

Embryonic Development and Larvae of Genus *Eviota* (Pisces: Gobiidae) II. Description of Seven Species

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Abstract Embryonic development and larvae of the gobiid fishes, *Eviota albolineata*, *E. fasciola*, *E. melasma*, *E. queenslandica*, *E. prasina*, *E. prasites* and *E. lacrimae*, are described. Egg surface of each species is covered with numerous minute processes, and this condition is probably diagnostic for the genus. Larvae of *E. prasina* and *E. prasites* live until 8 days after hatching, while those of other five species have died of starvation by the 3rd day after hatching. In all of these larvae, red pigments appear, and melanophores are found on the optic cups, the gasbladder, the dorsal part of the rectum and the ventral part of the tail. By these characters, larvae of *Eviota* are distinguishable from the other gobiid fishes.

Key words: Gobiidae, *Eviota*, embryonic development, larvae, minute processes, red pigments, melanophores.

Genus *Eviota* is one of the large groups of gobiid fish including 42 and several undescribed species (Cole, 1990). Species of this genus are widely distributed in tropical or subtropical zone of Indo-Pacific Ocean, and inhabit coral or rocky reefs (Lachner and Karnella, 1980; Karnella and Lachner, 1981; Jewett and Lachner, 1983).

Although early life history of gobiid fish has been studied for many species (Okiyama, ed., 1988), information on *Eviota* is poor in spite of the inclusion of many species. Dotsu *et al.* (1965) and Shinomiya *et al.* (1981) reported egg development and larvae of *E. abax* and *E. storthynx*, respectively, and we redescribed these species in the previous paper (Sunobe and Nakazono, 1987). In this paper, we describe egg development and larvae of following seven species of this genus to clarify early life history: *E. albolineata*, *E. fasciola*, *E. melasma*, *E. queenslandica*, *E. prasina*, *E. prasites* and *E. lacrimae*. Then, we discuss morphology of eggs and larvae of the genus.

Materials and Methods

The specimens used were as follows; *Eviota albolineata* (male; 21.0 mm SL, females; 18.9,

18.1 and 17.7 mm SL) and *E. fasciola* (male; 17.6 mm SL, females; 16.0, 15.0 and 13.2 mm SL) at Cape Maeda, Okinawa Isl., Japan on Aug. 21, 1983; *E. melasma* (male; 26.0 mm SL, females; 25.4, 24.8 and 21.0 mm SL) and *E. lacrimae* (male 13.7 mm SL, female; 14.6 mm SL) at Cape Sata, Kagoshima Pref., Japan on Jun. 15, 1982 and Jul. 2, 1983, respectively; *E. queenslandica* (male; 21.8 mm SL, females; 21.8 and 19.0 mm SL) at Miyako Isl., Okinawa Pref., Japan on Jul. 12, 1983; *E. prasina* (male; 30.0 mm SL, females; 26.5, 26.2 and 25.7 mm SL) at Hanaze, Kagoshima Pref., Japan on May 26, 1983; *E. prasites* (male; 23.2 mm SL, female; 21.0 mm SL) at Kuchierabu Isl., Kagoshima Pref., Japan on May 14, 1985.

Methods of rearing and observation followed Sunobe and Nakazono (1987). Measurements of eggs and larvae were made by means of a binocular microscope with a micrometer. Figures were drawn with a camera lucida.

