

## Congrid leptocephali in the western North and Middle Pacific – I

### Exterilium *Ariosoma*-type larvae

Noritaka MOCHIOKA \*, Shunpei KAKUDA and Osame TABETA \*\*

*Faculty of Applied Biological Science, Hiroshima University, Fukuyama*

\* *Faculty of Agriculture, Kyushu University, Fukuoka*

\*\* *Shimonoseki University of Fisheries, Shimonoseki*

Received: Sept. 13, 1982.

(Figs. 1–20, Table 1, Appendix 1)

### ABSTRACT

*Ariosoma*-type larvae with outer-intestine (exterilium) of the eel family Congridae from the western North and Middle Pacific are described and characterized. Nine types are recorded based on pigmentation, position of last vertical blood vessel at myomere level and number of myomeres. Five types from the western North Pacific and their relationship with the adult are discussed. None has been conclusively identified with the adult. A key is provided to the exterilium *Ariosoma*-type larvae known from the western North and Middle Pacific. Distribution maps showing capture locations are given for each type.

### INTRODUCTION

Congrid leptocephali are the most numerous among anguilliform larvae from the western North Pacific. However, especially in the western North Pacific, they are poorly described. Although, 15 species and 4 subspecies in 12 genera of Congridae have been recorded from Japan as adults,<sup>1)</sup> the larvae of only two species, *Conger myriaster* (BREVOORT)<sup>2,3)</sup> and *C. japonicus* BLEEKER,<sup>4)</sup> have been described. Moreover, the description of both species covers not the complete early life history, but only the stages from metamorphic larva to young eel. Recently, SOCOLOVSKII<sup>5)</sup> briefly described 10 types of congrid larvae from the Kuroshio waters (20–42°N, 138–152°E). CASTLE<sup>6)</sup> described 14 species of congrid larvae from Australasian waters (10–41°S, 113–172°E). However, there is no report on them from the Central Pacific.

The authors have studied over 10,000 specimens of congrid larvae collected from the western North and Middle Pacific (36°N–26°S, 115–177°E) over several years. In the present paper, we described one group of larvae, *Ariosoma* or *Ariosoma*-like larvae with outer-intestine (exterilium), as the first step. This group has been known to belong to the subfamily Bathymirinae.<sup>7)</sup>

## MATERIALS AND METHODS

A total of 441 pre-metamorphic specimens of exterilium *Ariosoma*-type larvae was found in the following collections: 285 larvae from the 1st, 2nd and 3rd research cruises for the biological study of larval stages of the Japanese eel in Ryukyu Deep and adjacent waters (1973, 1975), on board the R/V Hakuho Maru, Ocean Research Institute (ORI), University of Tokyo; 54 larvae from 5 cruises of the R/V Shunyo Maru (1963–1965, 1967, 1970), Far Seas Research Laboratory, Fisheries Agency, during a survey of scombrid fishes in the western North and Middle Pacific; 50 larvae from 5 cruises of the

