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Studies on the Larvae and Juveniles of the Sinistral Flounders—VI. *Psettina iijimae, P. tosana,* and *P. gigantea*

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Abstract Five postlarvae were caught off south west Japan. They are identified as *Psettina iijimae, P. tosana,* and *P. gigantea* on the basis of combinations of dorsal and anal ray counts. Descriptions and figures of the postlarvae of the three species are presented, and those of the latter two species are given here for the first time.

Introduction

In the course of studying the larvae and juveniles of the sinistral flounders, the author recently examined five moderately elongated postlarvae of the family Bothidae obtained from off south west Japan in August, 1966 and October, 1967. They are characterized by having a short and slender first dorsal ray and an elongated second dorsal ray, intestinal coil produced before anus, and smooth ventral margins of pelvic and urohyal bones. On the body shape and meristic characters, the postlarvae are similar to larvae of *Psettina iijimae* and *P. hainanensis* described by Pertseva-Ostroumova (1965) from the Gulf of Tonking, but her larvae have the serrated pelvic and urohyal bones. On the other hand, they resemble the larvae of *Arnoglossus* in the conditions of these bones, but clearly differ in body shape and features of the first and second dorsal rays (Amaoka, 1973, 1974). Therefore, the author checked the identification of the postlarvae on the meristic counts of adults of the family found in this area. The ranges of their meristic counts apparently fall into those of the genus *Psettina*. On the combinations of numbers of dorsal and anal rays the five postlarvae are identified as *P. iijimae, P. tosana,* and *P. gigantea.*

This paper describes, illustrates and discusses the larvae of these species.

Material and methods

The postlarvae examined were collected off south west Japan, by midwater trawl (Table 1), and preserved in 10% formalin. The specimens are deposited in the Department of Biology and Aquiculture, Shimonoseki University of Fisheries (SUF). The counts and proportional measurements were made in accordance with the method used by Norman (1934), and in the vertebral counts the urostyle is counted as one bone.

Description

1. *Psettina iijimae* (Jordan and Starks) Fig. 1.

Two specimens, SUF No. 66-J-3-1, No. 66-J-7-1. Following data are listed in the same order. 17.7, 10.0 mm in total length, 14.1, 9.1 mm in standard length.

Dorsal 92, 81; anal 68, 67; pelvic 6, 6; caudal 17, 17; vertebrae 10+28=38, 10+28=38.

In standard length: head 4.67, 4.79; depth

Table 1. The sampling data of five postlarvae, *Psettina iijimae, P. tosana,* and *P. gigantea.*

Species	Specimen (SUF)	Date	Time	Locality	Collection depth (m)
P. iijimae	66-J-3-1	Aug. 18, 1966	20.45~21.17	30°51.5N, 130°01.0E	0~30
	66-J-7-1	Aug. 18, 1966	21.25~22.08	30°51.5N, 130°01.0E	0~27
P. tosana	67-D-1-1	Oct. 29~30, 1967	19.17~19.47	29°36.5N, 126°12.0E	0~80
	67-D-1-2	Oct. 29~30, 1967	19.17~19.47	29°36.5N, 126°12.0E	0~80
P. gigantea	67-D-2-3	Oct. 29~30, 1967	20.04~20.34	29°35.9N, 126°08.5E	0~30

1.75, 1.9. In head length: snout 3.75, —; eye 4.29, 3.31; maxillary 3.75, —; lower jaw 2.73, 2.11; depth of caudal peduncle 1.5, 1.9; longest dorsal ray 1.2, —; longest anal ray 1.2, —; pectoral fin on both sides 1.67, —; pelvic fin 3.0, — on left side, 4.29, — on right side; base of pelvic fin 3.0, — on left side, 4.29, — on right side.

Body, highest near anterior 1/5 of body, its depth more than half body length. Dorsal contour with a deep notch above nostril; ventral contour having a deep notch below lower jaw, and expansion of abdominal region, somewhat steeply raising from anus to caudal base. Depth of caudal peduncle about 1/4 depth of body.

Head, about 1/5 length of body. Snout a little longer than eye diameter. Eyes situated symmetrically on each side of body. Olfactory organ on each side located in front of eye, a concave nostril without olfactory lamellae, not divided into two openings, and surrounded by thin membrane except for posterior margin.

Mouth oblique and subequal on both sides, maxillary not extending to below anterior margin of eye. Some small conical teeth on both jaws arranged in a single row.

Scales and lateral line not yet discernible.

