal fin by remnants of the finfold at the caudal peduncle, the fin rays were completed in number except the pelvic. Segmentation of the pectoral and dorsal rays started. Three preopercular spines were present. Melanophores newly appeared on the snout and along the lateral median of body, and increased in number at the anterior tips of both jaws, on the top of the head, and at the bases of pectoral and caudal fins.

Juveniles. Aggregate numbers of all fin rays including the pelvic were completed in specimens larger than 16 mm TL (Fig. 3A). HL, PAL and CPD were 27%, 44% and 7.2% of TL, respectively. ED was 30% of HL. The first dorsal fin

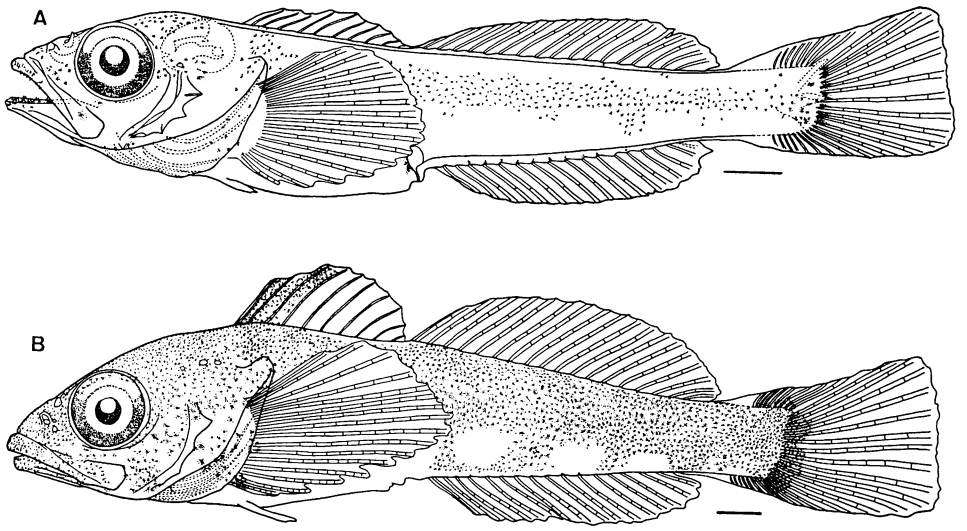

Fig. 3. Development of juveniles of *Pseudoblennius percoides*. A, early juvenile, 15.8 mm TL; B, juvenile, 21.0 mm TL. Scales indicate 1 mm.

well developed. Melanophores on the head increased in number, and those along the lateral median of the body spread simultaneously upwards and downwards to the dorsal and ventral medians. In juveniles of about 17 mm TL, melanophores appeared on the first dorsal fin membrane between the first and fourth spines and on the ventral surface of the lower jaw. In juveniles over 18 mm TL, the head and the dorsal surface of the body were almost pigmented. These juveniles changed from swimming at the surface to swimming at the bottom of the tank. When the juveniles attained to about 20 mm TL, the patches of melanophores on the ventrolateral surface of the tail were connected partially with each other just above the anal base, and some white marks formed (Fig. 3B). The pigment pattern in this developmental stage was very similar to that of *P. cottoides*. HL, PAL and CPD were 29%, 43% and 7.3% of TL, respectively. ED was 27% of HL. Iridophores appeared on the cheek, on the opercular bones, at the pectoral base, and on the lateral surface of the body. The pectoral fins developed and the lateral line began to form. In juveniles of about 25 mm TL, supraocular cirri formed. Melanophores were distributed on the pectoral and caudal rays, on the fifth to seventh spines of the first dorsal fin, on the lateral surface of the trunk, and in the white marks on the ventrolateral surface of the tail. Subsequently the body was entirely pigmented except the belly.

Young. In specimens over 44 mm TL, formation of lateral lines were completed and the caudal rays started to branch.

Morphological differences between *P. percoides* and *P. cottoides* in embryonic, larval and juvenile stages. Comparing the eggs, larvae and juveniles of *P. percoides* obtained here with those of *P. cottoides* given in the previous paper (Kimura et al., 1987), morphology of both species extremely resembled each other, but the following differences were observed.

