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Seasonal Occurrence and Food Habits of Larvae and Juveniles of Two Temperate Basses in the Shimanto Estuary, Japan

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Abstract Larvae and juveniles of *Lateolabrax japonicus* and *L. latus* occurred from January to May 1986 in the shallow waters of the Shimanto estuary. *L. japonicus* markedly outnumbered *L. latus*. Distinct ecological differences were recognized in habitats and food habits between the two species: *L. japonicus* mainly inhabited eelgrass beds composed of *Zostera nana*, while *L. latus* appeared evenly in both eelgrass beds and non-eelgrass habitats; the former fed on copepods and cladocerans, while the latter fed on copepods and fish larvae. From these habitat and food habit analyses, estuaries were considered to be important as a main habitat for *L. japonicus*, but not for *L. latus*. The fact that ecological differences have occurred during the early life stages was inferred to be one of the possible keys to speculate on the speciation of the two species.

It is known that *Lateolabrax japonicus* (Cuvier) is distributed in coastal waters from Hokkaido to the South China Sea; *L. latus* Katayama in southern Japan, from Chiba to Nagasaki Prefectures. In Wakayama and Kochi Prefectures, the latter is more common than the former (Katayama, 1960, 1984; Kinoshita, 1988).

A large number of works have been made on the ecology and early life history of *L. japonicus* (Mito, 1957; Hatanaka and Sekino, 1962a, b; Matsumiya et al., 1982, 1985). However, only a couple of works has been made on *L. latus*, dealing with early ecology in surf zones and morphological features of larvae and juveniles (Kinoshita and Fujita, 1988).

Recently, we found that larvae and juveniles of *L. japonicus* and *L. latus* occur in the same season in the Shimanto estuary, Kochi Prefecture. This study was made to describe the seasonal occurrence and food habits of these two related species and to compare some aspects of their early life histories.

Materials and methods

Monthly collections of the larvae and juveniles were made at 11 stations in the Shimanto estuary, Kochi Prefecture, from July 1985 to June 1986. These stations were set in shallow waters near shores from the river mouth to about 6 km upstream. On the detailed collection sites and methods, the reader is referred to our preceding report (Kinoshita et al., 1988). The monthly collections consisted of 24 to 43 hauls. Specimens were preserved in 10% formalin until sorting and measurements were completed in the laboratory.

Table 1. Collection records of *Lateolabrax japonicus* (J) and *L. latus* (L) with a seine 1×4 m, in the Shimanto estuary.

Date	Total fish no.		Range of TL (mm)	
	J	L	J	L
July 6–7, 1985	2	0	71.9–74.9	
Aug. 3–4, 1985	1	0	116.2	
Jan. 24–25, 1986	9	20	4.6–14.1	11.2–15.8
Feb. 22–23, 1986	413	20	11.5–22.9	12.5–20.7
Mar. 22–23, 1986	109	1	12.7–43.1	19.6–28.4
Apr. 27–28, 1986	113	10	13.8–60.9	15.2–55.1
May 24–25, 1986	14	12	28.0–55.0	25.5–49.6
June 22–23, 1986	2	1	64.4–79.8	42.7
Total	663	65	4.6–116.2	11.2–55.1

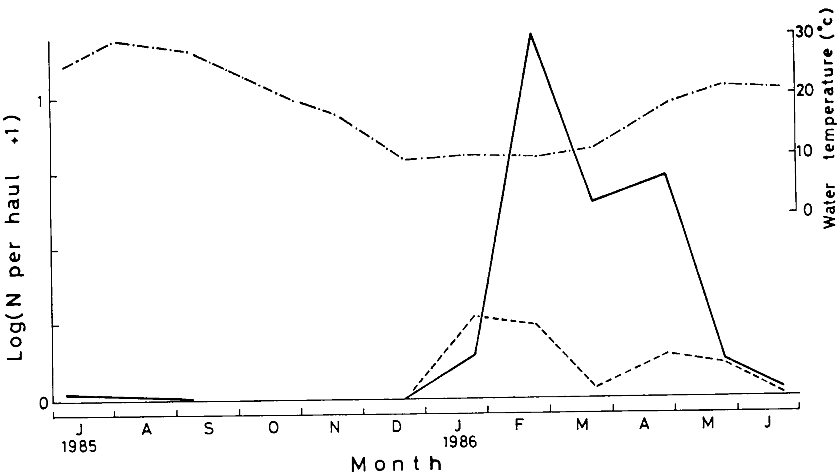

Fig. 1. Seasonal occurrence of *Lateolabrax* in the Shimanto estuary. Solid and dashed lines indicate *L. japonicus* and *L. latus*, respectively. Mean water temperatures are shown by a dot-dashed line.