Dorsal fin originating from notched region above nostril, the first ray slender and very short, about half eye diameter; second ray without any branch, feeble and elongate, about as long as head length; remaining rays becoming higher toward near half of body, the longest ray a little shorter than head length. Anal fin starting just behind anus, highest near middle part of its base. Pectoral fin symmetrical, fan-like in shape, with fleshy peduncle surrounded by a thin transpalent membrane, but rays undeveloped. Pelvic fins well developed on both sides of body, asymmetrical in shape and in position, the first ray on right side opposite the fourth ray on left side; the third and fourth ray longest on each side. Caudal fin rounded posteriorly, a little longer than head; some middle rays branched.

Urohyal situated above pelvic bone, and posteriorly connected by membrane with cleithrum and dorsal part of pelvic bone; its exposed part of bone forming ventral contour of body not serrated.

Pelvic bone well developed, asymmetrical in shape and position, an up-bent process supporting six rays; posterior process much elongated and tapering, running along below ventral margins of liver and large bending portion of intestinal coil, and extending backward, but not to near anus; ventral margin of process not serrated.

Convolute part of intestinal coil greatly produced beyond body, but rectal part not produced outward. Brain, digestive organ, heart, gill, and gas-bladder visible externally. Caudal skeleton completed.

Color in formalin. General ground color

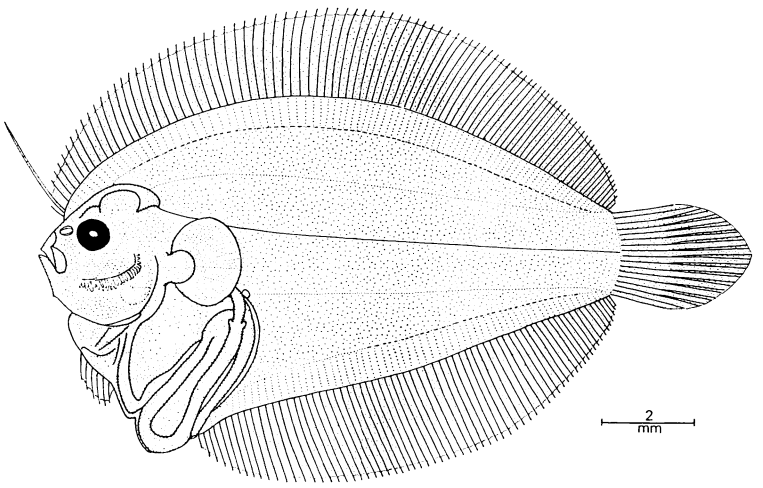

Fig. 1. Postlarva of *Psettina iijimae* in early metamorphic stage: SUF No. 66-J-3-1, 14.0 mm in standard length.

yellowish white, with blackish eye; many prominent brownish streaks arranged on both sides of body, between epaxial portion and dorsal interspinous region, and between hypaxial portion and anal interspinous region.

2. *Psettina tosana* Amaoka (Fig. 2.)

Two specimens, SUF No. 67–D–1–1, No. 67–D–1–2. Following data are listed in the same order. 19.0, 20.0 mm in total length, 16.5, 17.2 mm in standard length.

Dorsal 89, 91; anal 73, 71; pelvic 6, 6; caudal 17, 17; vertebrae 10+28=38, 10+28=38.

In standard length: head 5.32, 4.91; depth 2.06, 1.95. In head length: snout 3.88, 3.5; eye 4.43, 4.67; maxillary 3.88, 4.38; lower jaw 2.82, 2.92; depth of caudal peduncle 1.72, 1.75; longest dorsal ray 1.24, 1.4; longest anal ray 1.24, 1.4; pectoral fin 1.72, 1.75 on both sides; pelvic fin 3.1, 3.18 on left side, 3.44, 3.89 on right side; base of pelvic fin 3.1, 3.18 on left side, 4.43, 4.38 on right side.

The larvae of the present species closely resemble those of *P. iijimae* in general appearance. But they differ from the latter in following characters: somewhat larger number of anal fin rays; comparatively lesser depth of body; smaller head; nostrils with two openings on the left side, but an elliptical hollow surrounded anteriorly by thin marginal membrane on the right side; eyes slightly smaller, asymmetrical in position, right eye situated slightly above the