Results

Spawnings were observed from 8:00 to 11:00, but those of *Eviota albolineata* took place from 14:00 to 15:00. Eggs are spawned in a single layer on the ceiling of the shelter, and

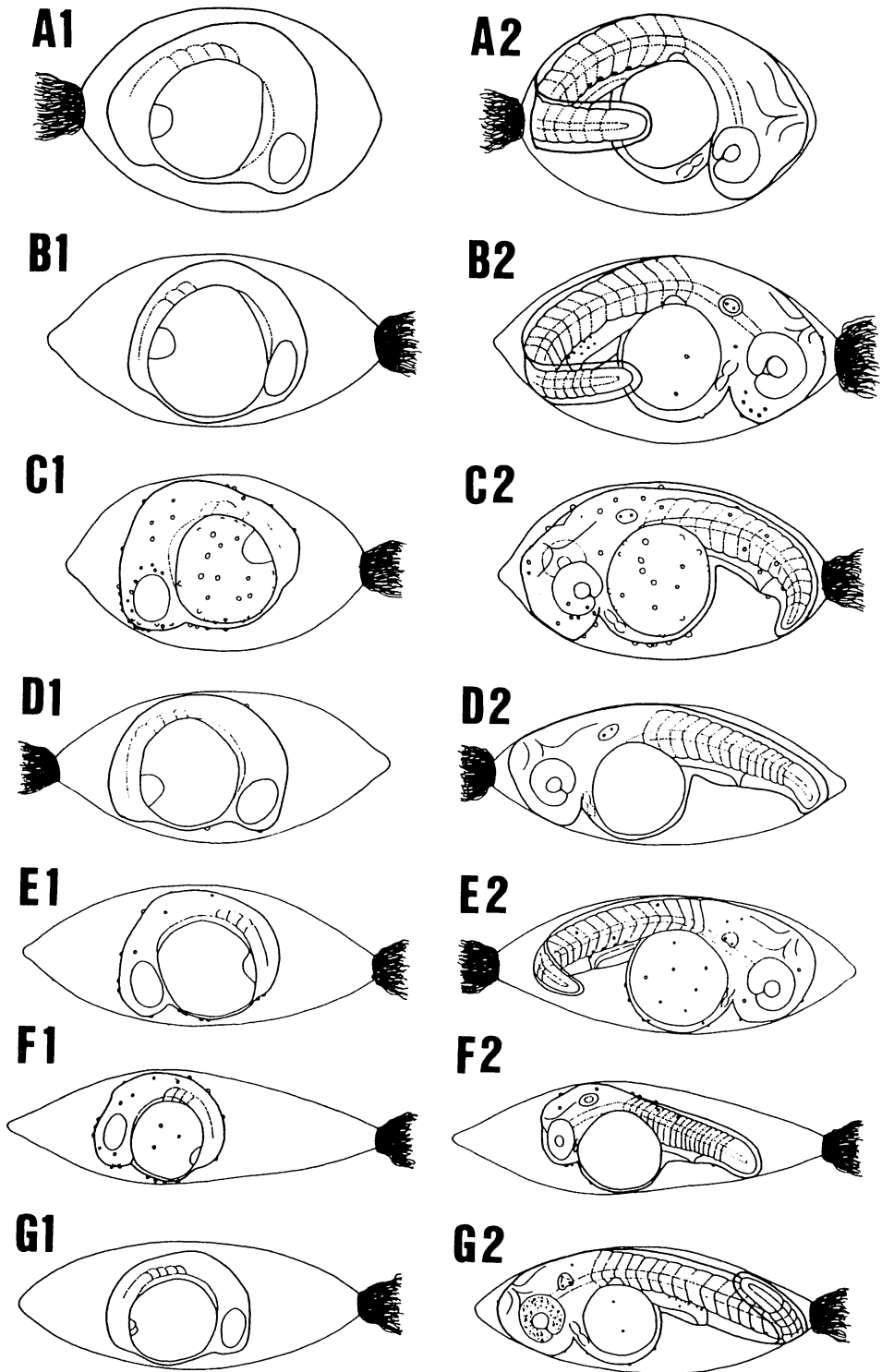


Fig. 1. Embryonic development of *Eviota*. A: *E. albolineata*; 1, 19 hrs. after fertilization; 2, 43 hrs. B: *E. fasciola*; 1, 18 hrs.; 2, 47 hrs. C: *E. melasma*; 1, 18 hrs.; 2, 34 hrs. D: *E. queenslandica*; 1, 22 hrs.; 2, 36 hrs. E: *E. prasina*; 1, 20 hrs.; 2, 58 hrs. F: *E. prasites*; 1, 14 hrs.; 2, 35 hrs. G: *E. lacrimae*; 1, 14 hrs.; 2, 46 hrs.

male stays in the shelter and guards the eggs mass until hatching.

