Japanese Journal of Ichthyology
Vol. 34, No. 4 1988

魚類学雑誌
34巻4号 1988年

Larvae and Juveniles of Temperate Bass, *Lateolabrax latus*, Occurring in the Surf Zones of Tosa Bay, Japan

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(Received April 13, 1987)

Abstract A total of 343 larval and juvenile *Lateolabrax latus* (9.2–27.0 mm TL) was collected with a small seine in surf zones of Tosa Bay. They are very similar in general morphology to those of the closely related *L. japonicus*, but can be distinguished from them by the distribution pattern of melanophores on the tail, head spination, proportion of head length to standard length and the 15 or 16 dorsal fin soft-rays. They occurred in surf zones of Tosa Bay from early January to middle May, being most abundant in middle April. Temperatures and salinities of waters where any number of them were collected ranged from 12.2 to 24.0°C and from 23.7 to 34.5‰, respectively. Larval and juvenile *L. latus* have not been reported so far in coastal and shallow waters, and eelgrass beds of southern Japan. It may be possible that they have been confounded with those of *L. japonicus*. Their occurrence seems to be limited in extremely shallow waters such as surf zones.

The temperate bass, *Lateolabrax latus* Katayama (Percichthyidae) is distributed from Chiba Prefecture (Kinoshita, unpubl.) to Nagasaki Prefecture and is more common than the related *L. japonicus* in southern waters (Katayama, 1957; Masuda et al., 1980). Both fishes are important for commercial and sport fishing. While much has been known about the ecology and early life history of *L. japonicus* (Mito, 1957; Hatanaka and Sekino, 1962; Watanabe, 1965; Matsumiya et al., 1981; Fukuhara and Fushimi, 1982), little is known about *L. latus*.

It was recently found that larvae and juveniles of *L. latus* commonly occur in surf zones of Tosa Bay (Senta and Kinoshita, 1985). On observing them, we became inclined to think that they must have been confounded with larvae and juveniles of *L. japonicus* in past morphological reports. Distinguishing morphological characteristics of the postlarvae and juveniles of *L. latus* and their seasonal occurrence in surf zones of Tosa Bay are presented in this paper.

Materials and methods

Semimonthly collections of larval and juvenile fishes with an unweighted 1×4 m seine (see Kinoshita, 1986) were made at Usa, Tanesaki and Tei, three beaches of Tosa Bay from May 1981 to May 1982 (Fig. 1). Two persons kept the net stretched, and waded backwards along the beach for a distance of about 50 m. A day's collection at each of the beaches usually consisted of three to eight hauls (mostly four to six hauls). Specimens were preserved in 10% formalin until sorting and measurement in the laboratory.

Of the 89,601 larval and juvenile fishes collected during the study period, 343 were identified as *L. latus*, 9.2–27.0 mm TL (Table 1).

Larval and juvenile *L. japonicus* used for morphological comparison were a part of the specimens collected from the Chikugo estuary, Fukuoka Prefecture in March of 1979, 1982 and 1983.

For observing the head spines and dorsal pterygiophores, some specimens were cleared and stained by the method of Dingerkus and Uhler (1977).

Results

1. Description of larvae and juveniles. Morphology: Larvae are compressed and relatively slender. The gut is thick and extends to 65% of body length (Fig. 2A–C).

Anterior and posterior parts of the dorsal fin are completed at about 14.5 and 17 mm TL, respectively and the pterygiophores are counted to 26 at about 14 mm TL, increase to 27 at about 16 mm TL (Fig. 2B, D). The number of anal and pectoral fin rays are completed in larvae measuring 14 to 16 mm TL (Fig. 2B, C). The pelvic buds are not present in the smallest larva in our collec-

