**A Giant Postlarva and Young of Bothid Flatfish,
with Notes on the Species of Genus *Bothus*
in Japanese Water**

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(With two figures and a plate)

The writer has lately had occasion to identify and study one larval and 8 young fishes, referred to the genus *Bothus* (Heterosomata), taken from the Pacific coast of Honshyu, Japan. One enormously large postlarva, collected near the surface of the sea off Misaki, is very thin, papery and almost transparent showing the characteristic features of the genus; the one specimen, apparently just finished the metamorphosis and taken alive at Hamana-ko, had beautiful red pigmentation on the nearly transparent body. This red pigmentation was noticed by European ichthyologists many years ago on the species of Atlantic Ocean, but has never been recorded for the Indo-Pacific form.

In the present paper there are given firstly the description of specimens and secondarily the identification of each specimen, which was done separately on genus and species.

The writer wishes to acknowledge his indebtedness to Dr. Kei Eri, Director of the Misaki Marine Biological Station, who allowed him to study the remarkable postlarva, and to Messrs. Kiyomatsu Matsubara and Reizo Seishi who submitted some of the specimens to his study.

DESCRIPTION

1. Postlarva of *Bothus bleekeri* Steindachner

The giant postlarva flatfish in Plate measures 61 mm. to the caudal base. It was collected near the surface of the sea off Misaki, Kanagawa-ken by a fisherman, and was kindly handed to the writer by Dr. KEI ERI. The date of collection is November 13, 1936. Unfortunately the specimen, probably due to unkind handling of fisherman, was slightly mutilated on the abdomen which perhaps resulted the loss of pelvic fins.

D 93; A. 78; P. ?; pores in lateral line 98; vertebrae $10+32=42$, counting the median urolateral plates as the last; myotomes about 41.

The flat fish, remarkable for the immense size which it has retained as a postlarva, has symmetrical eyes. The right eye locates slightly above the left but does not advance; the left eye is a little popped-out (by preservation?) and directed slightly outwards. There is a round depression, of nearly same size as the eye, just above the well developed bony-ridge which forms the upper wall of the orbit. This depression is supposed to receive the right eye which penetrates through the tissue beneath the dorsal fin. The mouth is oblique with the upper jaw extending below the front margin of the eye. The small teeth are conical and weak, arranged in a series on each jaw, the size of teeth being very variable. The nostrils

on the left, locating just in front of the anterior rim of the bony orbit, are both surrounded by a low dermal flap, the anterior one directing forwards. Those on the right locate almost in the symmetrical position with the left ones, but they are smaller than the latter, the anterior one is possessed by a small dermal flap on its posterior margin, but the posterior is a simple round opening. There are 3 short but prominent spines arranged in a semivertical series, the uppermost locating on the posterodorsal corner of the brain-case, the middle on the level of the upper margin of the eye, and the lowermost, much smaller than others, occurring

behind the eye. The 3 spines are symmetrically developed on the head, giving a characteristic feature to the fish. The lower prong of the urohyal is triangular with rough serration along the free margin. The external margin of the cleithrum, ridged out of the surface of the body, has rough serration in front of the pectoral fin. The gill-rakers, represented by small tuberculations, are counted 4 on the lower limb of the first arch.

The pelvic bones are formed by two bony up-bent bars each with a cartilagenous triangular process near the middle of the bar, the left one slightly advancing the other. The two

Giant postlarva, probably of *Bothus bleekeri*, 61 mm. in standard length, from Misaki, Japan.

bony bars, extending below the rectum, are tightly attached from each other, and the left one is possessed by a thin bony plate on its ventral margin (only behind the cartilagenous process), the free edge of the plate being well serrated. The pelvic fin-rays are not yet developed.⁽¹⁾ The symmetrical pectoral fin is pedunculated and fan-shape, but the rays are not yet discernible.

The scales are entirely absent.

The lateral line system is well developed only on the left side. The pores on the line are clearly observed from the beginning on the flat-topped anterior curve to the end of the line at the ural plates. The all discernible pores of the mucous canal on the head are shown in Plate; the arrangement of the canal system on the head may not be traced from these pores, but, at least, it is confirmed that the supratemporal branch of the lateral line.

The ural elements of the caudal fin is not clearly visible on this unstained specimen; the one of the vertebral column is seen running between the two central (ural) elements which seemed to be fairly well fused from each other; the hypural and epiural elements, well defined on their posterior margins but very obscure on their connection to the second last vertebra, are both well separated from the haemal and neural spines respectively of the same vertebra.