Size and number of eggs of seven species are given in Table 1. The surface of eggs of each species is covered with numerous minute processes as observed in *E. abax* (Sunobe and Nakazono, 1987). The shape of egg is usually fusiform, but elliptical to fusiform in *E. albolineata* and *E. melasma* (Fig. 1). A bundle of adherent threads is provided at their base (Fig. 1). The small oil globules in the yolk never merge throughout development.

Total lengths of newly-hatched larvae of seven species are given in Table 1. In these larvae, the mouth has opened, and peristalsis of the digestive tract can be seen. The larvae show phototaxis. Cuplae and free neuromasts are recognized on the lateral side of the body as shown in Fig. 2A-2. The Cuplae easily fall off after fixation with 5% formalin. One day after hatching, the yolk has been absorbed. Larvae of *E. prasina* and *E. prasites* live until 8 days after hatching, while those of the other five species have died of starvation by the 3rd day after hatching.

E. albolineata. By 19 hrs. after fertilization (Fig. 1A-1), a Kupffer's vesicle appears, and the embryo has 4 myomeres. Forty-three hrs. after fertilization (Fig. 1A-2), the Kupffer's vesicle has disappeared, and a lens in the optic cup and a pair of ear vesicles have been formed. A pair of pectoral fin buds are recognized, and a heart appears in front of the yolk. Melanophores are found on the abdominal region.

Larvae hatched at 20:00, 97 hrs. after fertilization. They have 9+16 myomeres (adult: 10+16). Melanophores are observed on the optic cups, the dorsal part of the gasbladder, the dorsal part of the rectum and the ventral part of the tail. Red pigments are recognized on the gasbladder and the ventral part of the abdomen (Fig. 2A-1).

E. fasciola. By 18 hrs. after fertilization (Fig. 1B-1), a kupffer's vesicle appears and the embryo has 2 myomeres. Forty-seven hrs. after fertilization (Fig. 1B-2), the Kupffer's vesicle has disappeared, and a lens in the optic cup and a pair of ear vesicles have been formed. A pair of pectoral fin buds are recognized, and a heart appears in front of the yolk. Melano-

phores are found on the abdominal region.

Larvae hatched at 20:00, 105 hrs. after fertilization. They have 9+16 myomeres (adult: 10+16). Melanophores are observed on the optic cups, the dorsal part of the gasbladder, the dorsal part of the rectum and the ventral part of the tail. Red pigments are recognized on the gasbladder and the anus (Fig. 2B).

E. melasma. By 18 hrs. after fertilization (Fig. 1C-1), a kupffer's vesicle appears and the embryo has 3 myomeres. Thirty-four hrs. after fertilization (Fig. 1C-2), the Kupffer's vesicle has disappeared, and a lens in the optic cup and a pair of ear vesicles have been formed. Number of myomeres is 14. A heart appears in front of the yolk.

Larvae hatched at 20:00, 103 hrs. after fertilization. They have 9+16 myomeres (adult: 10+16). Melanophores are observed on the optic cups, the dorsal part of the gasbladder, the dorsal part of the rectum and the ventral part of the tail. Red pigments are recognized on the gasbladder and the ventral part of the abdomen (Fig. 2C).

E. queenslandica. By 22 hrs. after fertilization (Fig. 1D-1), a kupffer's vesicle appears, a pair of optic cups have been formed and the embryo has 4 myomeres. Thirty-six hrs. after fertilization (Fig. 1D-2), the Kupffer's vesicle has disappeared, and a lens in the optic cup has been formed. Number of myomeres is 14.