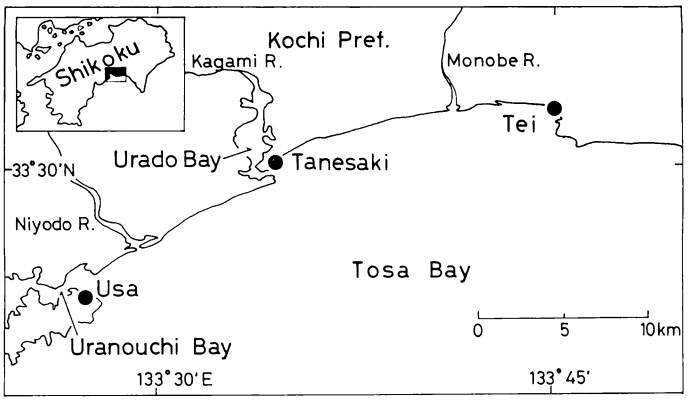

Fig. 1. A map showing three beaches, Usa, Tanesaki and Tei facing Tosa Bay where semimonthly collections in surf zones with a small seine were made (from Kinoshita, 1986).

tion (9.2 mm TL); they are found at 10.3 mm TL (Fig. 2A). The rays begin to ossify at about 16 mm TL and are completed at about 17 mm TL (Fig. 2C, D).

Head spines occur on the preopercle, opercle, interopercle, supracleithrum and posttemporal. Three spines are present both on the inner and outer margins of the preopercle at 10.3 mm TL, increasing to about eight at 19.5 mm TL, but those on the inner margin disappear in the juveniles over 25 mm TL (Fig. 2A, E, F). One opercular spine appears in about 16 mm larvae (Fig. 2C). One spine occurs on the supracleithrum in about 17 mm TL juveniles, and on the posttemporal and interopercle in about 19 mm TL juveniles. At 26.1 mm TL, the number of the spines on each of the three above-mentioned parts increases to three or four.

Pigmentation: Melanophore pattern in larval stages is relatively heavy. The melanophores are distributed at the lower end of the preopercular ridge, on the side of body (particularly on the tail), and along the dorsal and ventral margins of the tail. Those of the latter two extend to the posterior part of caudal peduncle. A row of melanophores is present ventrally from the chin to the hindgut and another row along the lateral midline, covering the posterior half of trunk and the anterior two-thirds of caudal peduncle. Small melanophores are also present on the snout, hindbrain, caudal fin base and lower lobe of caudal fin. Internal melanophores are distributed on the dorsal surfaces of the gas bladder and gut. Larvae over 14 mm TL have melanophores on the top of head and throat (Fig. 2A-C). The xanthophores are heavily are distributed along the myosepta of the body when alive.

In juvenile stages (Fig. 2D-F), the melanophores are more numerous on the head and tail, finally forming a brindle at 26.1 mm TL.

2. Morphological differentiation from larval and juvenile *L. japonicus*. Fig. 3 shows postlarvae and juveniles of *L. japonicus*.

Dorsal soft-rays: The most distinctive difference in adult morphology between *L. latus* and *L. japonicus* is the number of dorsal soft-rays: XII or XIII, 15 or 16 in the former and XII to XV (mostly XIII), 12 to 14 (mostly 13 or 14) in the latter (Katayama, 1957, 1960). The rays of dorsal fin could be counted XII or XIII, 15 or 16 in specimens larger than 14 mm TL of *L. latus*, against XII or XIII, 13 or 14 (mostly 13) in those of *L. japonicus* (Figs, 2, 3). Juveniles of the former had 26 or 27 dorsal pterygiophores, but those of the latter 24 or 25.

Pigmentation: A marked difference in the distribution pattern of melanophores between the two species was seen along the dorsal and ventral margins of the tail, and lateral midline. These melanophores extended to the posterior part of the caudal peduncle in *L. latus*, but exceeded a little beyond the posterior end of the dorsal and anal fin bases in *L. japonicus* (Figs. 2, 3). Moreover the melanophores on the top of head were present already at 14.5 mm TL in *L. latus*, but only in juveniles over 20 mm TL in *L. japonicus* (Figs. 2B, 3E).

