

## Occurrence of Post-larvae and Juveniles of *Laeops kitaharae* (Bothidae, Pleuronectiformes) in Korea

Chang-Ho Youn, Sung-Hoi Huh\* and Ik-Soo Kim\*\*

Dept. of Biology, Seonam University, Namwon 591-711, Korea

\*Dept. of Oceanography, Pukyong National University, Pusan 608-737, Korea

\*\*Dept. of Biology, Chonbuk University, Chonju 561-756, Korea

Several specimens belonging to the family Bothidae were collected by trawls in Kwangyang Bay and off Kadeok Island in March 1996 and June 1998. These specimens were confirmed to be the post-larvae and juveniles of *Laeops kitaharae* (Smith and Pope, 1906) that have not been reported in Korea. According to the Amaoka's criterion (1972), four specimens belong to the middle metamorphic post-larval stage, one specimen to the late metamorphic post-larval stage, and two specimens to the juvenile stage.

The middle metamorphic post-larval stage can be distinguished from the late metamorphic post-larval stage by the characters such as a notch between foreside of the dorsal fin and dorsal region of the right eye, and greatly elongated second spine of the dorsal fin. In the juvenile stage, the intestine was not externally exposed. However, the early metamorphic post-larval stage was not occurred in this study.

### Introduction

The fishes of the family Bothidae in the sub-order Pleuronectoidei are distributed throughout the tropical and temperate areas of the world. The bothids are benthic and usually inhabit in shallow waters (Amaoka, 1969).

The external form of the bothids is very peculiar; they have non-symmetrical body form, and both eyes are located on the left side of body (Amaoka, 1969; Nelson, 1994). Because larvae and adults of the bothids show obvious differences in external form, there have been many problems such as mis-classification and various synonyms among systematists (Franz, 1910; Hubbs, 1915; Jordan and Hubbs, 1925; Nor-

man, 1934; Mori, 1952).

The family Bothidae is composed of 5 species belonging to 5 genera in Korea (Kim and Youn, 1994). However, no studies on the larvae and juveniles of the bothids have been made in Korea until now. In the present study, several post-larvae and juveniles of *L. kitaharae* were collected for the first time in Korea. Therefore, we describe the morphological characters of the post-larvae and juveniles of this species in this paper.

### Materials and Methods

The examined specimens were collected by trawls in Kwangyang Bay (5 individuals) and

Table 1. A list of the specimens observed in this study

| Stage                                | Catalogue number                   | Collecting locality                                     | Collecting date                    |            |
|--------------------------------------|------------------------------------|---|------------------------------------|------------|
| Middle metamorphic post-larval stage | SUNB<br>00917                      | Kwangyang Bay, Chollanam-do Korea                       | March 1996                         |            |
|                                      | SUNB<br>00918                      |   |                                    |            |
|                                      | SUNB<br>00920                      |   |                                    |            |
|                                      | SUNB<br>00922                      | Yamagata Prefecture, Japan                              | October 1994                       |            |
|                                      | HUMZ<br>141288                     |   |                                    |            |
|                                      | HUMZ<br>155038                     |   |                                    |            |
|                                      | HUMZ<br>155039                     | Mimase fish market, Kochi Prefecture, Japan             | Unknown                            |            |
|                                      | Late metamorphic post-larval stage | SUNB<br>00916   | Kwangyang Bay, Chollanam-do Korea  | March 1996 |
|                                      | Juvenile stage                     | SUNB<br>00914   | off Kadeok-do Island, Pusan, Korea | June 1998  |
| SUNB<br>00915                        |                                    | off Kadeok-do Island, Pusan, Korea                      | June 1998                          |            |
| HUMZ<br>110222                       |                                    | Yamatahama fish market,<br>Yamatahama Prefecture, Japan | October 1986                       |            |

off Kadeok Island (2 individuals) in March 1996 and June 1998.

Methods for counts and measurements of the specimens followed Norman (1934). The specimens were measured with a caliper to the nearest 100th of millimeter. All counts of fin rays and vertebrae were taken from soft X-radiographs. The examined specimens were deposited in the laboratory of the Department of Biology, Seonam University (SUNB).

In order to obtain more precise systematic results, all meristic and measurement characters examined for this study were compared with those of specimens brought from the laboratory of Marine Zoology, Faculty of Fisheries, Hokkaido University (HUMZ) in Japan (Table 1).

## Results and Discussion

Seven specimens collected in this study were classified into the family Bothidae by two eyes

situated on left side of the body, lateral line present only on ocular side and pectoral fin of ocular side longer than that of blind side. The specimens were classified into the genus *Laeops* by the presence of teeth only on maxilla and mandible of the blind side. The specimens were classified into *Laeops kitaharae* by the first two rays separated from other rays of dorsal fin. And the specimens were confirmed to be the post-larvae of *Laeops kitaharae* by the various characters such as externally exposed intestine, very long filamentous second ray of dorsal fin (middle metamorphic post-larval stage), reticular black bands on ocular side and elongated dorsal and anal fins.