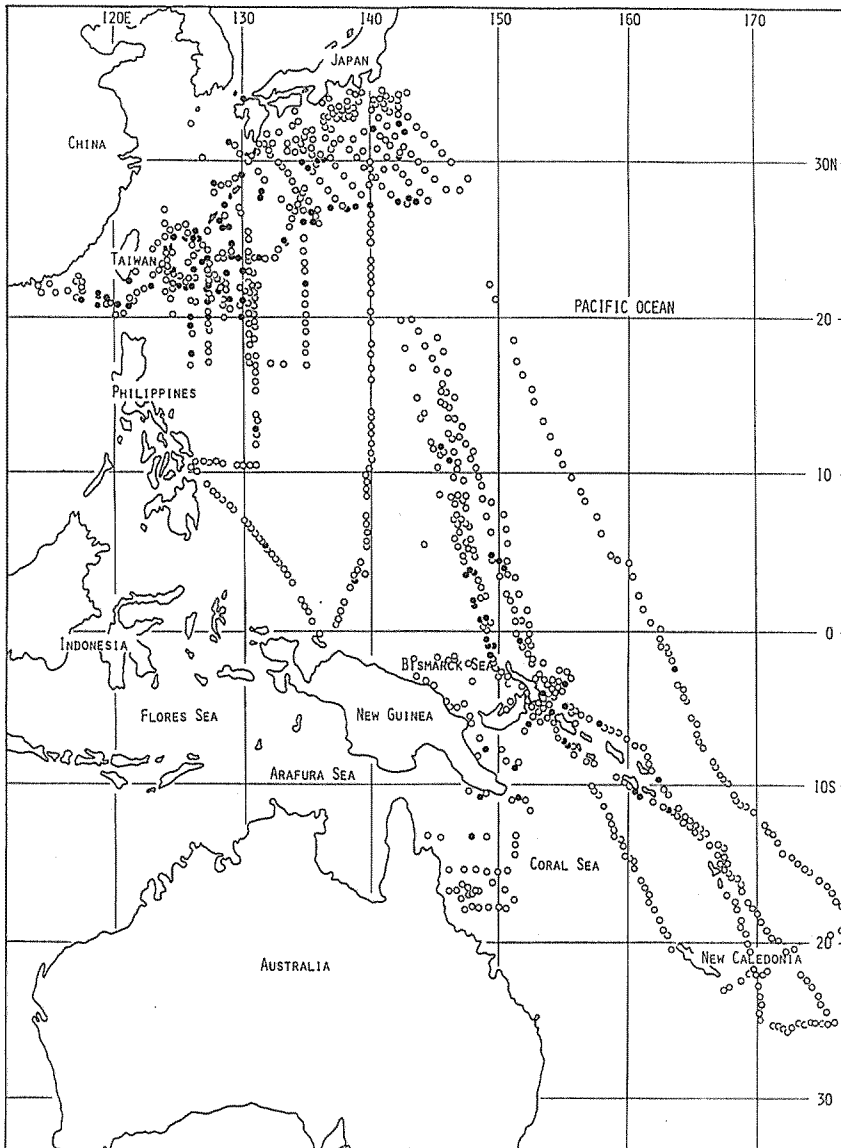


Fig. 1. Location of stations of the exterilium leptocephali. Solid circle, positive station; open circle, negative station.

R/V Shoyo Maru (1972–1974, 1979, 1980), Fisheries Agency, during a survey of scombrid fishes in the western North and Middle Pacific; 5 larvae from the R/V Shin-ei Maru No. 53 (1978), Nansei Regional Fisheries Research Laboratory, Fisheries Agency, during a survey of demersal fishes on the Kyushu-Palau Ridge in the western North Pacific; 1 larva from the T/S Kagoshima Maru (1980), Kagoshima University, during a study of reasonable exploitation of the ocean fishing grounds in extra-shelf regions around Ryukyu Island Arc; 46 larvae from the beach of northern Kyushu, Fukuoka Pref. (1966, 1967), during a survey of stranded animals by the third author. All collecting stations and data are shown in Fig. 1 and Appendix 1, respectively. These larvae were collected by larval nets of various types and towing methods are noted in Appendix 1.

Most specimens were preserved in 5% buffered Formalin solution; with the exception of the stranded samples from northern Kyushu, which were preserved in 70% ethanol. Measurements were made to the nearest 0.05 mm using an ocular micrometer in a binocular dissecting microscope for parts less than 10 mm. Measurements were made to the nearest 0.1 mm using the measurement plate for parts greater than 10 mm. Counting and measuring procedures described by JESPERSEN,<sup>8)</sup> CASTLE<sup>9)</sup> and TABETA and TAKAI<sup>10)</sup> were used. The methods of measuring the inner- and outer-intestine are shown in Fig. 2.

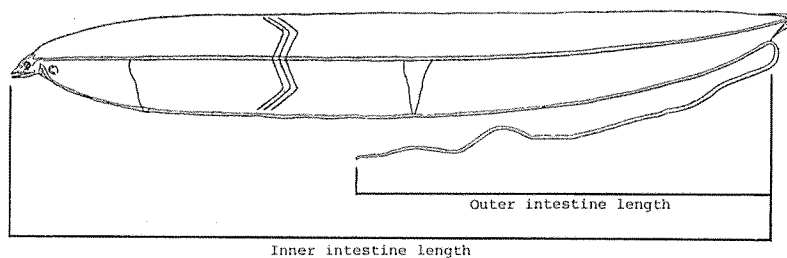


Fig. 2. Diagram showing measurement of outer- and inner-intestine length.

#### ARIOSOMA-TYPE LARVAE

Moderate to large leptocephali, about 100 to 400 mm total length (TL); body elongate but not filamentous, greatly compressed, except for head, depth about 10% of TL at about midpoint of body, tapering equally in front of, and behind the point; dorsal and anal fins very short, restricted to posterior tip of body, dorsal origin very close to level of anus at about 95–96% of TL; pectoral fin well developed; intestine straight, not festooned or swollen; outer-intestine present or absent; head short, about 5% of TL; eye sub-circular, no crescentic patch of pigment under the eye; lateral and ventral pigment always present; dorsal pigment present or absent; 1–3 series of minute melanophores of

short diagonal lines from head to tail on the myosepta; ventral melanophores below the gut anteriorly, switching to top of the intestine behind the liver; nasal organ closer to eye than tip of snout; lower jaw a little longer than upper; upper teeth consisting of one at the anterodorsal surface of the snout (slender tooth) above the second tooth (grasping tooth) followed by the 2 – 8 fangs (anterior teeth) and 1 – 27 smaller teeth (posterior teeth); lower teeth consisting of one at tip of jaw (grasping tooth) followed by a series of 2 – 6 anterior teeth and 2 – 16 posterior teeth, anterior ones larger than posterior.

*Ariosoma*-type larvae can be divided into two groups, those with an outer-intestine and those without, referred to here as exterilium-and non-exterilium-types. The larvae belonging to the non-exterilium-type are similar in overall appearance, but differ mainly in shape of snout and pigmentation; they have a relatively round snout and one row of melanophores on the myosepta along the side of the body just below midline. The larvae belonging to the exterilium-type usually have a more acute snout and one to three rows of melanophores on the myosepta along the side of the body. At least two species of the exterilium-type larvae have scattered melanophores or a patch of melanophores on the side of the body. This paper deals with the exterilium-type larvae. According to the revisions of congrid leptocephali by BLACHE,<sup>11)</sup> CASTLE<sup>6,7)</sup> and SMITH,<sup>12)</sup> these larvae were placed in *Parabathymyrus*, *Bathymyrus*, *Alloconger* or *Ariosoma*. The authors tentatively name these leptocephali *Ariosoma*-type, here. The non-exterilium-type larvae will be described in another paper.