According to Tanaka (pers. comm.), live larvae

Table 1. Collection records of larval and juvenile *Lateolabrax latus* in surf zones of three beaches facing Tosa Bay in 1982. A day's collection at each of the beaches consisted of three to eight hauls with a 1×4 m seine. Ta, Tanesaki; Te, Tei; U, Usa.

Date		Total fish no.			No./haul			Ranges of TL (mm)			W. T. (°C)			Salinity (‰)		
d	m	U	Ta	Te	U	Ta	Te	U	Ta	Te	U	Ta	Te	U	Ta	Te
9	1	0	31	10	0	5.2	2.0		9.2–14.0	11.2–13.9	14.8	15.7	15.5	34.2	32.0	32.5
23	1	4	19	8	0.8	3.2	1.6	11.6–16.8	10.4–16.4	11.6–14.8	15.6	14.5	14.5	32.7	32.0	32.5
7	2	0	0	1	0	0	0.2			10.4	13.5	14.1	12.2	32.9	30.9	32.0
25	2	0	3	8	0	0.5	1.7		13.1–13.6	10.4–14.4	14.5	14.5	15.1	32.7	30.9	31.4
10	3	0	0	25	0	0	5.0			10.3–17.8	14.0	15.1	16.0	34.7	32.0	34.3
21	3	0	7	30	0	1.2	8.0		12.6–16.6	12.1–23.8	16.5	15.7	14.9	31.8	26.6	28.5
16	4	0	35	78	0	5.8	15.6		11.8–17.8	12.2–27.0	18.0	17.8	16.0	32.5	34.5	32.2
25	4	1	50	27	0.2	8.7	5.4	14.8	11.6–21.0	12.0–19.5	19.1	18.7	18.7	34.4	29.4	27.6
11	5	0	5	1	0	0.8	0.3		16.2–26.7	17.8	21.1	21.0	24.0	30.0	23.7	28.2
Total or mean		5	150	188	0.1	2.8	4.4	11.6–16.8	9.2–26.7	10.3–27.0	16.3	16.3	16.3	32.9	30.2	31.0

and juveniles of *L. japonicus* seldom have any xanthophores. On the other hand, the xanthophores were heavily distributed all over the body in those of *L. latus*.

Head spination: The formation of spines in the head was considerably different between the two species (Fig. 4). The head spines first appeared over the eyes at 11.5 mm TL, and on the lachrymal and the subopercle at 17.0 mm TL in *L. japonicus*, against their total absence throughout the larval and juvenile stages in *L. latus* (Figs. 2, 3A, 3D, 4). Some spines on the interopercle, the posttemporal and the supracleithrum were first seen at 11.5 mm TL, 13.9 mm TL and 13.9 mm TL, respectively in *L. japonicus*, but in *L. latus*, the last-mentioned occurred in juveniles over 17 mm TL, and the former two in those over 19 mm TL (Figs. 2D–E, 3A–B, 4B–D).

Proportion of HL to SL: There was no difference in proportion of head length to standard length between the two species for specimens smaller than 12 mm TL. But in specimens larger than 12 mm TL, the head was relatively larger in *L. latus* with 0.32 ± 0.02 (mean and SD) than in *L. japonicus* with 0.27 ± 0.01.

3. Seasonal occurrence in Tosa Bay. Larval and juvenile *L. latus* first occurred in early January. After a short interposed period of low abundance in February, their occurrence in the surf zone rapidly increased to reach a peak in middle April and continued to be abundant until middle May (Fig. 5). Temperatures and salinities at waters where any number of them were collected ranged from 12.2 to 24.0°C and from 23.7 to 34.0‰, respectively. Most of them were collected at Tanesaki and Tei (Table 1).