Amaoka (1972) reported that the post-larvae of *L. kitaharae* collected from the coasts around Japan can be divided into 3 stages: early metamorphic post-larval stage, middle metamorphic post-larval stage, and late metamorphic post-larval stage on the basis of position of right eye

and the length of intestine exposed. According to the keys of Amaoka (1972), four specimens examined belong to middle metamorphic post-larval stage and one specimen to late metamorphic post-larval stage. And two other specimens belong to the juvenile stage. The early metamorphic post-larval stage was not collected in this study (Photo. 1). The morphological characteristics of two post-larval stages and juvenile stage examined in this study are as follows;

**Middle metamorphic post-larval stage  
(Fig. 1, Photo 2A, B)**

Body elongated and elliptical. Right eye migrating and located above left eye. A notch present between foreside of dorsal fin and dor-

sal region of right eye. Except semicircular lateral line above pectoral fin of ocular body side, lateral line on ocular side straighted. No lateral line on blind side. This result differs from Amaoka (1972)'s result that "all the lateral line of this stage is straighted". Second ray of dorsal fin greatly elongated with broad base and tip. First and second fin rays separated with other rays of dorsal fin. Between pelvic fin and anal fin, coiled intestine exposed externally, as long as a half of head length (Fig. 1). All fins (especially dorsal and anal fins) greatly elongated; Length of dorsal and anal fins longer than head length (Fig. 1, Table 2). Many black spots present on dorsal fin, anal fin and lateral part on ocular side. No pigmentation on blind side. Mouth small and oblique. Maxillary extended posteriorly below anterior margin of left eye. Eye diameter much greater than length of maxillary (Table 2). Dentition developed only on jaws of blind side; villiform teeth. No dentition developed on ocular side.

**Photo 1. Early metamorphic post-larval stage of  
*Laeops kitaharae*. HUMZ-L 00456. 71.66  
mm SL.**

**Fig. 1. Middle metamorphic post-larval stage of  
*Laeops kitaharae* from Korea. SUNB 00920.  
78.54 mm SL.**

**Photo 2. Middle metamorphic post-larval stage of  
*Laeops kitaharae*. A: SUNB 00920. 78.54  
MM SL., B: HUMZ 141288. 67.5 mm SL.**

**Table 2. Comparisons of meristic and morphometric characters for the middle metamorphic post-larval stage, late metamorphic post-larval stage, and juvenile stage of *Laeops kitaharae*.**

| Characters                   | Korea(Present study) |        |             | Japan(HUMZ) |        |
|------------------------------|----------------------|--------|-------------|-------------|--------|
|                              | MMS                  | LMS    | JVS         | MMS         | JVS    |
| No. of specimens             | 4                    | 1      | 2           | 3           | 1      |
| Standard length(mm)          | 71.20~83.35          | 83.10  | 86.17~88.86 | 67.50~71.70 | 72.3   |
| Dorsal fin rays              | II,101~105           | II,103 | II,107~108  | II,106~109  | II,102 |
| Anal fin rays                | 86~89                | 86     | 89~91       | 85~86       | 85     |
| Vertebrae                    | 50~52                | 51     | 50~51       | 51          | 51     |
| In head length (mm)          |                      |        |             |             |        |
| Eye diameter (low)           | 4.83~5.88            | 5.37   | 3.12~3.71   | 5.10~6.00   | 3.23   |
| Snout length                 | 4.27~5.03            | 4.68   | 3.96~4.72   | 3.92~4.56   | 4.42   |
| Maxilla length               | 3.71~4.21            | 4.53   | 4.06~4.20   | 4.08~4.29   | 3.53   |
| In standard length (mm)      |                      |        |             |             |        |
| Body depth                   | 2.45~2.68            | 2.54   | 2.73~2.81   | 2.67~2.89   | 2.87   |
| Head length                  | 5.65~6.18            | 5.73   | 5.93~6.15   | 5.92~6.79   | 5.46   |
| Dorsal fin length            | 0.65~0.86            | 0.74   | 1.25~1.51   | 0.60~0.74   | 1.61   |
| Anal fin length              | 0.66~0.75            | 0.79   | 1.45~1.56   | 0.65~0.71   | 1.40   |
| Second dorsal spine length   | 0.58~1.00            | 0.71   | 3.45~3.79   | 0.48~0.68   | 2.75   |
| Pectoral fin (ocular) length | 1.91~2.59            | 2.46   | 2.16~2.62   | 1.84~2.56   | 1.49   |
| Pelvic fin (ocular) length   | 1.58~2.07            | 2.54   | 1.94~2.49   | 1.54~2.23   | -      |

MMS: middle metamorphic post-larval stage, LMS: late metamorphic post-larval stage, JVS: juvenile stage, SUNB: Seonam University, Namwon, HUMZ: Marine Zoology, Faculty of Fisheries, Hokkaido University.