A key to the types of exterilium *Ariosoma*-type larvae  
from the western North and Middle Pacific

- a<sub>1</sub> One row of melanophores on the myosepta along the side of the body just below the lateral midline . . . . . b
  - b<sub>1</sub> No melanophores on the dorsal margin; minute melanophores on the myomeres of the upper and lower lateral sides of the body; myomeres 129–141 . . . Type A<sub>1</sub>
  - b<sub>2</sub> Minute melanophores on the dorsal margin; no melanophores on the myomere . . . . . c
    - c<sub>1</sub> Myomeres 131–140; last vertical blood vessel (VBV) at myomere 62–72 . . . . . Type A<sub>2</sub>
    - c<sub>2</sub> Myomeres 146–149; last VBV at myomere 68–79 . . . . . Type A<sub>3</sub>
    - c<sub>3</sub> Myomeres 160–173; last VBV at myomere 78–91 . . . . . Type A<sub>4</sub>
    - c<sub>4</sub> Myomeres 171–177; last VBV at myomere 101–103 . . . . . Type A<sub>5</sub>
- a<sub>2</sub> Two rows of melanophores on the myosepta along the lateral side of the body . . . . d
  - d<sub>1</sub> No melanophores inside the opercle and along the upper lateral midline; myomeres 151–154; last VBV at myomere 80–88 . . . . . Type B<sub>1</sub>

- d<sub>2</sub> Minute melanophores inside the opercle and along the just dorsal side of the lateral midline; myomeres 157; last VBV at myomere 75 . . . . . Type B<sub>2</sub>
- a<sub>3</sub> Three rows of melanophores on the myosepta along the lateral side of the body . . . e
- e<sub>1</sub> A patch of melanophores at the level of the 30th–50th myomeres; myomeres 146–155 . . . . . Type C<sub>1</sub>
- e<sub>2</sub> No patch of melanophores; myomeres 146–161 . . . . . Type C<sub>2</sub>

Type A<sub>3</sub>, A<sub>5</sub>, B<sub>1</sub> and B<sub>2</sub> were not found from the western North Pacific.

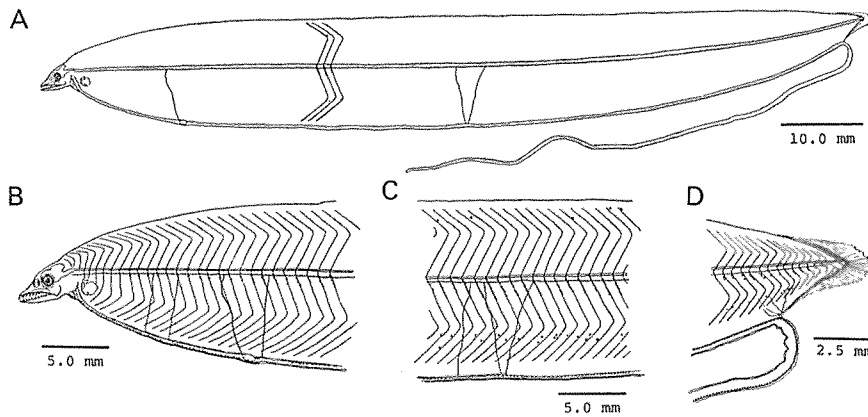


Fig. 3. Type A<sub>1</sub>, 101.0 mm in total length. A, lateral view of the body; B, anterior region; C, last vertical blood vessel region; D, tip of caudal region. The marks in Figs. 5,7,9,11,13,15,17 and 19 are same as those in this Figure.

1. Type A<sub>1</sub>  
(Figs. 3 and 4; Appendix 1)

L. ?*Alloconger anagoides*; CASTLE, 1964: 14, figs. 5A-5D.<sup>6)</sup>

L. ?*Alloconger anagoides*; CASTLE, 1969: 64.<sup>13)</sup>

**Diagnosis** Exterilium *Ariosoma*-type larva with 129–141 myomeres characterized by a row of melanophores on the myosepta just below the lateral midline, scattered melanophores on the myomere of the upper and lower lateral sides of the body, and a lack of minute melanophores on the dorsal margin.

**Description** 26 specimens examined. The description given below is based on a specimen of 101.0 mm TL (Cat. ORI KH-73-5, No. B-16-1). The other specimens were utilized to show the range of characters.

Measurements in mm: TL 101.0 (32.0-235.1), standard length (SL) 100.0 (31.8-233.1), head 4.85 (2.45-6.50), snout 1.95 (1.05-3.10), eye 1.10 (0.65-1.70), cleft of mouth 2.40 (1.40-3.60), postorbital 1.80 (0.85-1.80), pre-outer-intestine 96.8 (31.0-

222.0), predorsal 96.4 (30.5-223.0), depth just before eye 2.30 (1.20-3.15), at neck 2.65 (1.30-4.00), at the end of inner-intestine 4.10 (1.00-10.1), at midpoint between pectoral and the end of inner-intestine 13.4 (4.10-24.7), maximum depth 13.5 (4.35-25.6), outer-intestine length 61.0 (1.30-86.0).