There was little difference between sizes of specimens collected at the two locations; 9.2 to 26.7 mm TL in Tanesaki specimens vs. 10.3 to 27.0 mm TL in Tei specimens, both with a mode at 15.1–16.0 mm TL (Fig. 6). Seasonal changes in size of lavral and juvenile *L. latus* are shown in Fig. 7. The mode at 12.1–13.0 mm TL in early January increased to 15.1–16.0 mm TL in early March. The mode did not change through March and April. In middle May, the mean of total length abruptly increased to 20.4 mm TL.

Discussion

In specimens of 8.34–25.90 mm TL described as

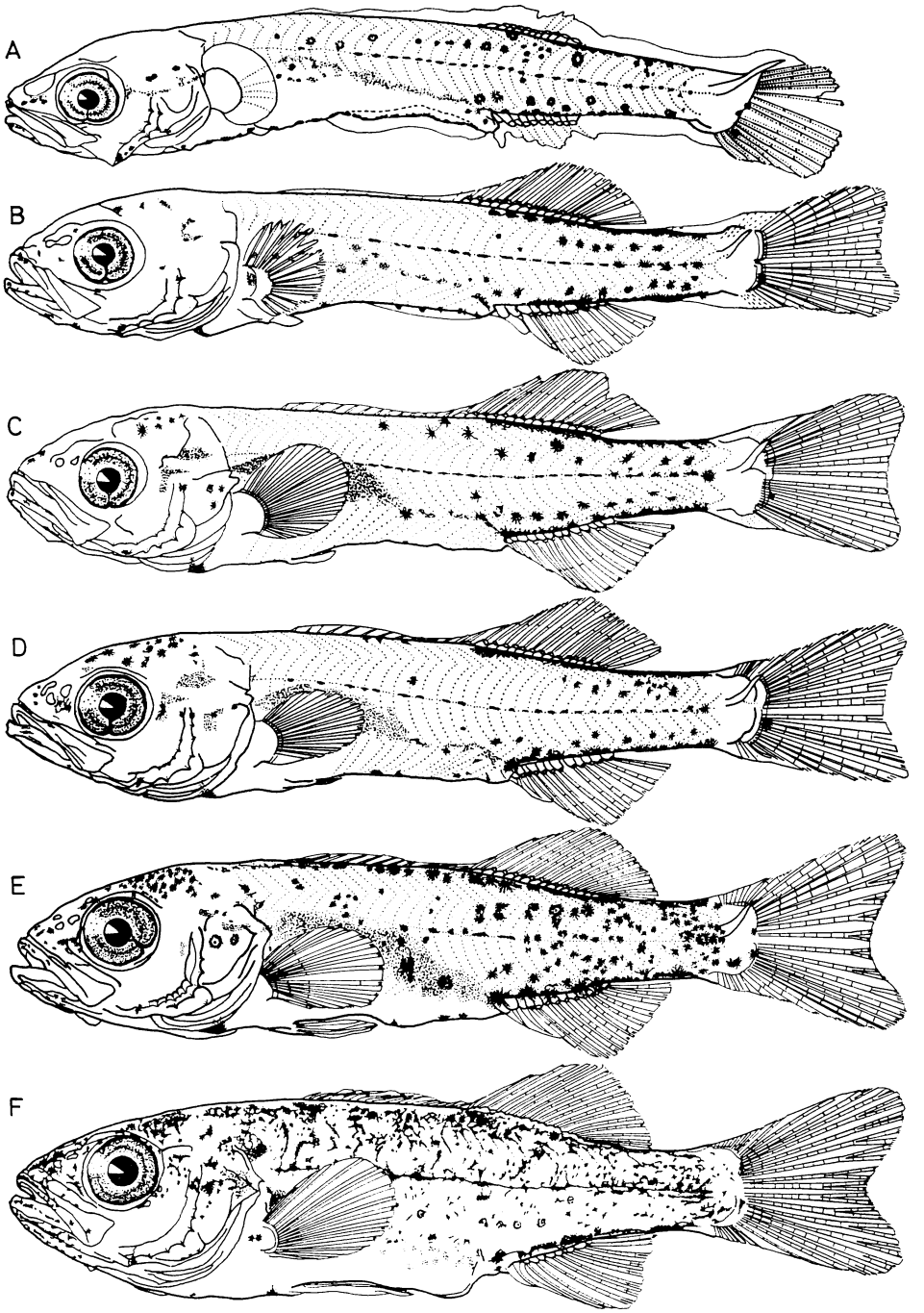

Fig. 2. Developmental stages of *Lateolabrax latus*. A, 10.3 mm TL (9.1 mm SL) postlarva; B, 14.5 mm TL (12.3 mm SL) postlarva; C, 16.2 mm TL (13.8 mm SL) postlarva; D, 17.1 mm TL (14.3 mm SL) juvenile; E, 19.5 mm TL (16.3 mm SL) juvenile; F, 26.1 mm TL (21.4 mm SL) juvenile.

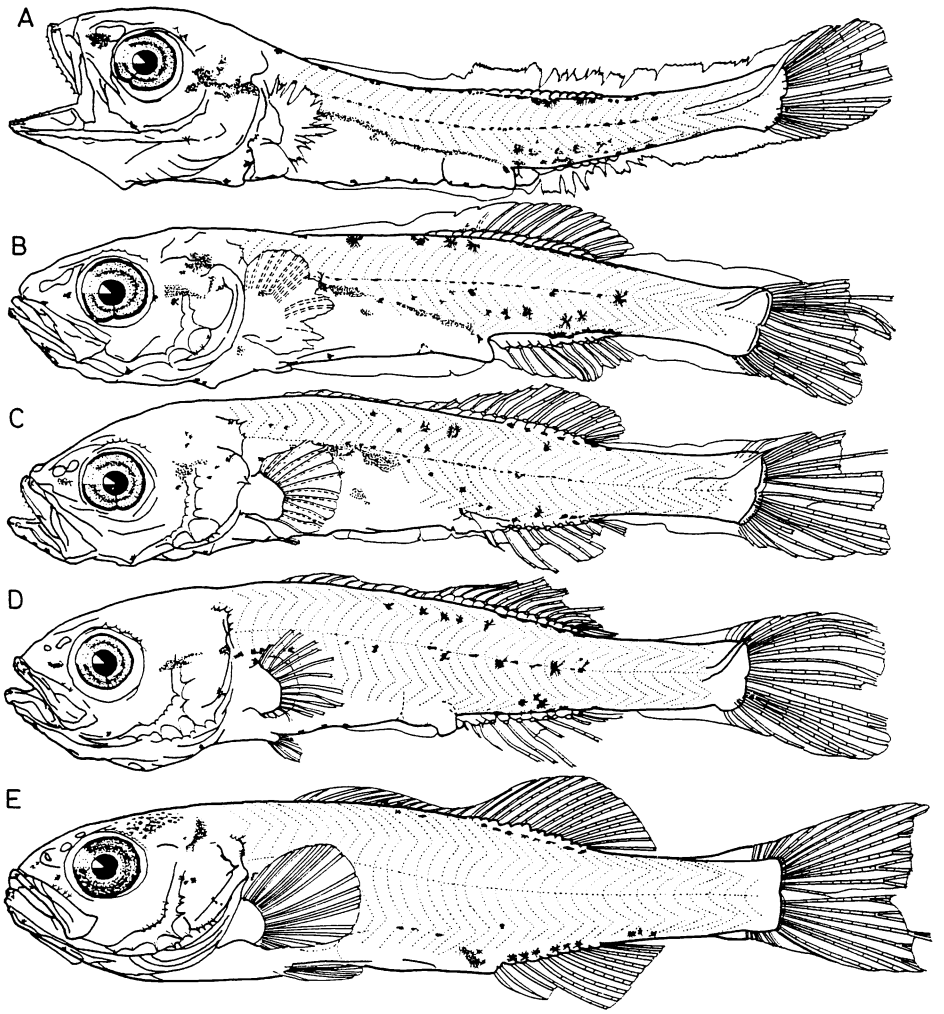

Fig. 3. Developmental stages of *Lateolabrax japonicus*. A, 11.5 mm TL (9.1 mm SL) postlarva; B, 13.9 mm TL (12.0 mm SL) postlarva; C, 15.5 mm TL (13.4 mm SL) postlarva; D, 17.0 mm TL (14.5 mm SL) juvenile; E, 24.9 mm TL (20.7 mm SL) juvenile.