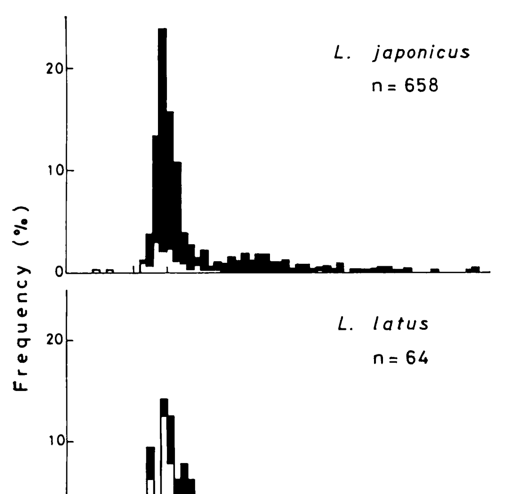

Fig. 2. Total length frequencies of *Lateolabrax japonicus* and *L. latus* collected from January to May 1986. Solid and open areas indicate fishes from eelgrass beds and non-eelgrass habitats, respectively.

Measurements of surface-water temperature and salinity were made at each sampling station.

For gut content analyses, 60 *L. japonicus* (12.4–20.0 mm TL) and 33 *L. latus* (12.2–20.0 mm TL) were examined (Table 2). These samples were collected from January to April 1986. Samples were selected from two habitats; eelgrass beds composed of *Zostera nana* and non-eelgrass habitats. The size of the specimens was also selected so that the two groups had nearly the same size compositions. Ingested foods were removed from the whole alimentary canal, i.e., from the mouth to the anus, with fine needles and were identified under a dissecting microscope and classified into major taxonomic categories.

Dry weight of copepod and cladocera specimens was calculated from the length-weight relationships presented by Uye (1982). Average dry weight of postlarval *Luciogobius* sp. taken by temperate bass was substituted by 34 μg/ind. based on a sample of larvae ranging 3.3–4.9 mm TL (N=10) collected with a larva net (diameter, 0.8 m; mesh, 0.33 mm) in the Shimanto estuary in February 1987.

Results

About 28,000 larval, juvenile and young fishes were collected during the study period, of which 663 were identified as *L. japonicus* (4.6–116.2 mm TL), and 65 as *L. latus* (11.2–55.1 mm TL) (Table 1).

1. Seasonal occurrence. *Lateolabrax japonicus*: Larvae and juveniles first occurred in January. In February, the maximum number occurred, and the number of the fish remained abundant until May (Fig. 1). Temperatures and salinities of the waters where they were collected ranged from 9.7 to 22.8°C and from 2.3 to 29.0 (mostly 5 to 15) ‰, respectively. Youngs of *L. japonicus* were also collected in July and August 1985 and June 1986 (Table 1).

Most of larvae and juveniles were collected in eelgrass beds (Fig. 2). The modal size of the specimens collected from January to May was 14.1–15.0 mm TL (Fig. 2). The monthly mode shifted from 13.1–14.0 mm TL in January, through 16.1–17.0 mm TL in March, to 26.1–27.0 mm TL in April (Fig. 3).

Lateolabrax latus: Larvae and juveniles occurred from January to June, being most abundant in January (Fig. 1). Temperatures and salinities of waters where they were collected ranged from 9.1 to 23.9°C and from less than 1.8 to 29.0 (mostly 5 to 15) ‰, respectively.

Larvae under 16 mm TL were collected more abundantly in non-eelgrass habitats than in eelgrass beds. Conversely, the majority of juveniles over 16 mm TL were caught in eelgrass beds (Fig. 2). The length mode of larvae and juveniles collected from January to May was 14.1–15.0 mm TL (Fig. 2). The monthly mode shifted from 14.1–15.0 mm TL in January to 15.1–19.0 mm TL in February. Thereafter, the size distribution was too sporadic to know the modes (Fig. 3).

