

# Fish Ecology of Littoral Weed Beds— I Fish Eggs and Larvae Found among *Zostera* Beds

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## Preface

The submerged sea weed beds, such as *Zostera* and *Sargassum* beds, are the littoral area showing predominantly high primary productions. These beds is an independent ecosystem having a rich fauna composed of various kinds of small invertebrates and fishes. In order to clear the characteristics of this independent ecosystem, the author carried out the ecological research on fish fauna among and on leafs of *Zostera marina* on the western part of the Seto Inland Sea, especially off coasts of Tabuse, Hiraon and Yanai, Yamaguchi Prefecture. This paper is treated with the results of fish eggs and larvae collected from the these beds as the first report of this series. The species treated here were all reared for a short term in the laboratory after collecting.

## Materials and Methods

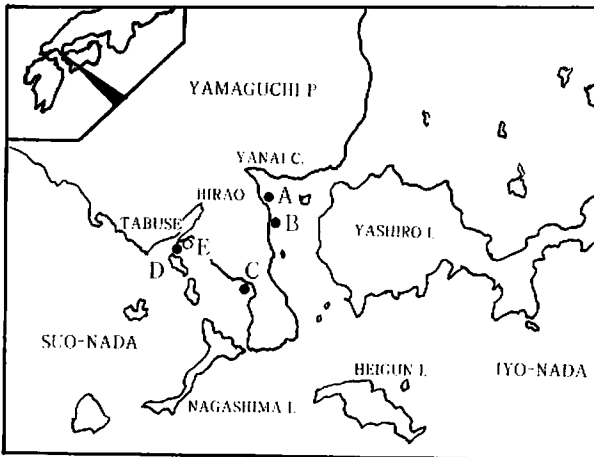


Fig. 1 Map showing the sampling stations (solid circle) in *Zostera* beds.

The research stations in *Zostera* beds were 5 (A ~ D, E) shown in the Fig. 1, in addition to some specimens collected from *Sargassum* beds for reference. The collections were carried out all seasons, but mainly summer (July and August) and winter (January and February). Two collecting gears were used, one was a tow net with mouth diameter of 0.74 m, and GG38 and 28 in mesh size; the

other was a dredge-type net (0.21 × 2 m) with mouth area of 0.43m<sup>2</sup>. Some species were made the figures after keeping eggs and larvae in an small aquarium of the laboratory until showing

the specific characters.

### Description of Species

**R 1 — 1**                    *Konosirus punctatus* (Temminck et Schlegel)                    (Mid April)

Eggs globular in shape, with single oil globule, free pelagic. Egg diameter 1.69mm, yolk diameter 0.94mm and oil globule diameter 0.17mm. Perivitelline space wide. Egg membrane thin and transparent, surface with luster. Embryo just before hatching scattered with Melanophores. Yolk segmented.

Larva, one day old, 4.2mm in total length.

Body slender. Anus situated at 42nd segment of myotomes at posterior part of body. Number of myotomes  $42 + 7 = 49$ . Oil globule present on postero-ventral part of yolk. Melanophores scattered along dorsal surface from head to caudal part. Moreover four groups of melanophores present on both of dorsal and ventral sides of caudal end and three groups of melanophores present on digestive tract of abdomen.

Larva, two day old, 5.1mm in total length.

Yolk nearly absorbed. Mouth open. Anus situated at 42nd segment of myotomes. Number of myotomes  $42 + 8 = 50$ . Melanophores: three on head in front of eyes, one on lateral part of body under pelvic fin and three on ventral side of thorax, and a series of 21 along digestive tract and 4 - 5 on ventral side of caudal part.

**R 1 — 2**                    *Engraulis japonica* (Houtuyn)                    (Late April)

Egg oblong in shape, without oil globule, free pelagic. Long diameter 1.21mm and short diameter 0.62mm. Egg membrane thin, without special structure. Perivitelline space narrow. Yolk segmented. Embryo just before hatching scarcely with melanophores, but no xanthophore.

Larva, just hatched, 2.75mm in total length.