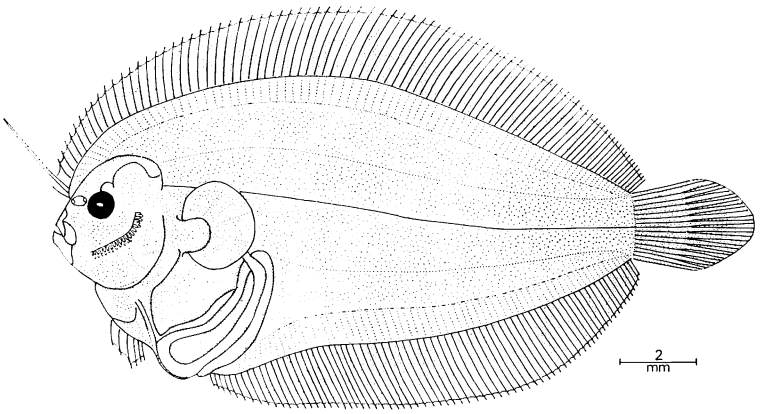

Fig. 2. Postlarva of *Psettina tosana* in early metamorphic stage: SUF No. 67–D–1–1, 16.5 mm in standard length.

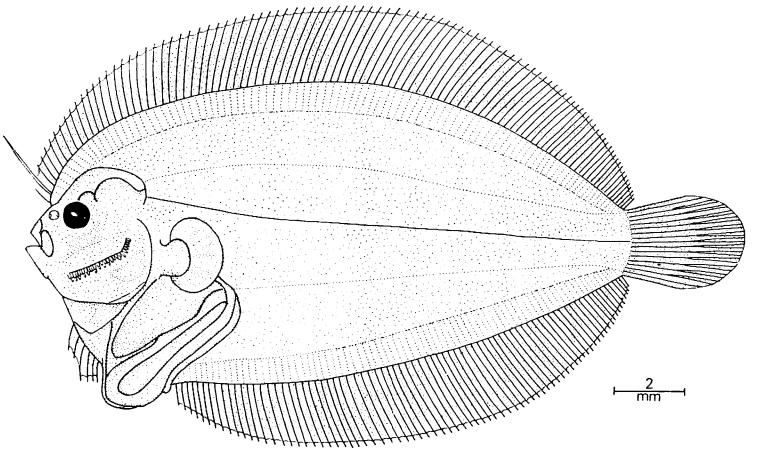

Fig. 3. Postlarva of *Psettina gigantea* in early metamorphic stage: SUF No. 67–D–2–3. 19.1 mm in standard length.

left; bending part of intestinal coil and lower end of liver not more produced beyond body, and thus anus more neared pelvic fin. However, some of them are from differences of the developmental stage, and thus the present larvae seems to be more advanced than those of *P. iijimae*.

3. *Psettina gigantea* Amaoka (Fig. 3.)

One specimen, SUF No. 67-D-2-3, 22.0 mm in total length, 19.1 mm in standard length.

Dorsal 100; anal 79; pelvic 6; caudal 17; vertebrae 10+28=38.

In standard length: head 5.16; depth 2.17. In head length: snout 3.7; eye 4.63; maxillary 3.7; lower jaw 3.08; depth of caudal peduncle 1.76; longest dorsal ray 1.42; longest anal ray 1.42; pectoral fin 2.06 on both sides; pelvic fin 3.08 on both sides; base of pelvic fin 2.85 on left side, 6.17 on right side.

The larva of the present species closely resembles those of *P. iijimae* and *P. tosana* in general appearance. It seems to be impossible to clearly separate it from the larvae of the two species by other characters, except for having the larger number of the dorsal and anal rays, lesser depth of body and shorter pectoral fin.

Discussion

The present postlarvae belong evidently to species of the family Bothidae in having the asymmetrical pelvic fin. The author attempted to search for adults having meristic counts similar to those of the present postlarvae (dorsal 81～100; anal 67～79; vertebrae 10+28=38). The genera *Crossorhombus, Engyprosopon*, and *Asterorhombus* have lower numbers of dorsal and anal rays and vertebrae. The genera *Neolaeops, Parabothus, Kamoharaia, Taeniopsetta, Arnoglossus, Laeops*, and *Chascanopsetta* have higher numbers of these counts. Moreover, the postlarvae of the latter six genera differ greatly from the present postlarvae in general appearance (Hubbs and Chu, 1934; Nielsen, 1963; Smith, 1967; Amoaka, 1970, 1971, 1972, 1974).

In the meristic counts the postlarvae are somewhat similar to the species of three other genera, *Bothus, Tosarhombus*, and *Psettina*. The postlarvae of *Bothus* are already well known in certain species and are easily separable from the present larvae in having a circular body (Kyle, 1913; Kuronuma, 1942; Ochiai and Amaoka, 1963; Amaoka, 1964). Though the meristic counts of the species of *Tosarhombus* partly correspond to those of the present postlarvae, the species seems to be excluded from the identification by a little higher meristic counts. Thus, the characters of the species of the only remaining genus *Psettina* agree well with those of the present postlarvae.