The dorsal fin begins on the thmoidal region of the head and in the level of upper margin of the eye, but the first inter-neural spine which supports the first ray grows a little behind the ray and directing almost forwards, with a very narrow slit between the spine and

the upper profile of the head. The second dorsal ray is slightly longer than the third.

The vent is apparently not opened.

Color in formalin solution: except the characteristic jet-black eye, no pigmentation is observed in any extent.

2. Red pigmented young of *Bothus ovalis* (REGAN) Figure 1.

A young, probably just finished the metamorphosis, was collected alive on the shore of Hamana-ko, near the entrance of the lake from the sea, on March 25, 1939. This fish was handed to the writer by Mr. REIZO SEISHI.

The specimen (No. 10035) measures 40 mm. in standard length, 46 in total length, maximum depth of body 30 exclusive of fins, and inter-orbital space 3.

Fig. 1.—Red pigmented young, probably of *Bothus ovalis*, 40 mm. in standard length, from Hamana-ko, Japan.

D. 89; A. 67; P. 10; vertebrae $10+28=38$, counting the median ural plates as the last: myotomes about 40.

The specimen is very interesting and remarkable by the possession of red pigments on

(1) By the mutilation on this region of the belly, it is not certain whether the fin-rays are undeveloped or lost.

the almost transparent body in addition to the ordinary black pigmentation. The red as well as black pigments, however, all fade out about 12 hours after the immersion in formalin solution. The life color notes made by the writer run as follow :

The eyes are characteristically black. The light blackish spots, nearly as large as eye, on the dorsal and anal fins are arranged along the bases of the fins. The light crimson-red spots, smaller than the blackish spots but slightly flattened, occur in a single series, 1) along the both dorsal and ventral contours of the body from near the mouth to the caudal base, 2) along the bases of supporting rays (interneural and interhaemal spines), the upper series running from the brain to the caudal base, and the lower behind the visceral cavity to the caudal base, and, 3) along the free margin of dorsal fin for anterior 2/3 the fin, and along the free margin of the anal fin for anterior half of the fin. The spots on the series mentioned in 2) are lighter than those of others.

3. 5 young fishes of *Bothus ovalis*

(REGAN) Figure 2.

The five specimens (No. 19001) taken from the bottom about 200 meters deep off Owase are in the same stage of growth as the previous specimen (10035) or only slightly advanced. These specimens were collected by a trawl-boat before March 1939, and handed to the writer by Prof. KIYOMATSU MATSUBARA.

The measurements in mm. are : 36.0, 36.5, 37.5, 38.5 and 39.5 respectively, in standard length ; 29.2, 27.0, 26.6, 27.0 and 27.5 in maximum depth of body exclusive of the fins ; 2.2, 2.6, 2.4, 2.7, and 2.7. The meristic characters given in the same order are : D. 86, 90, 92, 93 and 92 ; A. 65, 71, 68, 69 and 66 ; P. 10, 10, 10, 11 and 10 ; vertebrae 10+27, 10+27, 10+27, 10+27 and 10+28, counting the median ural plates as the last. The myotomes were not

clearly discernible in these specimens.

Fig. 2.—A young, probably of *Bothus ovalis*, 36.5 mm. in standard length, taken off Owase, Japan. The fish, stained and cleared, was photographed on its blind side.

Within these 5 fishes, ranging from 36.0 to 39.5 mm. in standard length, the decrease of relative depth of body with the growth is well observed, the ratio between the standard length and the maximum depth of body being 1.23, 1.31, 1.40, 1.40 and 1.43. In other features, for instance the pelvic bones or caudal (ural) plates, there found no difference by which the stage of the growth is recognized among these specimens.

The general body shape and color pattern of these fishes are well represented by the drawing of FRANZ (1910, pl. 7, fig. 66) which shows a young 40 mm. long (in total length ?) of *Platophrys circularis*. Our fishes apparently finished metamorphosis not long time before ; the pelvic fin is fully developed and all the fin-rays are laid down ; the tip of the cleithrum completely retired from the ventral margin of the body.

4. Two subadult fishes of *Bothus ovalis* (REGAN)

These two fishes, measuring 64 and 70 mm

(standard length) respectively, were taken from the bottom about 20 meters deep off Miya, Aichi-ken on September 18, 1937. They were caught by a utase-trawl and handed to the writer by Mr. MATSUBARA.