Yolk long, pointed at posterior part. Anus situated at 31st segment of myotomes at posterior part of body. Number of myotomes  $31 + 15 = 46$ . Yolk diameter about 0.12-0.14mm. About 16 melanophores appeared along ventral side of body, but no xanthophore.

Larva, seven day old, 4.0mm in total length.

Body slender. Number of myotomes  $30 + 14 = 44$ . Yolk nearly absorbed. Melanophores in eyes increased. Melanophores on body comparatively scarce: one on opercle, six along dorsal side of digestive tract and 11 along ventra side of digestive tract, 5 – 6 on ventral side of caudal part. No xanthophore.

**R 2 – 1**

***Repomucenus* sp.**

(Early September)

Egg globular in shape, without oil globule, free pelagic. Egg membrane with hexagonal mesh structure (diameter of meshes 0.029–0.031mm). Yolk segmented. Perivitelline space narrow. Embryo just before hatching with xanthophores.

Larva, just hatched, 1.21mm in total length.

Anus open at 9 th segment of myotomes just after yolk. Number of myotomes  $9 + 13 - 14 = 22 - 23$ . Yolk spherical. Many xanthophores on yolk surface and eyes. Moreover group of xanthophores densely on caudal part itself, and upper and lower fin membranes of caudal part. Eight melanophores on yolk surface. Two day old larva with a few melanophores on head and caudal part.

Larva, six day old , 2.0mm in total length.

Yolk absorbed. Mouth open. Anus open at 8 th segment of myotomes. Number of myotomes  $8 + 15 = 23$ . Needle-like processes appeared on fin membranes from three day old larva. Melanophores scattered on head, lateral side of body, abdomen and fin membranes. Of these six on abdominal cavity becoming larger. Xanthophores appeared same place as Melanophores.

**R 2 – 2**

***Mylio macrocephalus* (Basilewsky)**

(Mid May)

Egg globular in shape, with single oil globule, free pelagic. Egg diameter 0.92mm and oil globule diameter 0.22mm. Egg membrane thin, without special structure. Perivitelline space narrow. Yolk unsegmented. Melanophores and xanthophores appeared on body and oil globule 12 hours after embryonic body completed.

Larva, just hatched, 2.4mm in total length.

Anus situated before central part of body, at 9 th segment of myotomes just after yolk. Number of myotomes  $9 + 18 = 27$ . Oil globule situated at posterior part of yolk. Melanophores

present on apex of head, dorsal margin of body, and oil globule (12–13 in number). Xanthophores densely present on margin of eyes and on auditory bulla in head, and 8th to 22nd myotomes and on oil globule in caudal part.

Larva, five day old, 3.3mm in total length.

Mouth open. Oil globule disappeared. Anus open at 8th myotome. Number of myotomes  $8 + 18 = 26$ . Melanophores disappeared at dorsal side of body, but those changed to thread-like structure at ventral side of abdomen. Four groups of melanophores present on abdominal cavity and 24 dot-like melanophores along ventral side of abdomen.

**R 3 – 1**                      ***Saurida elongata* (Temminck et Schlegel)**                      (Early June)

Egg globular in shape, without oil globule, free pelagic. Egg diameter 1.28–1.30mm. Egg membrane without special structure. Perivitelline space narrow. Yolk segmented. Embryo just before hatching scarcely with melanophores along dorsal and ventral sides of body.

Larva, 12 hours old, 3.5mm in total length.

Yolk long. Anus open at 32nd segment of myotomes separated from posterior end of yolk. Number of myotomes  $32 + 27 = 59$ . Granule-like tissues scattered over total body surface. Melanophores Not many, appeared at anterior part of just before eyes, margin of eyes and ventral side of body (3–4 in number).

**R 3 – 2**                                      ***Sillago sihama* (Forskål)**                                      (Late May)

Egg globular in shape, with single oil globule, free pelagic. Egg diameter 0.68mm and oil globule diameter 0.15mm. Egg membrane without special structure. Yolk segmented. Perivitelline space narrow. Melanophores and xanthophores appeared on surface of oil globule (9 in number) and dorsal side of embryonic body from embryonic stage of eye capsule formation.