The larvae of the genus *Psettina* were reported first from the Gulf of Tonking, South China Sea by Pertseva-Ostroumova (1965), and identified as *P. iijimae* and *P. hainanensis*. They closely resemble them in general appearance and meristic characters, but there are clear differences in the urohyal, the pelvic bone, and the anterior rays of the dorsal fin. Therefore, it is necessary to check the identity of the present postlarvae.

In the *Psettina*, there are three species, *P. iijimae, P. tosana* and *P. gigantea* occuring in the waters of the south western Japan (Amaoka, 1969). The adult forms of these species are well separated by the number of scales on lateral line, mouth size, and coloration. Since on the present postlarvae, these distinguishing charac-

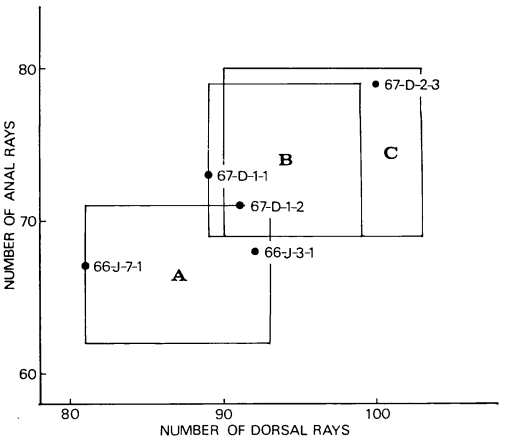

Fig. 4. Relation of numbers of dorsal and anal fin rays in the three species of the genus *Psettina* (A, *P. iijimae*; B, *P. tosana*; C, *P. gigantea*). A～C showing ranges of their counts of the three adult forms on the basis of Amaoka (1969); 66-J-3-1 and 66-J-7-1 fall into ranges of *P. iijimae*, 67-D-1-1 and 67-D-1-2 into *P. tosana* and 67-D-2-3 into *P. gigantea*.

ters of the adult are still undeveloped, the larvae cannot but be identified by a combination of the numbers of dorsal and anal rays and vertebrae, though these counts fairly overlapped each other in range. As the vertebrae of the postlarvae show same counts of 38, the relation of number of dorsal and anal rays in the three species is presented on the basis of adult forms shown by Amaoka (1969), and those of the five postlarvae are plotted in it (Fig. 4). Thus, undoubtedly of the four specimens, 66–J–7–1 and 66–J–3–1 fall into ranges of *P. iijimae*, 67–D–1–1 into *P. tosana*, and 67–D–2–3 into *P. gigantea* respectively. On only one specimen 67–D–1–2, the counts are included in either ranges of *P. iijimae* and *P. tosana*. But it is probably regarded as the larva of the same species to the 67–D–1–1 specimen because they come from same collecting point and net.

Comparison of larvae of the present three species with those of the two species, *P. iijimae* and *P. hainanensis* described by Pertseva-Ostroumova (1965), shows that the former three differ from the latter two having serrated ventral margins of the urohyal and the pelvic bones and elongated first dorsal ray or not. It is obscure whether these characters are only a short existance during the developmental stage or are easily damaged. But it is judged that the larvae are all of the genus *Psettina*, because they are closely similar in general appearance and in meristic counts.

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ヒラメ類の稚仔魚の研究—VI. イイジマダルマガレイ，トサダルマ，ソコダルマ

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1966年8月と1967年10月に日本の南西海域の4地点，水深 0～80 m 層から採集された5個体（体長 9.1～19.1 mm）のダルマガレイ科 (Bothidae) の後期仔魚を調査した．これらの仔魚は，背鰭条数 81～100，臀鰭条数 67～79，脊椎骨数 10＋28＝38 であり，体はだ円形で，背鰭第2条が伸長し，尾舌骨と腰骨の腹縁に鋸歯を欠くなどの共通した特徴をもつ．これらの体節的形質に基づいて査定を試みた結果，明らかにイイジマダルマガレイ属 (*Psettina*) の種類であった．南日本近海には本属に3種（イイジマダルマガレイ，トサダルマ，ソコダルマ）が知られている．これら3種の成魚は上顎長，側線鱗数，色彩などから明確に区別されるが，これらの形質が未発達な仔魚には適用出来ない．しかし，成魚の背臀鰭条数の範囲から判定して，これら5個体の仔魚のうち，2個体はイイジマダルマガレイ，2個体はトサダルマ，そして1個体はソコダルマに同定された．

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