Larvae hatched at 20:00, 103 hrs. after fertilization. They have 9+16 myomeres (adult: 10+16). Melanophores are observed on the optic cups, the dorsal part of the gasbladder, the dorsal part of the rectum and the ventral part of the tail. Red pigments are recognized on the gasbladder and the ventral part of the tail (Fig. 2D).

E. prasina. By 20 hrs. after fertilization (Fig. 1E-1), a kupffer's vesicle appears, a pair of optic cups have been formed and the embryo has 3 myomeres. Fifty-eight hrs. after fertilization (Fig. 1E-2), the Kupffer's vesicle has disappeared, and a lens in the optic cup and a pair of ear vesicles have been formed. A heart appears in front of the yolk. Melanophores are found on the abdominal region.

Larvae hatched at 18:00, 113 hrs. after fertilization. They have 9+16 myomeres (adult: 10

Table 1. Length (mm), width (mm) and number of eggs and TL (mm) of newly-hatched larvae (NHL) in seven species of *Eviota*. *E. a.*, *E. albolineata*; *E. f.*, *E. fasciola*; *E. m.*, *E. melasma*; *E. q.*, *E. queenslandica*; *E. pn.*, *E. prasina*; *E. pt.*, *E. prasites*; *E. l.*, *E. lacrimae*.

	<i>E. a.</i>	<i>E. f.</i>	<i>E. m.</i>	<i>E. q.</i>	<i>E. pn.</i>	<i>E. pt.</i>	<i>E. l.</i>
Length of eggs							
Range	0.63–0.67	0.94–1.00	0.87–1.00	1.02–1.08	1.30–1.48	1.62–1.68	1.25–1.26
Mean±SD	0.65±0.08	0.50±0.01	0.55±0.02	1.05±0.02	1.40±0.06	1.65±0.02	1.26±0.36
<i>n</i>	11	7	14	17	11	12	5
Width of eggs							
Range	0.39–0.43	0.49–0.52	0.52–0.57	0.44–0.48	0.55–0.60	0.56–0.63	0.48–0.53
Mean±SD	0.41±0.08	0.50±0.01	0.55±0.02	0.47±0.01	0.58±0.06	0.60±0.03	0.49±0.20
<i>n</i>	11	7	14	17	11	12	5
Number of eggs							
Range	352	117–211	104–270	160–374	293–358	195–409	20–77
Mean±SD	—	171±42	192±69	291±90	326±28	280±82	56±24
<i>n</i>	1	4	7	5	4	6	5
TL of NHL							
Range	1.52–1.60	1.96–2.01	2.32–2.39	2.02–2.09	2.55–2.65	2.83–2.85	2.23–2.26
Mean±SD	1.56±0.03	1.98±0.01	2.36±0.03	2.05±0.02	2.60±0.04	2.84±0.01	2.25±0.01
<i>n</i>	5	6	6	8	5	6	5