L. japonicus by Mito (1957: pl. 11, figs. 3–6; 1966: pl. 19, fig. 46b), the melanophores on the tail, both along the dorsal and ventral margins and along lateral midline, extend to the posterior part of the caudal peduncle; and the spines are present on the opercle and on the shoulder, but not present over the eye, on the lachrymal, on the subopercle and on the interopercle. Furthermore the proportions of head length to standard length were calculated for the data given by Mito (1957, table 2) to range from 0.31 to 0.34 in specimens larger than 13 mm TL. These suggest that the larvae and juveniles mentioned above are not *L. japonicus* but *L. latus*. On the other hand, the 5.95 mm TL postlarva illustrated by Mito (1966, pl. 19, fig. 46a) is considered to be *L. japonicus* by the distribution pattern of melanophores on the tail. It is not sure whether the 5.00 and 6.48 mm TL postlarvae by him (Mito, 1957, pl. 11, figs. 1–2) are *L. latus* or *L. japonicus*.

Based on the growth of reared *L. japonicus* (Kumagai et al., 1984), we consider that the larval and juvenile *L. latus* collected during the present study colud be about 25–80 days old (mostly 30–50 days old). We estimate that *L. latus* spawns from late November to late March. We actually

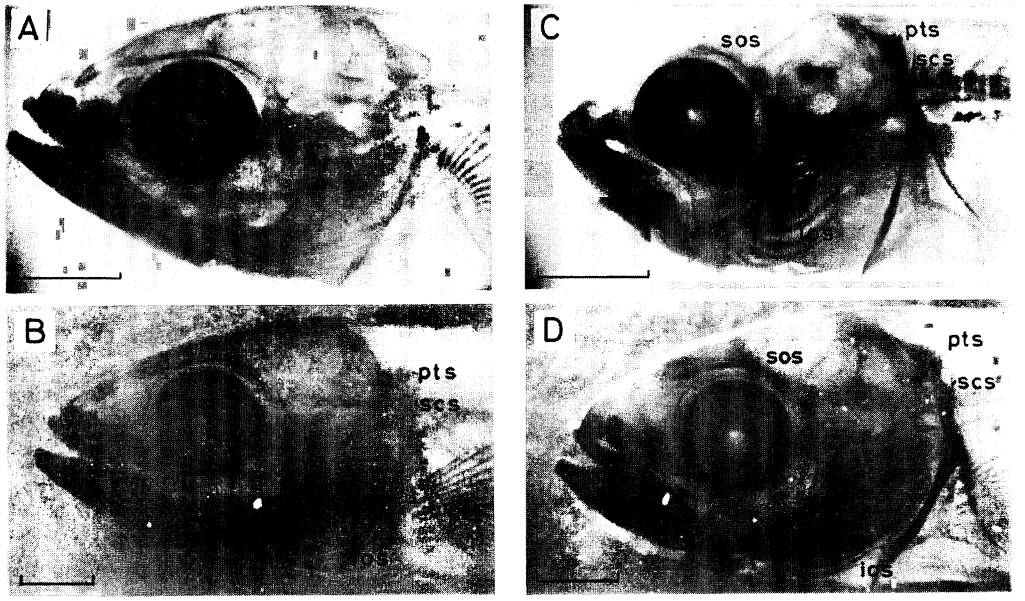

Fig. 4. Photographs of cleared and alcian blue-alizarin stained specimens showing head spination. A, *Lateolabrax latus* 13.9 mm TL (11.9 mm SL) postlarva; B, Same 19.1 mm TL (16.1 mm SL) juvenile; C, *L. japonicus* 14.1 mm TL (12.2 mm SL) postlarva; D, Same 19.0 mm TL (16.1 mm SL) juvenile. ios, interopercular spine; las, lachrymal spine; pts, posttemporal spine; scs, supracleithral spine; sos, supraocular spine. Scales indicate 1 mm.