In the following description the smaller specimen was mentioned first. The depth of body 1.4 and 1.3 measured in the standard length, the length of head 4 and 3.8. The profile of the head is evenly rounded in front of the lower. The diameter of lower eye is 4 and 3.7 measured in the head; the interorbital width measures 1.5 and 1.4 times the diameter of eye; the anterior edge of upper eye is about middle of the lower. There is a prominent spine on the snout, and a slight projection below the symphysis of the lower jaw. The maxillary, 3.6 and 4 in the length of head, extends to below the well developed anterior ridge of the orbit. The teeth are more strongly developed on the blind side of jaws; gill-rakers on the lower limb of the first arch number 6 and 7. The scales are all cycloid on ocular side, except at extreme upper and lower edges of body, where they are rather strongly ctenoid; the pores on the lateral line number 83 and 85. Dorsal 92 and 92. Anal 71 and 71. Pectoral of ocular side, with 10 rays, measures 1.1 and 1.2 times the length of head.

Color in formalin solution; grayish chest-nut brown is the ground color on the head and trunk, marked with darker and pale blotches; a circular ocellus occurs just behind the curve of lateral line, and 3 or 4 less distinct darker blotches on upper and lower halves of body; a diffuse dark blotch, as large as or larger than eye, occurs on the middle of the straight portion of the lateral line. Dorsal and anal fins, dusky

along the free margins, have small dark spots in a series; the distal portion of the caudal is dark.

IDENTIFICATION

1. Generic

The giant postlarva at hand, characterized by extremely thin and translucent body, anterior blunt profile, small mouth and jet-black eyes, is undoubtedly identified as a species of genus *Bothus*. More specifically the specimen falls on the so-called second period postlarval stage defined by KYLE (1913) in the genus.

If, taking precaution on this identification, we consider the fin-formulae alone of the specimen, the genera *Arnoglossus*, *Psettina*, and *Engyprosopon* seem to have some possibility for generic identification. These 3 genera, however, are characterized by the absence of the supratemporal branch of lateral line which, as stated already, was found to exist in our postlarva. In the agreement that the pores and the scales develop on the lateral line in nearly equal number, our postlarva, having 98 pores, may not be identified with any of these genera mentioned in which the scale count ranges between 30 and 70. According to KYLE (*ibid.*), who extensively studied the European forms of *Arnoglossus*, no postlarva in the genus has such deep body as our postlarva, and the larvae and youngs of *Arnoglossus* have always pigmentation of some kind in addition to black eyes. In the light of such evidence, we may be well justified to eliminate these 3 genera from our discussion on generic identification.

The genus *Laeops* is another form to which the attention should be paid. The genus, with or without supratemporal branch, is charac-

terized by elongated body and much higher meristic characters, and may be taken out from the present consideration. The small anterior curve of the lateral line in *Laeops* helps to discriminate our larva from this genus. Of one species *L. parviceps*, the postlarva was discovered by HUBBS and CHU (1936) which distinctly differs from our postlarva.

The only other generic identification, if possible, would be *Parabothus*, of which no development nor metamorphosis has ever been studied. According to NORMAN (1934) the genus is distinguished from *Bothus* by the interorbital space, spines near the nostrils, dentition and the scalation on the membrane joining operculum to pectoral arch. These characters, only discernible in the adult fishes, do not afford the criteria to distinguish larval specimens. However, so far we can learn from literature (mainly Norman (*ibid.*)), the 3 species in *Parabothus* which are reported to live in our water (namely *violaceus*, *coarctatus* and *kiensis*) have higher fin-ray counts, more than 100 in dorsal and 90 in anal, than our postlarva (D. 93, A. 78). This fact will probably eliminate the genus *Parabothus* from the present discussion. On the fin-ray counts further consideration may be added in the following section (p. 129).

The red pigmented young (No. 10001) taken alive from Hamana-ko is identified as a species of *Bothus* on account of its red coloration (see Kyle (*ibid.*: 96)). The five young fishes (No. 10001) taken from Owase may be also in the same genus, because we were unable to find any bodily character distinct from the one just

mentioned.

By the possession of widely separated eyes, a well developed nasal spine and from the fin-ray counts the 2 subadult specimens are also included in the genus *Bothus*.

2. Specific

As already stressed by KYLE (*ibid.*: 98, footnote) the specific identification of the larval form is based mainly on the meristic characters in the group of flatfish now dealt with. But in the attempt of the identification of our specimens, we had to experience a not small amount of uncertainty. This is not because of the vagueness involved in the specimens at hand, but is caused by the lack of the proper identification as well as the knowledge of geographical range of the adult forms of the genus *Bothus* and of other related genera which occur in the waters of Japan. Such circumstance is so often confronted by the students of larval fish.