Larva, five to six hour old, 2.09mm in total length.

Oil globule situated at posterior part of yolk. Anus open at 12th segment of myotomes separated from posterior part of yolk. Number of myotomes  $12 + 23 = 35$ . Melanophores appeared on oil globule and a series of melanophores appeared along dorsal and ventral sides of body from head to caudal part, and two additional ones present on ventral side of digestive tract. Xanthophores appeared at lateral side of body as six transverse lines and also on margin of eyes and

oil globule.

Larva, four day old, 2.4mm in total length.

Anus open at 12th segment of myotomes. Pectoral fins appeared. Number of myotomes  $12 + 23 = 35$ . Melanophores present along dorsal side of body (5 in number), ventral side of body (about 14 in number), and also along dorsal and ventral margins of digestive tract.

**R4 - 1      *Heteromycteris japonicus* (Temminck et Schlegel)      (Late February)**

Egg globular in shape, with many oil globules, free pelagic. Egg diameter 0.90–0.94mm and oil globule diameter 0.17–0.086mm. Number of oil globules 20–40. Egg membrane without special structure. Yolk segmented. Perivitelline space narrow. Melanophores and xanthophores appeared from embryonic stage of eye capsule formation. Melanophores present on embryonic body, yolk and oil globule.

Larva, six hour old, 1.8mm in total length.

Yolk partly segmented. Oil globules concentrated at ventro-central part of yolk. Anus open at 10th segment of myotomes just after end of yolk. Number of myotomes  $10 + 28 = 38$ . Bud of pectoral fins appeared. Melanophores scarce in number: one at apex of head, area in front of eyes and jaw area, 13–14 on yolk, 3 on dorsal margin of body, 12 ventral side of body, 1 – 2 on fin membrane. Xanthophores appeared at head, anterior margin of eyes, digestive tract near anus, center of caudal part, dorsal fin membrane (2 places) and on yolk.

Larva, five day old, 2.8mm in total length.

Anus open at 9th segment of myotomes, anterior of central part of body. Number of myotomes  $9 + 28 = 37$ . Apex of head elevated. Digestive tract once coiled. Caudal part slender. Branched melanophores present along dorsal side of body from apex of head (about 10 in number), ventral side of body (about 6 in number), and also along digestive tract and small dot-like melanophores present at area in front of eyes, pectoral fins and distal end of caudal part.

**R5 - 1      *Areliscus interruptus* (Günther)      (Early September)**

Egg globular in shape, with many oil globules, free pelagic. Egg diameter 0.65–0.70mm. Number of oil globules 7 –15. Egg membrane without special structure. Yolk unsegmented. Peri-

vitelline space narrow. Melanophores and xanthophores appeared from embryonic stage of eye capsule formation, both present on embryonic body and yolk.

Larva, just hatched, 2.25mm in total length.

Anus open at 11th segment of myotomes separated from end of yolk. Two melanophores present at apex of head and area in front of eyes, and 12 melanophores scattered at caudal part. Group of xanthophores appeared at posterior part of yolk. Six transverse bands of xanthophores present from upper part of eyes to end of caudal part and extended to dorsal and ventral fin membranes. Melanophores in eyes increased and oil globules concentrated at posterior part of yolk at larvae of 2 – 4 day old. Apex of head with one extended process. Caudal fin membrane with granule-like xanthophores.

Larva, seven day old, 2.75 mm in total length.

Number of myotomes  $11 + 42 = 53$ . Oil globules disappeared. Digestive tract once coiled. Melanophores slightly increased in number and scattered at head, abdomen and dorsal and ventral sides of body and caudal fin membrane. Five bands of xanthophores present. Apex of extended process of head becoming orange in color, because of concentration of xanthophores.

**R 5 – 2**

***Halichoeres tenuispinnis* (Günther)**

(Mid April)

Egg globular in shape, with single oil globule, free pelagic. Egg diameter 0.75–0.79mm and oil globule diameter 0.15mm. Egg membrane without special structure. Yolk unsegmented. Perivitelline space narrow. Melanophores appeared on embryonic body from embryonic stage of eye capsule formation.