collected a total of 119 eggs probably of *L. latus* with the small seine at the present study sites from December 1981 to February 1982. This spawning period almost accords with that of *L. japonicus* (Tanaka and Matsumiya, 1982).

In past studies using traditional larval nets or minnow-nets, few larvae and juveniles of *Lateolabrax* had been reported from coastal or shallow waters of Tosa Bay (Matsuda, 1969; Ikemoto et al., 1983). It seems that distribution of larval and juvenile *L. latus* is limited in extremely shallow waters such as surf zones.

The mode of their size did not change in the surf zones during March and April (Fig. 7). We can conclude that *L. latus* is among the "migrants" (Modde, 1980) during this period. The juveniles larger than 18 mm TL seldom occurred in the surf zones (Fig. 6), however juenile *L. latus* as large as 20 mm TL or larger are collected abundantly with a dragnet from eelgrass beds in Uranouchi Bay (Fig. 1) in April and May (Kochi Prefectural Fisheries Experiment Station, unpubl.). Their biotope after departure from the surf zones seems not to be the estuaries as in *L. japonicus* (Matsumiya et al., 1981) but inlet waters with

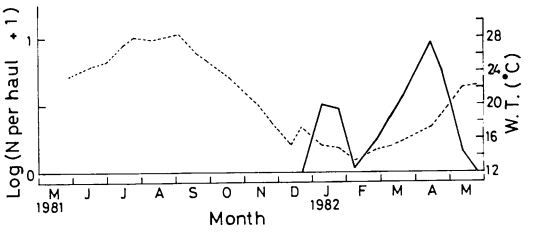

Fig. 5. Seasonal occurrence of larval and juvenile *Lateolabrax latus* in surf zones of Tosa Bay. Mean water temperature of the three beaches is shown by a broken line.

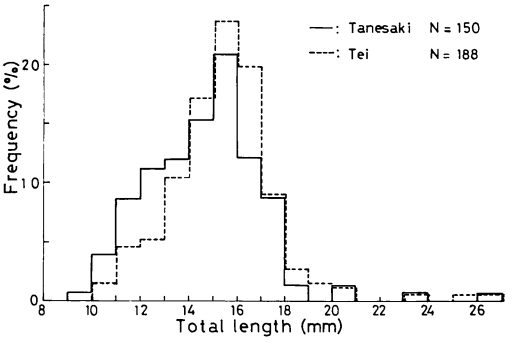

Fig. 6. Length frequencies of larval and juvenile *Lateolabrax latus* at Tanesaki and Tei.