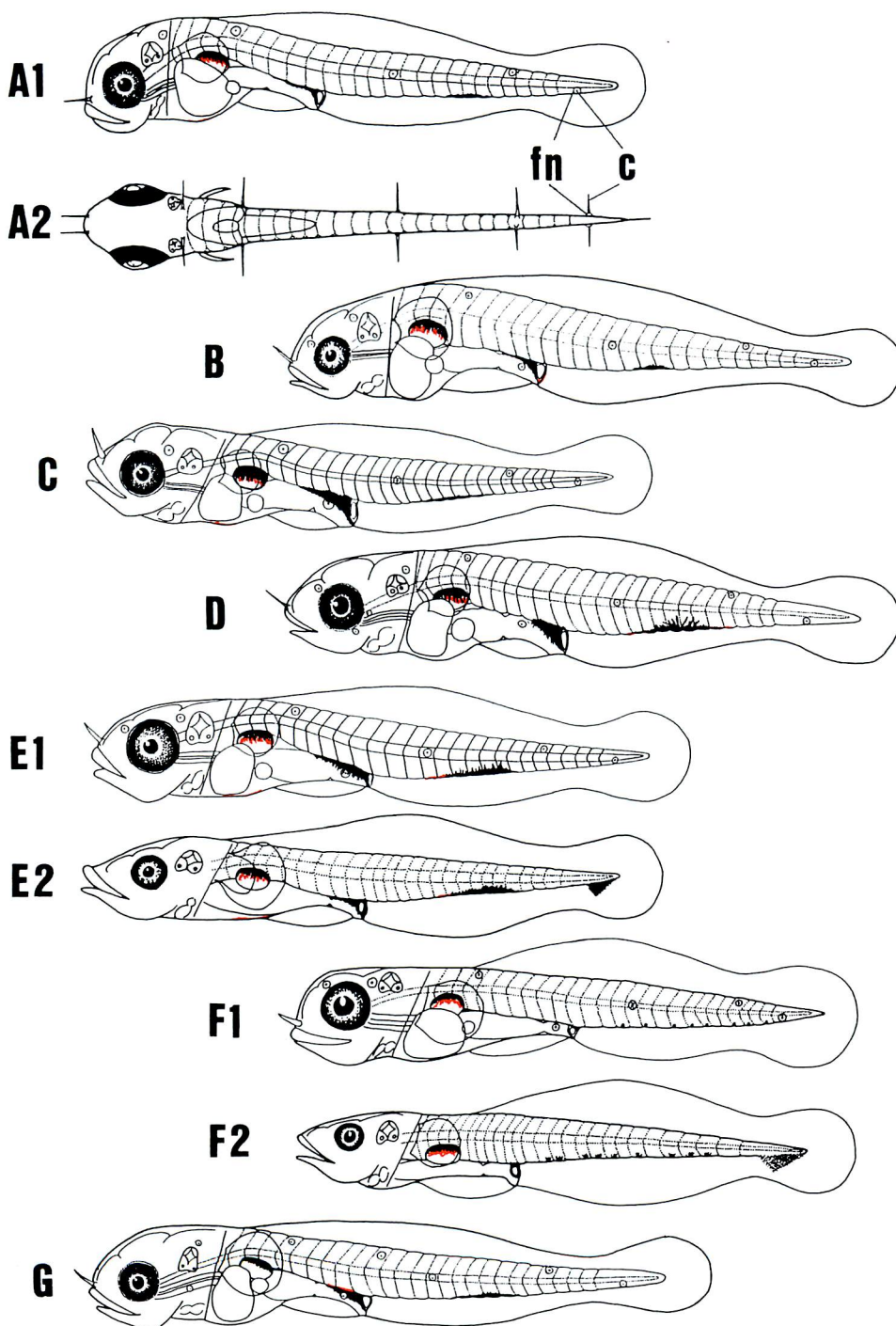


Fig. 2. Larvae of *Eviota*. A: *E. albolineata*; 1, newly-hatched larva (NHL), 1.56 mm TL; 2, dorsal view of the same specimen. B: NHL of *E. fasciola*, 2.01 mm TL. C: NHL of *E. melasma*, 2.35 mm TL. D: NHL of *E. queenslandica*, 2.06 mm TL. E: *E. prasina*, 1, NHL, 2.60 mm TL; 2, 8 days after hatching, 3.62 mm TL. F: *E. prasites*, 1, NHL, 2.83 mm TL; 2, 8 days after hatching, 3.21 mm TL. G: NHL of *E. lacrimae*, 2.25 mm TL. c, cupla; fn, free neuromast.

+16). Melanophores are observed on the optic cups, the dorsal part of the gasbladder, the dorsal part of the rectum and the ventral part of the tail. Red pigments are recognized on the gasbladder, the ventral part of the abdomen and the ventral part of the tail (Fig. 2E-1).