Larva, six hour old, 2.3mm in total length.

Oil globule situated at anterior part of yolk. Anus open at central part of body, just 11th segment of myotomes separated from posterior end of yolk. Number of myotomes  $11 + 15 = 26$ . Melanophores present at apex of head and lateral side of body, from 5th to 26th myotomes. No xanthophores.

Larva, three day old, 2.2mm in total length.

Mouth open. Yolk absorbed. Pectoral fin appeared. Number of myotomes  $11 + 15 = 26$ . Melanophores in choroid of eyes developed, becoming eyes black in color. One melanophore present

at area in front of eye, and more than two melanophores present on fin membrane of caudal, and also a series of melanophores and a group of melanophores present on digestive tract.

**R 6 — 1**      *Paralichthys olivaceus* (Temminck et Schlegel)      (Early October)

Egg globular in shape, with single oil globule, free pelagic. Egg diameter 0.77–0.82mm and oil globule diameter 0.12–0.14mm. Egg membrane without special structure. Yolk unsegmented. Perivitelline space narrow. Melanophores and xanthophores appeared on yolk and embryonic body but xanthophores absent from oil globule.

Larva, six hour old, 2.57mm in total length.

Anus open at central part of body, just 14th segment of myotomes separated from end of yolk. Number of myotomes  $14 + 23 = 37$ . Oil globule situated at posterior part of yolk. Branched melanophores present at dorsal and ventral fin membranes and on yolk (8–10 in number) and dot-like melanophores present at area in front of eye, apex of head and lateral side of body. Groups of xanthophores appeared at same place as melanophores.

Larva, two and half day old, 2.87mm in total length.

Eyes black and mouth open. Pectoral fin appeared. Yolk absorbed. Digestive tract once coiled. Anus open at a little anterior of central part of body, just 13th segment of myotomes. Number of myotomes  $13 + 23 = 36$ . Needle-like processes appeared at dorsal and ventral fin membranes of caudal part. Distributional pattern of melanophores like that of larva just hatched, but new melanophores appeared at dorsal and ventral sides of digestive tract. Xanthophores pattern also similar to those of larva just hatched, but generally pale.

**R 6 — 2**      *Chelidonichthys kumu* (Lesson et Garnot)      (Early December)

Egg globular in shape, with single oil globule, free pelagic. Egg diameter 1.23mm and oil globule diameter 0.26mm. Egg membrane without special structure. Yolk unsegmented. Perivitelline space narrow. Xanthophores appeared more earlier than melanophores and both appeared on yolk, embryonic body and oil globule.

Larva, one day old, 3.38mm in total length.

Oil globule situated at posterior part of yolk. Anus open at 11th segment of myotomes just after posterior end of yolk. Number of myotomes  $11 + 24 = 35$ . Xanthophores present at apex of

head (one line). Moreover group of xanthophores present at middorsal line of caudal part ( 2 in number), dorsal and ventral fin membranes and on oil globule and digestive tract. Yolk with both dot-like xanthophores and melanophores.

Melanophores scattered at head, body, dorsal and ventral fin membranes and oil globule.

## PLATE I

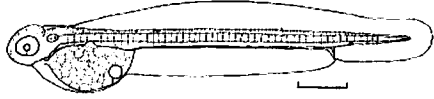
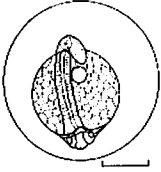
( scales in mm )

- R 1 - 1 . *Konosirus punctatus* (T et S)
- R 1 - 2 . *Engraulis japonica* (Houtuyn)
- R 2 - 1 . *Repomucenus* sp.
- R 2 - 2 . *Mylio macrocephalus* (Basilewsby)
- R 3 - 1 . *Sautida elongata* (T et S)
- R 3 - 2 . *Sillago sihama* (Forsk.)
- R 4 - 1 . *Helcromycteris japonica* (T et S)
- R 5 - 1 . *Areliscus interruptus* (Günter)
- R 5 - 2 . *Halichoeres tenuispinnis* (Günter)
- R 6 - 1 . *Paralichthys olivaceus* (T et S)
- R 6 - 2 . *Chelidonichthys kumu* (L et G)