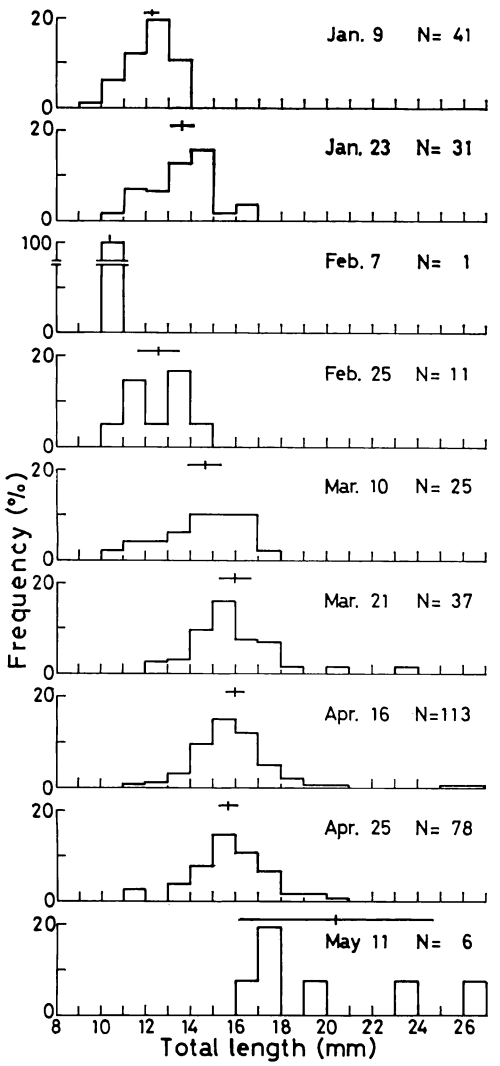

Fig. 7. Seasonal changes in length frequency of *Lateolabrax latus* specimens obtained from the semimonthly collections in Tosa Bay surf zones in 1982. Vertical and horizontal bars above histogram represent means and their 95% confidence limits of total length, respectively.

eelgrass beds and so on. A total number of 16 larval and juvenile *L. japonicus* (11.6–17.7 mm TL) also occurred at the present sites (Kinoshita, 1984), but the number collected was only one-twentieth of that of *L. latus*. Conversely, in the Shimanto estuary, Kochi Prefecture, the number of the latter was one-tenth of that of the former (Fujita et al., unpubl.). Hence habitat isolation between *L. latus* and *L. japonicus* may occur as early as in larval and juvenile stages.

Juvenile *L. japonicus* are known to occur abundantly in the estuaries of Ariake Bay (Matsumiya et al., 1981). In the seas other than Ariake Bay, they are reported to utilize eelgrass beds as nursery ground (Oshima, 1954; Hatanaka and Sekino, 1962). We, however, consider that a part of juvenile *L. latus* collected in eelgrass beds of southern Japan was reported as *L. japonicus*.

Acknowledgments

We express our gratitude to Dr. Tetsushi Senta, Professor of the Faculty of Fisheries, Nagasaki University, for his revising the manuscript. Mr. Shubun Fukudome, President of Nishinihon Institute of Technology, encouraged us to undertake the present study, and we are much obliged. Thanks are due to the researchers of the same Institute who helped us in the collections. We are indebted to Dr. Yoshiharu Matsumiya, Associate Professor of Ocean Research Institute, the University of Tokyo and Dr. Masaru Tanaka, Associate Professor of the Department of Fisheries, Kyoto University, for loaning us materials in their cares. We thank Dr. Satoshi Mito, Director of Seikai Regional Fisheries Research Laboratory and Mr. Jun-ichi Kojima, Marine Ecology Research Institute, for their valuable advice. This work was partially supported by the grant from the Nippon Life Insurance Foundation, and we are much grateful for that.

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土佐湾の砕波帯に出現するヒラスズキ仔稚魚

木下　泉・藤田真二

合計 343 尾のヒラスズキ仔稚魚 (9.2–27.0 mm TL) が，土佐湾の砕波帯において小型曳網によって採集された．ヒラスズキ仔稚魚は，同属のスズキ仔稚魚と形態的に酷似するが，尾部での黒色素胞の分布様式，頭部棘形成，頭長/体長比および背鰭 15 または 16 軟条を有することにより，それらと識別できる．ヒラスズキ仔稚魚は，土佐湾の砕波帯では 1 月上旬–5 月中旬にかけて出現し，最も量的に多かったのは 4 月中旬であった．それらの出現時の水温・塩分の範囲は，各々 12.2–24.0°C・23.7–34.5‰ であった．過去，南日本の沿岸域，浅海域およびアマモ場において，本種仔稚魚は全く報告されておらず，スズキ仔稚魚に混入されていた可能性がある．いずれにしても，本種仔稚魚の出現域は砕波帯およびその付近に限られているようである．

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