Counts and proportional measurements of four specimens belonging to this stage are shown in Table 2.

#### Late metamorphic post-larval stage (Fig. 2, Photo 3)

Body elongate and elliptical, and slender than that of middle metamorphic post-larval stage. Mouth small and oblique. Maxillary extending posteriorly below anterior margin of left eye. Right eye situated above left eye. No notch between first two rays of base of dorsal fin, and margin of right eye finished migrating. Dentition developed only on jaws of blind side; villiform teeth. No dentition developed on jaws on ocular side. Lateral line with a small curve above pectoral fin developed on left side. Second spine of dorsal fin not filamentous, short and rod shaped. Length of second ray of dorsal fin approximately equal to eye diameter, and much shorter than that of middle metamorphic stage.

**Fig. 2. Late metamorphic post-larval stage of *Laeops kitaharae* from Korea. SUNB 00920. 82.94 mm SL.**

**Photo 3. Late metamorphic post-larval stage of *Laeops kitaharae*. SUNB 00920. 82.94mm SL.**

The first and second fin rays separated from other rays of dorsal fin. Length of dorsal and anal fins shorter than that of middle metamorphic post-larval stage. Length of the longest fin rays of dorsal fin and anal fin as same as head length (Fig. 2, Table 2). Many black spots present on margin of dorsal and anal fins. Black spots present on body of ocular side. Length of intestine exposed much shorter than that of middle metamorphic post-larval stage.

Counts and proportional measurements of a specimen belonging to this stage are shown in Table 2.

#### Juvenile stage (Fig. 3, Photo 4A, B)

Body elongated and elliptical, and slender than that of late metamorphic post-larval stage. Maxillary extending posteriorly below anterior margin of left eye. Length of maxillary longer than eye diameter. Right eye situated above left eye; eyes larger than those of post-larval stages. Dentition developed only on jaws of blind side; villiform teeth. Lateral line with a strong curve above pectoral fin developed on left side. Second ray of dorsal fin not filamentous, short, rod shaped, and separated from other dorsal rays. Length of dorsal and anal fins as same as or shorter than that of post-larval stages (Fig. 3, Table 2). Scales very small, and deciduous. Scales covered on head part except snout and jaws. All fin membranes black except pectoral fin and all fin rays white. Body color generally yellowish except blackish head part. Ocular side more blackish than blind side. Intestine not exposed externally between pelvic fin and anal fin (Fig. 3, Photo 4A, B).

Counts and proportional measurements of two specimens belonging to this stage are shown in Table 2.

In this study, our authors confirmed that

**Fig. 3. Juvenile stage of *Laeops kitaharae* from Korea. SUBN 00920. 82.68 mm SL.**

**Photo 4. Juvenile stage of *Laeops kitaharae*.**

**A: SUNB 00920. 82.68 mm SL.,**

**B: HUMZ 110222. 72.3mm SL.**

post-larvae and juveniles of *L. kitaharae* occurred in coastal waters of the South Sea of Korea from March to June (Table 1). Kim and Youn (1994) reported that *Laeops lanceolata* is a synonym of *L. kitaharae*. And *L. variegata* was also confirmed to be a synonym of *L. kitaharae* (Norman, 1934; Amaoka, 1969; Amaoka, 1972). Therefore, *L. kitaharae* is only species of the genus *Laeops* found in the Korean waters.

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## 한국산 흰비늘가자미의 후기 자어와 치어 출현

윤창호 · 허성희\* · 김익수\*\*

서남대학교 생물학과 · \*부경대학교 해양학과 · \*\*전북대학교 생물학과

분류학적으로 등글넙치과(Bothidae)에 속하는 표본을 1996년 3월과 1998년 6월에 남해의 광양만과 가덕도 주변 해역에서 채집하였다. 조사 결과, 흰비늘가자미 *Laeops kitaharae* (Smith and Pope)의 후기 자어와 치어로 확인되었다. Amaoka(1972)의 기준에 의하면, 채집된 4개체는 중-후기 자어(middle metamorphic post-larval stage), 1개체는 후-후기 자어(late metamorphic post-larval stage)에 해당되었다. 그리고 나머지 2개체는 흰비늘가자미의 치어에 해당되었다. 중-후기 자어는 등지느러미 기조부와 우측 눈부위 사이에 결각이 있는 특징과 등지느러미의 2번째 극조가 긴 사상인 특징에 의하여 후-후기 자어와 구분되었다. 치어의 경우는 소화관이 외부로 노출되어 있지 않은 특징을 보였다. 전-후기 자어(early metamorphic post-larval stage)는 이번 연구에서 채집되지 않았다.