Total myomeres 136 (129-141, mean 137.1), predorsal 128 (118-134, 126.1), pre-outer-intestine 129 (117-133, 127.1), VBV just before gall bladder at 19th myomere (17th-22nd, 18.9th), last VBV at 63rd (60th-68th, 64.6th). Anterior margin of gall bladder at 21st myomere (19th-23rd, 20.9th). Each fin obvious, dorsal rays 14, anal 15, caudal  $4 + 3 = 7$ . Teeth  $1 + 1 + VI + 10/1 + VII + 5 (1 + 0 \sim 1 + III \sim VI + 5 \sim 13/1 + II \sim VIII + 5 \sim 8)$ .

Body elongate, compressed, comparatively deep, depth 13.3% of TL at about midpoint of body. Head short, 4.8% of TL. Snout short, 40% of head length. Pectoral fin small, 12.4% of head length, oval, base of fin fleshy with unclear rays. The intestine made a flexion at the 22nd myomere. The gall bladder located before the flexion of inner-intestine, clear from the both sides. The outer-intestine extended free from the body just before the anal fin (60.3% of TL).

Pigmentation on specimens preserved in Formalin: a short, oblique line of minute melanophores on the 9th-136th myosepta just below the lateral midline making a row of melanophores on the myosepta, with 7 to 10 melanophores in these lines in the middle of the body; minute spots scattered on the upper and lower lateral surface, about 1-4 per myomere, especially more abundant on the posterior part of the body; minute spots along the body just above the lateral midline with one spot on the 1st through the 15th myomeres; 8 minute spots beneath the heart region; a regular series of less than 10 small, compact melanophores to each myomere from the pectoral region to the posterior margin of the gall bladder on the body wall of the ventral margin; posterior to this series, minute melanophores switching to the dorsal side of the intestine, less than 10 to each myomere; a number of scattered small spots on the basal portions of the most dorsal and anal fins, a few spots over the base of the caudal fin; no pigment in dorsal midline; chorioid pigment present.

**Remarks** These larvae agree in almost all details with *L. Alloconger anagoides* from Australasian waters.<sup>6)</sup> The myomere counts and level of last VBV (almost equal to the first caudal vertebra in adult) of the present larvae is within the range of the vertebral component of *Alloconger anagoides* (BLEEKER).<sup>14)</sup> However, Type A<sub>2</sub>, which will be described next, has almost the same myomere component, too. Both of these two types could belong to *A. anagoides*, but as no metamorphosing specimens of Type A<sub>1</sub> and A<sub>2</sub> were available, a conclusive identification was not possible. D'ANCONA<sup>15)</sup> described exterilium-type larva *Leptocephalus macreteron* from the Red Sea. Meristic and morphometric characteristics in his description almost agree with our Type A<sub>1</sub> and A<sub>2</sub>, but information about pigmentation in the dorsal margin and on the myomeres was lacking.

The catch locations are shown in Fig. 4. This type has a wide distribution from off southern Kyushu to off southern New Guinea. Our captures of 2 small larvae, 39.5 and 32.0 mm, off southern Kyushu (Dec.) and near the Palau Islands (May) indicated spawning occurred in both waters. This type was relatively common in the western Middle Pacific.

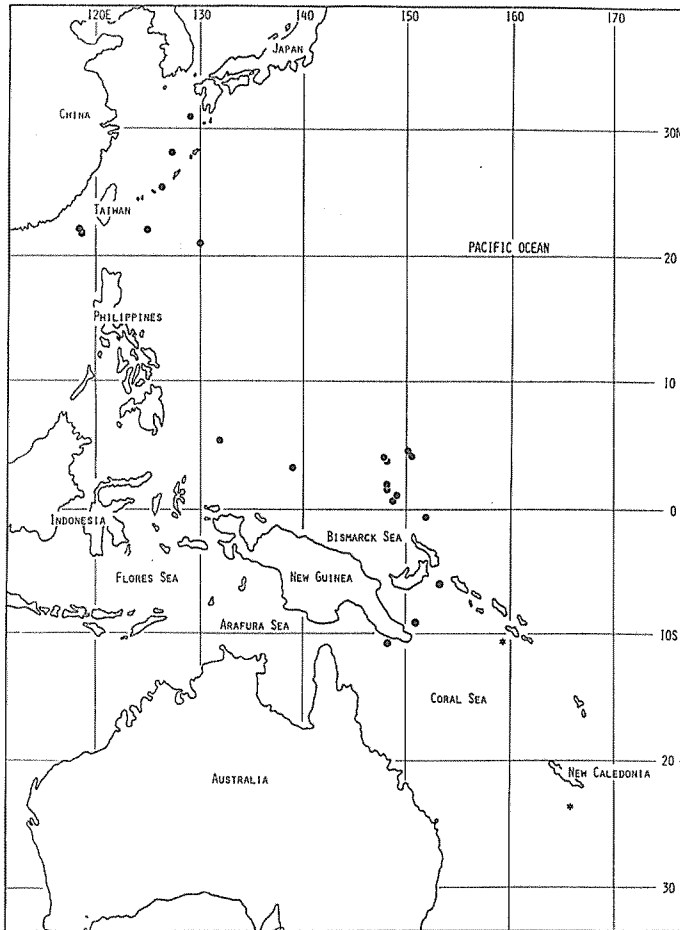


Fig. 4. Station locations of Type A<sub>1</sub>. Asterisks show the capture locations of *L. Alloconger anagoides* by CASTLE<sup>6)</sup>.