Egg: The color of yolk was yellowish green or bluish green in *P. percoides* as against yellow or greenish yellow in *P. cottoides*. Xanthophores were present on the embryo in *P. percoides* but absent in *P. cottoides*.

Yolk-sac larvae (6.3–7.5 mm TL): Xanthophores on the body were present in *P. percoides* but absent in *P. cottoides*. Melanophores on the top of the head were present in *P. cottoides* as against present or absent in *P. percoides*.

Preflexion larvae smaller than 9 mm TL: Both species possessed melanophores on the top of the head and xanthophores on the body. Remarkable difference could not be found between the two species in this developmental stage.

Preflexion larvae larger than 9 mm TL and flexion larvae (10–14 mm TL): Melanophores at

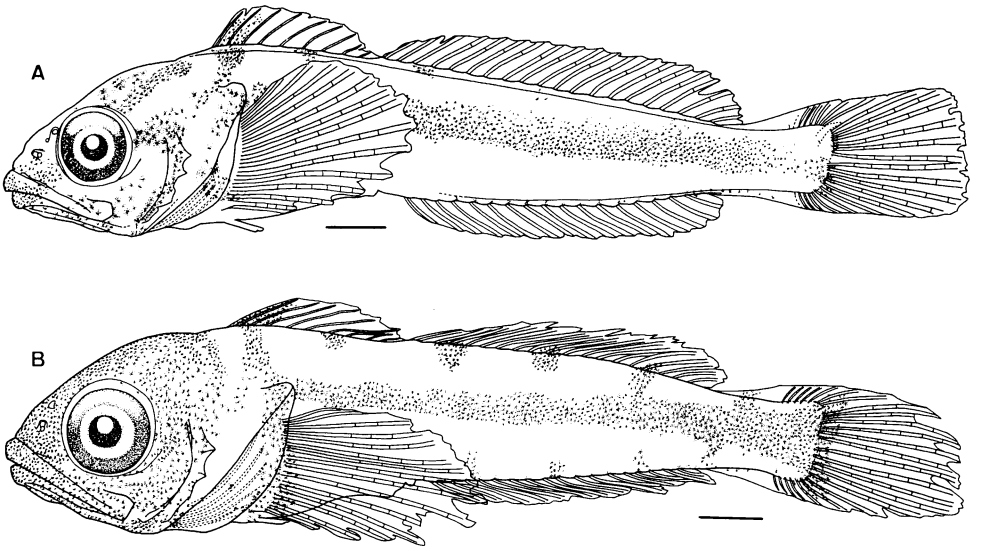

Fig. 4. Wild juveniles of *Pseudoblennius marmoratus*, 15.9 mm TL (A), and *P. zonostigma*, 14.9 mm TL (B). Scales indicate 1 mm.

the posterior end of the angular and those at the pectoral base were present in *P. percoides* but absent in *P. cottoides*.

Postflexion larvae (14–16 mm TL): Melanophores at the posterior end of the angular were present in both species. But those at the pectoral base were present in *P. percoides* as against absent in *P. cottoides*.

Juveniles (16–ca. 40 mm TL): In *P. cottoides* melanophores at the pectoral base newly appeared at 20 mm TL, and they were located in two patches. But in *P. percoides* those pigments were distributed widely on the pectoral base. While melanophores along the lateral median of the body spread first upwards to the dorsal median, subsequently downwards to the ventral median in *P. cottoides*, as against they spread simultaneously upwards and downwards in *P. percoides*.

Brief descriptions of juvenile *P. marmoratus* (Döderlein) and *P. zonostigma* Jordan et Starks. Four species of *Pseudoblennius* (i.e. *P. percoides*, *P. cottoides*, *P. marmoratus* and *P. zonostigma*) inhabit Ago Bay (Kimura and Suzuki, 1980, 1982). Of these, the early stages of the former two species were made clear from the rearing experiments given by the previous paper (Kimura et al., 1987) and in ours given here, but those of the latter two species have been indistinct until now. Accordingly, we describe briefly here the wild juveniles of the latter two species caught in Ago Bay, and indicate their diagnostic characters.