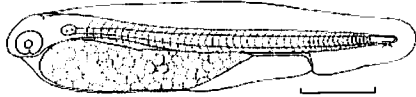
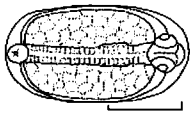


Eggs and Larvae in *Zostera* beds

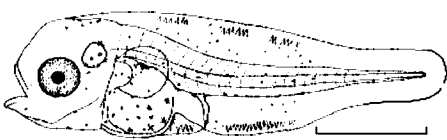
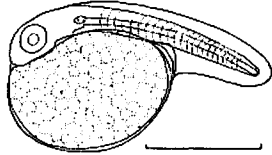
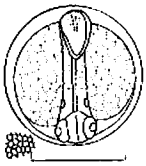
R1-1



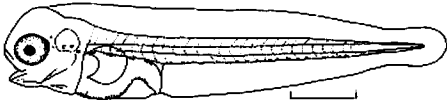
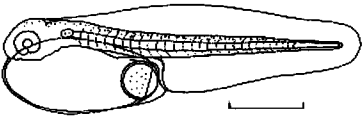
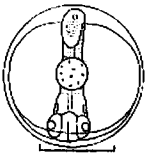
R1-2



R2-1



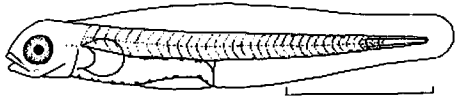
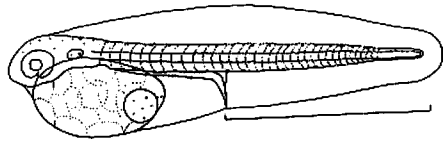
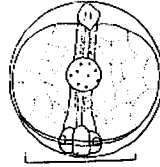
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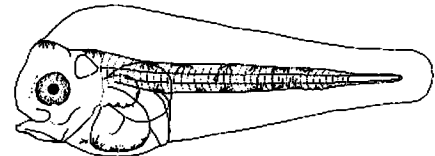
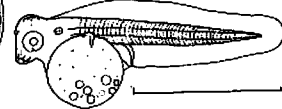
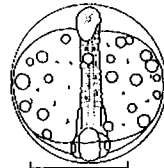
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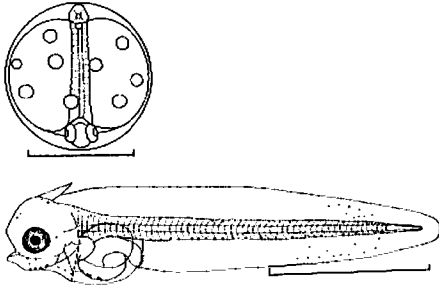
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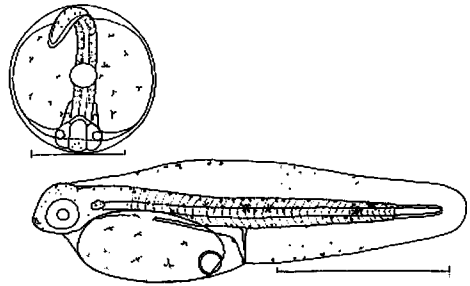
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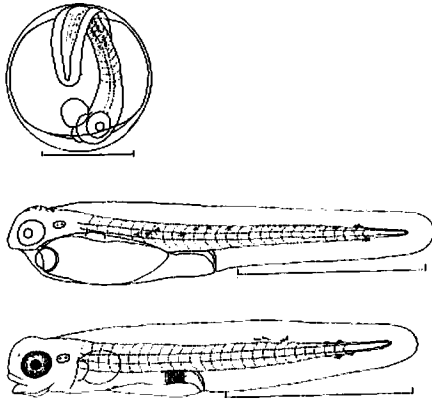
R5-1



R6-1



R5-2



R6-2