2. Type A<sub>2</sub>

(Figs. 5 and 6; Appendix 1)

**Diagnosis** Exterilium *Ariosoma*-type larva with 131-141 myomeres characterized by a row of melanophores on the myosepta just below the lateral midline.

**Description** 18 specimens examined. The description given below is based on a specimen of 111.6 mm TL (Cat. ORI KH-73-2, No. 44-18-2). The other specimens were utilized to show the range of characters.

Measurements in mm: TL 111.6 (47.5-261.0), SL 110.2 (47.0-259.8), head 5.50 (3.30-5.90), snout 1.80 (1.45-2.80), eye 1.10 (0.90-1.80), cleft of mouth 2.75 (2.00-2.75), postorbital 2.60 (1.00-2.60), pre-outer-intestine 105.9 (45.0-251.8), predorsal 105.6 (45.3-253.7), depth just before eye 2.20 (1.70-3.00), at neck 2.60 (1.90-3.75), at the end of inner-intestine 4.10 (1.60-6.10), at midpoint between pectoral and the end of inner-intestine 12.2 (5.60-25.7), maximum depth 12.3 (6.20-25.7), outer-intestine length 77.0 (6.50-77.0).

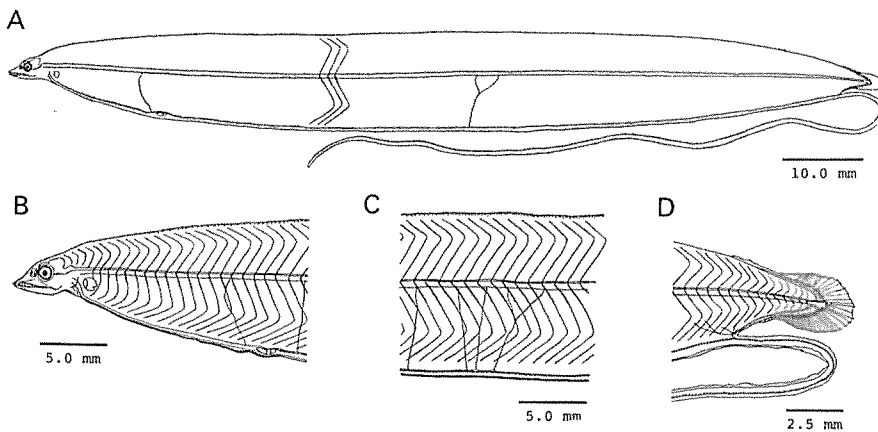


Fig. 5. Type A<sub>2</sub>, 111.6 mm in total length.

Total myomeres 133 (131-141, mean 135.1), predorsal 123 (122-131, 126.0), pre-outer-intestine 124 (122-130, 126.4), VBV just before gall bladder at 18th myomere (17th-24th, 18.9th), last VBV at 66th (62nd-72nd, 66.1st). Anterior margin of gall bladder at 21st myomere (19th-24th, 20.9th). Each fin obvious, dorsal rays 27, anal 16, caudal 4 + 3 = 7. Teeth 0 + 0 + VI + 12/1 + VII + 7 (0 ~ 1 + 0 ~ 1 + V ~ VIII + 8 ~ 13/0 ~ 1 + V ~ IX + 5 ~ 7).

Body elongate, compressed, comparatively deep, depth 11.0% of TL at about midpoint of body. Head short, 4.9% of TL. Snout short, 32.7% of head length. Pectoral fin small, 18.0% of head length, oval, base of fin fleshy with unclear rays. The intestine made a flexion at the 22nd myomere. The gall bladder located before the flexion, clear from the both sides. The outer-intestine extended free from the body just before the anal fin (69.0% of TL).



Pigmentation on specimens preserved in Formalin: a short, oblique line of minute melanophores on the 5th-133rd myosepta just below the lateral midline making a row of melanophores on the myosepta, with 20 to 25 spots in these lines in the middle of the body; a series of small, diffuse melanophores on the dorsal margin from the 12th to the 110th myomeres; a minute spot (2-5 in the other specimens) beneath the heart region; a regular series of more than 20 small, compact melanophores to each myomere from the pectoral region to the posterior margin of the gall bladder on the body wall of the ventral margin; posterior to this series, minute melanophores switching to the dorsal side of the intestine, more than 20 to each myomere; scattered small spots on the basal portions of the most dorsal and anal fins, a few spots over the base of the caudal fin; chorioid pigment present.