P. marmoratus (Fig. 4A): This juvenile is clearly distinguished from the other *Pseudoblennius* species in having 13 pectoral rays. In the specimen of 15.9 mm TL, black bands from the tip of the snout through the eye and the opercle to the anterior portion of the first dorsal, from the eye to the nape, along the posterior margins of the preopercle and the opercle, and along the lateral median of the body are very distinct and characteristic. HL, PAL and CPD are 25%, 39% and 6.2% of TL, respectively. ED is 28% of HL.

P. zonostigma (Fig. 4B): In the specimen of 14.9 mm TL, most part of the head is uniformly pigmented. A vertical black band from the origin of the first dorsal through the pectoral base to the pelvic base, and a wide longitudinal black band along the lateral median of the body are distinct. There are five and four short black bands on the dorsolateral and the ventrolateral surfaces of the body, respectively. This species can be distinguished from the congeneric juveniles by such pigment patterns. HL, PAL and CPD are 31%, 43% and 7.3% of TL, respectively. ED is 28% of HL.

Acknowledgments

We wish to express our sincere gratitude to Dr. Kiyoshi Suzuki, Faculty of Fisheries, Mie Uni-

versity, for his helpful suggestions and critical reading of the manuscript. Thanks are also due to Drs. Kunihiko Fukusho, Teruyuki Nakanishi and Masanori Okauchi, National Research Institute of Aquaculture, for their advice in culture of food organisms. Messrs. Takaharu Okazawa, Atsushi Sato and Yoichi Tsukamoto, the students of our university, are thanked for their help in the present study.

This work was supported partially by a Grant-in-Aid for Scientific Research from the Ministry of Education, Science and Culture.

Literature cited

Fujita, S. 1957. On the development of egg and prelarval stage of a marine sculpin, *Pseudoblennius percoides* Günther. Sci. Bull. Fac. Agr. Kyushu Univ., 16(1): 111–114, pl. 9. (In Japanese with English summary.)

Kimura, S. and K. Suzuki. 1980. Fish fauna of Ago Bay and its adjacent waters, Mie Prefecture, Japan. Rep. Fish. Res. Lab., Mie Univ., (2): 1–58.

Kimura, S. and K. Suzuki. 1982. Fish fauna of Ago Bay and its adjacent waters, Mie Prefecture, Japan. Supplement—I. Rep. Fish. Res. Lab., Mie Univ., (3): 1–20.

Kimura, S., K. Tsumoto and K. Mori. 1987. Development of eggs, larvae and juveniles of the cottid fish, *Pseudoblennius cottoides*, reared in the laboratory. Japan. J. Ichthyol., 34(3): 346–350.

(SK: Fisheries Research Laboratory, Mie University, P. O. Box 11, Wagu, Shima-cho, Mie 517-07, Japan; KT and KM: Faculty of Fisheries, Mie University, 2–80, Edobashi, Tsu 514, Japan; KT, present address: Fisheries Research Institute of Mie, Hamajima, Hamajima-cho, Mie 517-04, Japan)

アナハゼの卵および仔稚魚

木村清志・津本欣吾・森　浩一郎

水槽内で自然産卵させたアナハゼ卵を飼育し，卵内発生および孵化仔魚から若魚までの外部形態の形成過程を観察した．本種は体内受精を行い，卵は産出直前に受精する．卵は球形の沈性凝集卵で，卵径 1.66–1.82 mm，卵黄は淡黄緑色から淡青緑色を呈し，多数の油球が存在する．水温約 16°C で受精 13–16 日後に孵化する．孵化仔魚は全長 6.5–7.3 mm，黄色素胞が存在する．全長約 7.5 mm で卵黄が完全に吸収される．脊索末端の屈曲は全長約 10 mm で開始し，約 14 mm で終了する．全長 16 mm 以上になると，各鰭条数が定数に達し，稚魚になる．側線は全長 44 mm 以上で完成する．アサヒアナハゼの仔稚魚とは黄色素胞や黒色素胞の分布状態によってかなり明瞭に区別できる．また，これら 2 種やアヤアナハゼおよびオビアナハゼの稚魚はそれぞれ主として黒色素胞の分布様式によって明瞭に識別できる．

(木村：517-07 三重県志摩郡志摩町和具志摩郵便局私書箱 11 号　三重大学水産学部附属水産実験所；津本・森：514 津市江戸橋 2–80　三重大学水産学部；津本，現所属：517-04 三重県 志摩郡 浜島町浜島　三重県水産技術センター)