First of all we are convinced to recognize two species of *Bothus* involved in the 3 specimens at hand by the reasons given below. When we consider the stage of growth and the size attained by the fishes, it seems very clear that the giant postlarva measuring 61 mm. in standard length could not be same species as the 2 subadult fishes taken off Miya, measuring 64 and 70 mm. respectively. On the other hand the red-pigmented specimen (10035) as well as 5 young specimens' (10001) are, without hesitation, treated as the 2 subadult specimens, on this basis of size and growth of stage.⁽¹⁾

(1) Presumably the metamorphosis in this species takes place at a size, 30 to 40 mm. HUBBS (1915) reported symmetrical larva of *Bothus myriaster*, but not accompanied by description nor comments.

This identification into 2 species is also supported by the fact that the vertebrae of the giant postlarva number $10+32=42$, whereas those of other 8 specimens (6 youngs and 2 subadult) number from 37 to 39; in the count of anal fin-rays the postlarva (78) is higher than any of other specimens (65-71); of the pores on lateral line the postlarva has 98 and two subadult fishes 83 and 85 respectively. In view of the fact noted above we may reasonably conclude that the large postlarval specimen is specifically different from other 8 specimens which all fall within one species. This well harmonizes with the conclusion, reached by KYLE (*ibid.*), that within the same genus (*Bothus*) the species with lower number of vertebrae and fin-rays metamorphoses as a rule at a small size.

In the attempt of these (supposedly) 2 species, we, firstly, need to recall all the species in the genus *Bothus* which would possibly occur in our water. Our knowledge on the systematic and the distribution of the species which fall in this category, however, is entirely depended on the literature (mostly NORMAN (1934)), because we have no single specimen of the bothid fish referred to the present genus, except those which we are now concerned. In the literature we find 6 species which have higher probability to occur in our water; they are *mancus*, *pantherinus*, *bleekeri*, *myriaster*, *ovalis* and *assimilis*. Within these forms the last 4 species seem to have, judging from the geographical distribution, further higher probability than others. Unfortunately, however, our present knowledge can hardly distinguish *bleekeri*, *myriaster* and *ovalis* with each other, and it seems very probable that these species altogether eventually

fall in one species.

It seems very clear that 2 subadult fishes are neither *pantherinus*, *assimilis* nor *mancus* on account of their feature of scales, and it is more likely that they are *ovalis*, on the basis of the proportional length of the depth, head and maxillary. The red-pigmented young as well as 5 fishes (10001) are, consequently, also called *ovalis*.

Theoretically, thus, the postlarva at hand is to be identified as one of either *mancus*, *pantherinus*, *bleekeri*, *myriaster* or *assimilis*; in this specific identification of the larval fish before metamorphosis we are urged to depend entirely on the meristic characters for criteria. These characters are, as described already, clarified in the specimen at hand, but only incompletely known in these species listed above, the vertebrae count known in none of them and even the fin-ray counts, in the range of variation, not satisfactorily understood. The identification made under such circumstance is consequently merely tentative.

The combination of D. 93 and A. 78 possessed by the giant postlarva is not found in any of these 5 species now considered. The larva, however, seems to be close to *mancus* (D. 98-103, A. 76-80) and *bleekeri* (D. 86-99, A. 62-73) than to other 3 species which have lower counts of dorsal and anal rays. Between these two species, the fin-rays of *mancus* is too high in dorsal, and the same of *bleekeri* is too low in anal, admitted that the range of the counts given for each species may further extends. The anal-rays of *mancus* and dorsal-rays of *bleekeri* are in the range reached by the larva. In the number of scales on the lateral line, on the other hand, *mancus* (85 to 90) is much

fewer than in *bleekeri* (ca. 100) which seems closer to the larva possessed with 98 pores on the line. In the light of such evidence we may be able to reach final decision that the giant postlarva taken from Misaki is called *Bothus bleekeri* (REGAN).

As to the species of *Parabothus*, in which *violaceus*, *coarctes*, and *kiensis* were reported to live in our water, no study on the development or metamorphosis have been made; if it happens that the present larva is one of these species, the fin-ray count alone may be taken into consideration. However, all these species have, as already stated on p. 128, more than 100 dorsal and 90 anal -rays (only *kiensis* reported to have 85 by KAMOHARA (1938) and 87 anal rays by TANAKA (1918)). These fin-ray counts show much less probability of identification than any of species of *Bothus* considered above.

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