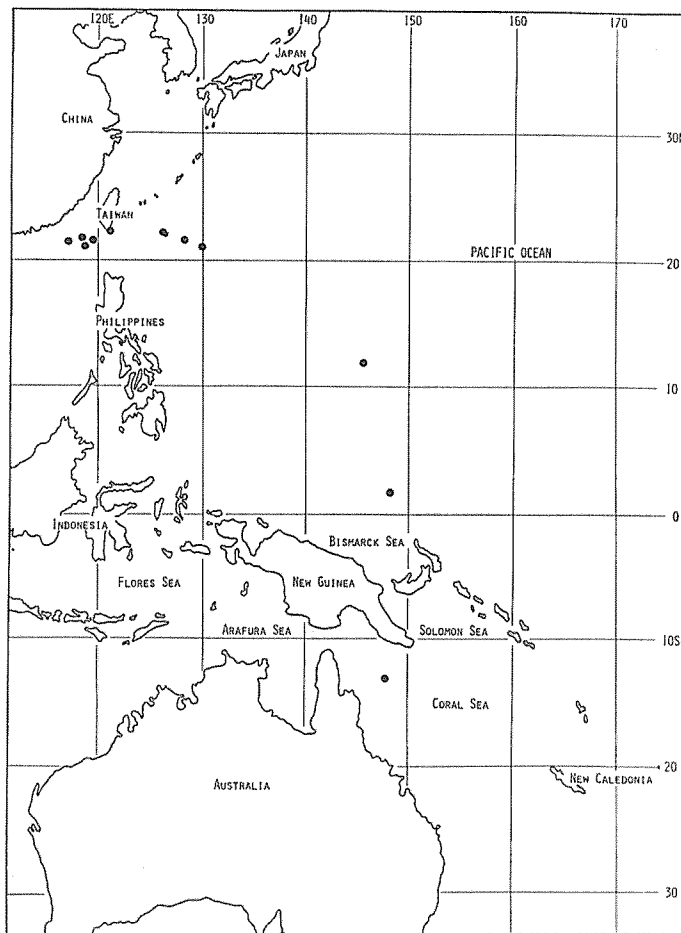


Fig. 6. Station locations of Type A<sub>2</sub>.

**Remarks** This type has not been previously described. The myomere component of this type, as mentioned above, closely related to the vertebral component given by ASANO<sup>14)</sup> for *Alloconger anagoides*, but no evidence existed either to confirm or deny the identification.

The catch locations are shown in Fig. 6. This type was collected from off southern Taiwan (about 22°N) to the northern Coral Sea (about 12°S). None of this type was taken in Japanese waters. Small larvae less than 50.0 mm did not occur in our collection. This type was relatively common in the western North Pacific.

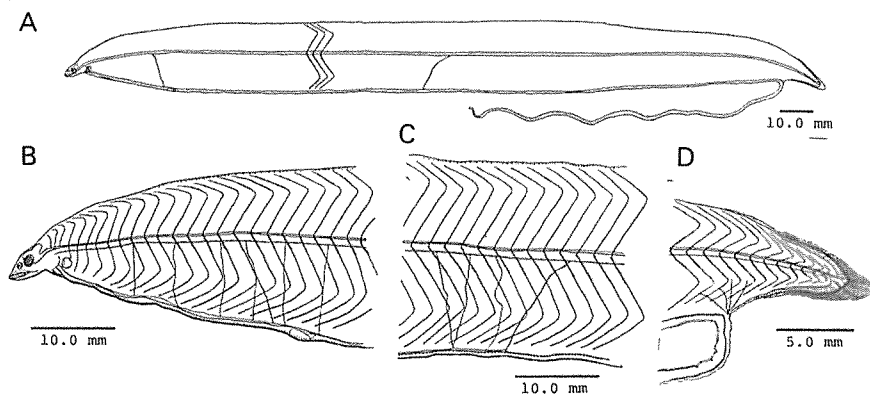


Fig. 7. Type A<sub>3</sub>, 255.0 mm in total length.

### 3. Type A<sub>3</sub>

(Figs. 7 and 8; Appendix 1)

Leptocephale 6 (part); BLACHE, 1963: 12.<sup>16)</sup>

L. *Cynoponticus ferox* (part); BLACHE, 1968: 702, figs. 10-13.<sup>17)</sup>

L. *Ariosoma mellissi*; BLACHE, 1977: 102, fig. 33.<sup>11)</sup>

**Diagnosis** Exterilium *Ariosoma*-type larva with 146-149 myomeres characterized by a row of melanophores on the myosepta just below the lateral midline.

**Description** 9 specimens examined. The description given below is based on a specimen of 255.0 mm TL (Cat. Shunyo Maru, 1964, No. 25M-1). The other specimens were utilized to show the range of characters.

Measurements in mm: TL 255.0 (48.6-255.0), SL 252.5 (48.3-252.5), head 7.55 (2.45-7.55), snout 2.60 (0.95-2.60), eye 1.70 (0.65-1.70), cleft of mouth 3.50 (1.30-3.75), postorbital 3.25 (0.80-3.25), pre-outer-intestine 244.0 (47.0-244.0), predorsal 242.0 (46.9-242.0), depth just before eye 3.20 (1.20-3.25), at neck 3.95 (1.40-4.10), at the end of inner-intestine 7.50 (1.05-7.50), at midpoint between pectoral and the end of inner-intestine 24.3 (4.15-24.3), maximum depth 24.3 (4.45-24.3), outer-intestine length 120.0 (4.30-171.0).

Total myomeres 145 (145-151, mean 147.6), predorsal 135 (135-140, 136.7), pre-outer-intestine 136 (136-141, 138.7), VBV just before gall bladder at 18th myomere

(18th-25th, 21.7th), last VBV at 69th (68th-79th, 73.1st). Anterior margin of gall bladder at 21st (18th-25th, 21.7th). Each fin obvious, pectoral rays 5, dorsal 35, anal 39, caudal 4 + 4 = 8. Teeth 0 + 0 + V + 19/1 + VIII + 7 (0~1 + 0~1 + V~VII + 1~19/1 + IV~IX + 2~7).