2. Food habits of larvae and juveniles. Numerical percentage of food items in the gut of *L. japonicus* and *L. latus* collected from both kinds of habitats (eelgrass beds and non-eelgrass habitats) are shown in Table 2. Dry weights of three prevalent food animals, copepods, cladocerans and

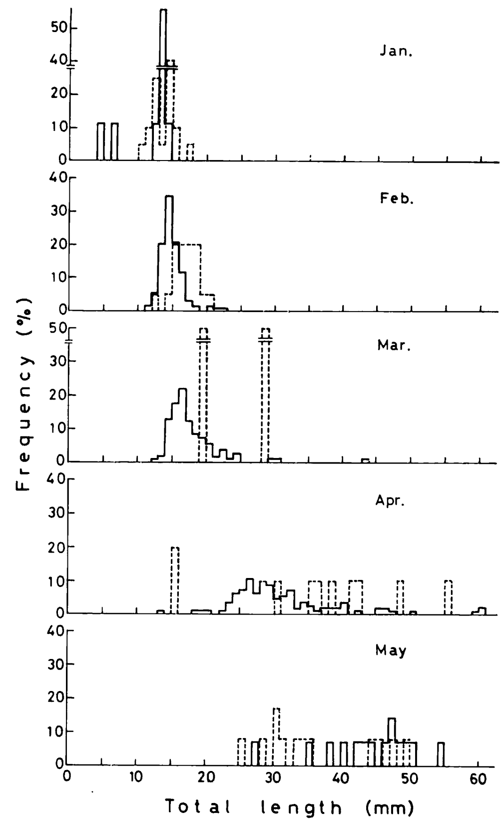

Fig. 3. Seasonal changes in length distribution of *Lateolabrax*. The monthly number of individuals is shown in Table 1. Solid and dashed bars indicate *L. japonicus* and *L. latus*, respectively.

Table 2. Numerical percentage of food animals taken by *Lateolabrax japonicus* and *L. latus* collected in the eelgrass beds and non-eelgrass habitats of the Shimanto estuary. +, uncountable.

	L. japonicus		*L. latus*	
	Eelgrass beds	Non-eelgrass	Eelgrass beds	Non-eelgrass
No. of fish examined	32	28	15	18
Range of TL (mm)	12.4–19.6	12.6–20.0	12.3–19.0	12.2–20.0
No. of fish with food	32	27	15	18
Range (mean) of food no./individual	1–195 (37)	0–96 (12)	2–55 (21)	1–83 (30)
Food items				
Polychaets	0.2	0	1.6	0
Cladocerans	29.4	33.2	3.2	5.4
Ostracods	0.1	0	0.3	0
Copepods	69.4	65.0	70.2	90.3
Cumaceans	0.1	0.3	0	0
Gammarids	0.4	1.2	1.3	0.4
Shrimp larvae	0.1	0.3	0	0.2
Crab larvae	0	0	3.2	0.6
Fish larvae	0.3	0	20.0	3.1
Unknown	0	+	+	0

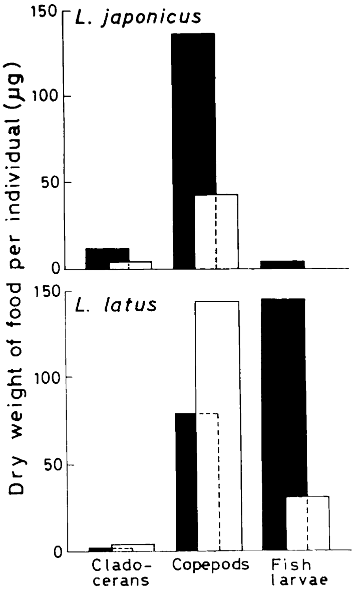

Fig. 4. Average dry weights of three prevalent food items detected from the gut of single *Lateolabrax japonicus* and *L. latus*. Solid bars show eelgrass beds and open bars non-eelgrass habitats.

fish larvae, detected from the gut of single *Lateolabrax* are shown in Fig. 4.

Lateolabrax japonicus: Larvae and juveniles fed predominantly on copepods in both habitats. Cladocerans were ranked second in numerical percentage. Most of the copepods were identified as *Paracalanus* sp., having a prosome length of about 0.7 mm; most of the cladocerans were identified with *Podon leuckerti*, with about 0.4 mm body length. Some other animals were found, but they were negligible in number. The number of food organisms per fish was about three times as large in larvae and juveniles collected from eelgrass beds as in those from non-eelgrass habitats.