At eight days after hatching (Fig. 2E-2), one individual remains alive, attaining 3.62 mm TL. Number of myomeres is 9+16. All of cuplae and free neuromasts are disappeared. Primordium of hypurals and caudal fin rays are recognized.

E. prasites. By 14 hrs. after fertilization (Fig. 1F-1), a Kupffer's vesicle appears, a pair of optic cups have been formed and the embryo has 3 myomeres. Thirty-five hrs. after fertilization (Fig. 1F-2), the Kupffer's vesicle has disappeared, and a lens in the optic cup and a pair of ear vesicles have been formed. A heart has appeared in front of the yolk. Number of myomeres is 18.

Larvae hatched at 18:00, 102 hrs. after fertilization. They have 9+15 myomeres (adult: 10+15). Melanophores are observed on the optic cups, the dorsal part of the gasbladder and the dorsal part of the rectum. Small melanophores are recognized on the ventral part of the tail. Red pigments are recognized on the gasbladder (Fig. 2F-1).

At eight days after hatching (Fig. 2F-2), three individuals remain alive, measuring 2.99, 3.13 and 3.21 mm TL, respectively. Number of myomeres is 10+15, attaining the same number as adult. All of cuplae and free neuromasts are disappeared. Melanophores on the ventral part of the tail become dendritic. Primordium of hypurals and caudal fin rays are recognized.

E. lacrimae. By 14 hrs. after fertilization (Fig. 1G-1), two Kupffer's vesicles appear, a pair of optic cups have been formed and the embryo has 4 myomeres. Forty-six hrs. after fertilization (Fig. 1G-2), the Kupffer's vesicles have disappeared, and a lens in the optic cup and a pair of ear vesicles have been formed. A heart has appeared in front of the yolk. A pair of pectoral fin buds appear. Melanophores are recognized on the abdominal and tail region.

Larvae hatched at 19:00, 102 hrs. after fertilization. They have 9+16 myomeres (adult: 10+16). Melanophores are observed on the optic

cups, the dorsal part of the gasbladder and the dorsal part of the rectum. Small dendritic melanophores are recognized on the ventral part of the tail. Red pigments are recognized on the dorsal part of the abdomen (Fig. 2G).

Discussion

The surface of egg is covered with numerous minute processes in nine species of *Eviota*, as shown in this study and Sunobe and Nakazono (1987). This character is probably diagnostic for the genus.

Newly-hatched larvae of nine species and 7-8 days larvae of *E. abax*, *E. prasina* and *E. prasites* reported in this study and Sunobe and Nakazono (1987) have red pigments. This character is rarely known in the other gobiid fishes except for *Acanthogobius lactipes* (Uchida and Dotsu, 1980). Melanophores are found in the optic cups, the gasbladder, the dorsal part of the rectum and the ventral part of the tail. By these characters, we can distinguish these stages of *Eviota* from the other gobiid fishes.

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ハゼ科イソハゼ属の卵発生および仔魚 II.
7種の記載

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ハゼ科イソハゼ属7種, シロイソハゼ *Eviota albolineata*, トラノコイソハゼ *E. fasciola*, アカホシイソハゼ *E. melasma*, ホシヒレイソハゼ *E. queenslandica*, ナンヨウミドリハゼ *E. prasina*, アオイソハゼ *E. prasites*, ヤマイソハゼ *E. lacrimae* の卵発生, 孵化仔魚およびナンヨウミドリハゼとアオイソハゼについては孵化後8日目の仔魚を観察した。卵の表面は細かい突起物で覆われていた。これはイソハゼ属の特徴と考えられる。本属の孵化仔魚および8日目の仔魚は, 黒色素胞が眼, 鰾, 直腸上部, 尾部下縁部に出現すること, 赤色胞があることで他のハゼ科の仔魚と区別することができる。