Body elongate, compressed, comparatively deep, depth 9.5% of TL at about mid-point of body. Head short, 3.0% of TL. Snout short, 34.4% of head length. Pectoral fin small, 13.2% of head length, oval, base of fin fleshy with clear rays. The intestine made a flexion at the 22nd myomere. The gall bladder located before the flexion of the inner-intestine, clear from the both sides. The outer-intestine extended free from the body just before the anal fin (47.1% of TL).

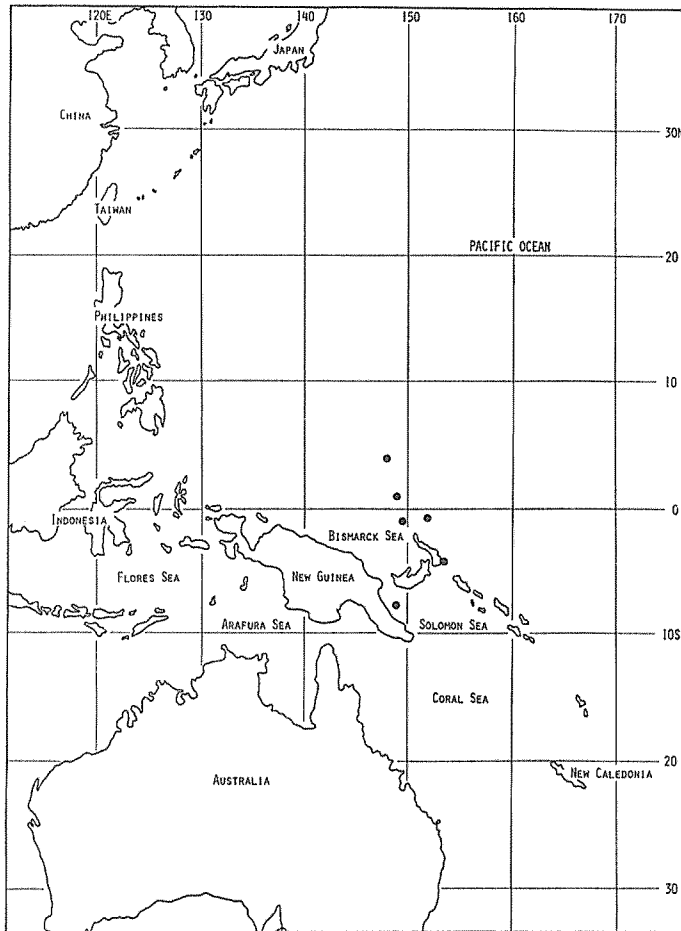


Fig. 8. Station locations of Type A<sub>3</sub>.

Pigmentation on specimens preserved in Formalin: a short, oblique line of minute melanophores on the 7th-145th myosepta just below the lateral midline, making a row of melanophores on the myosepta, with 30 to 35 melanophores in these lines in the middle of the body; a series of small, diffuse melanophores on the dorsal margin from the 15th to the 125th myomeres; many minute spots beneath the heart region; from the heart

region to the 24th myomere, a regular series of more than 30 small, compact melanophores to each myomere on the body wall of the ventral margin, especially spots very numerous beneath the gall bladder region; posterior to this series, minute melanophores switching to the dorsal side of the intestine; a number of scattered spots over the posterior half of the dorsal and anal fins, many spots all over the caudal fin; chorioid pigment present.

**Remarks** BLACHE<sup>11)</sup> described exterilium-type larvae *L. Ariosoma mellissi* from the Gulf of Guinea. Meristic and morphometric characteristics in his description almost agree with our observation. This type has not been previously described from the Pacific.

The catch locations are shown in Fig. 8. The distribution of this type is restricted to the western Middle Pacific. Our materials of small larvae (about 49 to 57 mm) off New Ireland I. indicated that spawning occurred in its neighboring waters. This type was fairly rare.

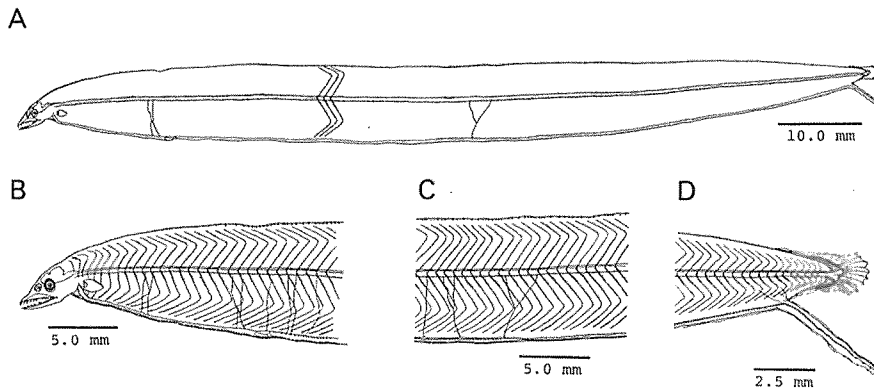


Fig. 9. Type A<sub>4</sub>, 102.5 mm in total length.

#### 4. Type A<sub>4</sub>

(Figs. 9 and 10; Appendix 1)

**Diagnosis** Exterilium *Ariosoma*-type larva with 160-173 myomeres characterized by a row of melanophores on the myosepta just below the lateral midline and last VBV at the 78th-91st myomere.

**Description** 8 specimens examined. The description given below is based on a specimen of 102.5 mm TL (Cat. ORI KH-73-5, No. B-15-1). The other specimens were utilized to show the range of characters.