Lateolabrax latus: Larvae and juveniles fed mainly on copepods in both habitats. Other prevalent food animals were fish larvae and cladocerans in numerical percentage, but the former occupy a much more important part than the latter in terms of weight. A major part of fish larvae in the gut was identified as *Luciogobius* sp. (Gobiidae), which were about 4 mm TL. The smallest *L. latus* larva that fed on gobiids was 13.3 mm TL in size. The number of food animals per fish was not so different between eelgrass beds and non-eelgrass habitats as in *L. japonicus*.

Discussion

Larvae and juveniles of *L. japonicus* were found to be markedly more abundant than those of *L. latus* in the estuary (Fig. 1). In the surf zones of Tosa Bay facing the open sea, however, *L. latus* prominently outnumbered *L. japonicus* (Kinoshita, 1984). A large number of juveniles of *L. latus* (larger than 20 mm TL) have been collected from eelgrass beds (*Z. marina*) in Uranouchi Bay, Kochi Prefecture (Kochi Prefectural Fisheries Experimental Station, unpubl.). This bay, being deeply embayed and having few inflowing rivers, usually has relatively high-salinity water of 27–34‰ (Kimura et al., 1986). The evidence and information suggest that estuaries may not be the primary habitat for the early life stages of *L. latus*, but surf zones and eelgrass beds consisting of *Z. marina* are more important.

Between estuaries and surf zones, salinity may be the most different environmental factor. The habitat separation of the two species may be related to their specific salinity preference; *L. japonicus* prefers lower salinities than *L. latus*.

Larvae and juveniles of *L. japonicus* were concentrated in eelgrass beds consisting of *Z. nana*. They were found to feed on a greater number of foods in eelgrass beds than in non-eelgrass habitats. On the other hand, in *L. latus* larvae and juveniles which occurred equally in both habitats, only a small difference in the number of foods was found between the two habitats (Fig. 2, Table 2). These suggest that eelgrass beds are more important as a nursery ground in *L. japonicus* than in *L. latus*, at least within the estuary.

The major difference in gut contents between the two species was the second-ranked food items; cladocerans in *L. japonicus* and fish larvae in *L. latus*. Fish larvae in *L. latus* guts are ranked second in numerical percentage in eelgrass beds (Table 2), but they occupy the most important part in terms of weight. In contrast, cladocerans, ranked second or third in numerical percentage, are not so important in terms of weight (Fig. 4). *L. japonicus* is well known to be a typical piscivorous fish (Hatanaka and Sekino, 1962a), but the stage when the piscivorous habit begins in the ontogeny has never been clarified. It is very interesting that it starts during the postlarval stage in *L. latus*. This can be the most significant difference in food habits between the two closely related species.

The difference of habitats and foods among closely related species has been mostly attributed to interspecific coaction (Mizuno et al., 1958; Saishu, 1963; Omori, 1975). In the present paper, we provided some evidence about the difference of habitats and food habits between *L. japonicus* and *L. latus*. These differences do not always imply the significant evidence resulting from the coaction between the two species. However, the fact that ecological differences have already occurred during the postlarval stage would be a valuable information in analyzing the speciation of the present two species. To approach the problem, a further detailed ontogenetic comparison of ecology must be made together with morphology and physiology throughout their early stages.

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四万十川河口域におけるスズキ，ヒラスズキ仔稚魚の出現の季節変化と食性

藤田真二・木下　泉・高橋勇夫・東　健作

四万十川河口域の浅所にスズキ仔稚魚 (4.6–60.9 mm TL) およびヒラスズキ仔稚魚 (11.2–55.1 mm TL) が同所的に 1986 年 1 月から 5 月の間出現した．採集量はスズキの方がヒラスズキよりかなり多かった．スズキは，出現量，摂餌量ともコアマモ場内で多く，主に橈脚類と枝角類を摂餌していた．一方，ヒラスズキはコアマモ場とそれ以外の水域で出現量，摂餌量とも大差なく，主に橈脚類と仔魚を摂餌していた．今回の結果から，河口域はスズキにとっては主生育場であるが，ヒラスズキにおいては，そうでないことが示唆された．これら近似 2 種における初期生態の相違は，両種の分化を推論する 1 つの手がかりとなるかもしれない．

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