Measurements in mm: TL 102.5 (41.8-398.0), SL 101.5 (41.6-394.0), head 4.45 (2.80-9.35), snout 1.90 (1.05-2.75), eye 0.95 (0.75-2.00), cleft of mouth 2.50 (1.65-4.95), postorbital 1.70 (1.10-4.70), pre-outer-intestine 99.3 (40.7-335.0), predorsal 98.4 (40.5-357.0), depth just before eye 2.20 (1.35-4.10), at neck 2.45 (1.50-5.65), at pectoral

base 3.55 (2.00-8.65), at the end of inner-intestine 3.20 (0.65-23.8), at midpoint between pectoral and the end of inner-intestine 9.00 (4.30-32.9), maximum depth 9.10 (4.40-37.8), outer-intestine length 4.60 (4.60-59.0).

Total myomeres 166 (160-173, mean 166.1), predorsal 157 (149-157, 153.2), pre-outer-intestine 160 (151-160, 156.3), VBV just before gall bladder at 21st myomere (20th-23rd, 20.8th), last VBV at 79th (78th-91st, 82.2nd). Anterior margin of gall bladder at 23rd myomere (20th-24th, 23.0th). Each fin obvious, dorsal rays 10, anal 6, caudal 4 + 4 + 1 = 9. Teeth 1 + 1 + V + 10/1 + V + 6 from right side of body, (0~1 + 0~1 + II~VII + 5~26/0~1 + II~X + 5~9).

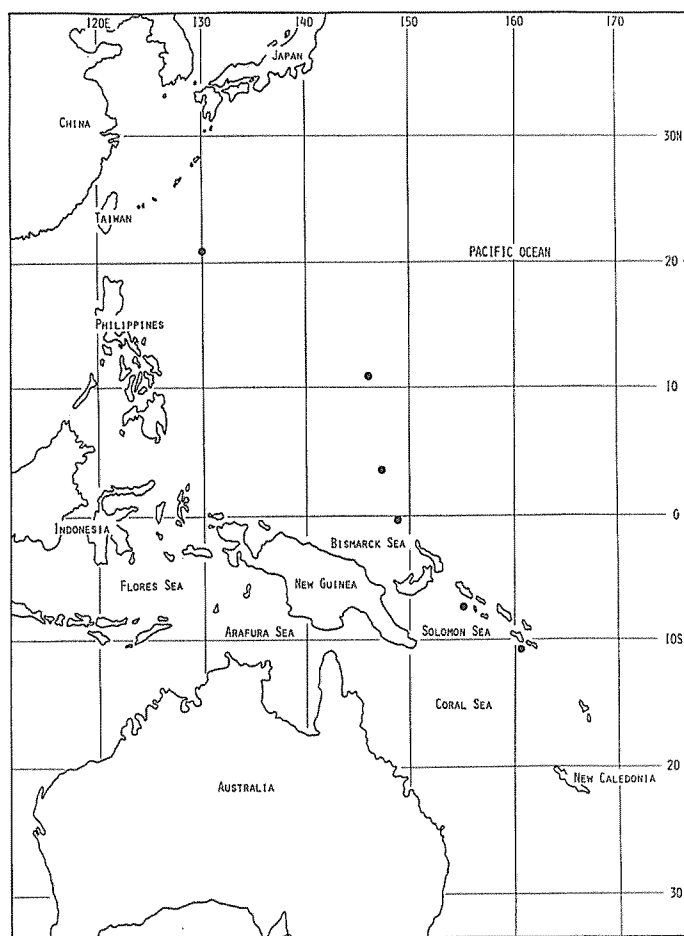


Fig. 10. Station locations of Type A<sub>4</sub>.

Body elongate, compressed, depth 8.9% of TL at about midpoint of body. Head short, 4.3% of TL. Snout short, 42.7% of head length. Pectoral fin small, oval, 22.0% of head length, base of fin fleshy with unclear rays. The intestine made a flexion at the 25th myomere. The gall bladder located before the flexion, clear from the both sides. The outer-intestine extended free from the body just before the anal fin, but very short (4.5% of TL) and thick. The outer-intestine seemed to be regenerated after destruction.

Pigmentation on specimens preserved in Formalin: a short oblique line of minute melanophores on the 5th-165th myosepta just below the lateral midline, forming a row of melanophores on the myosepta, with 18 to 22 melanophores in these lines in the middle of the body; a series of small, diffuse melanophores on the dorsal margin from the 18th to the 148th myomeres; 20 minute spots beneath the heart region; from the heart region to the 29th myomere, a regular series of more than 20 small, compact melanophores to each myomere on the body wall of the ventral margin; posterior to this series, minute melanophores switching to the dorsal side of the intestine; scattered minute spots over the posterior half of the dorsal and anal fins, a few spots over the base of the caudal fin; chorioid pigment present.

**Remarks** This type has previously not been described. ASANO<sup>14)</sup> described *Alloconger shiroanago shiroanago* from the coastal waters of Japan. The vertebral component of this species (80~86 + 74~79 = 156~161) appeared to be similar in myomere component with both our Type A<sub>4</sub> and one of the non-exterilium-types which will be described in another paper. The latter appears to be more similar in myomere component to *A. s. shiroanago* than Type A<sub>4</sub>, and is more common in the western North Pacific. However, there is no evidence to confirm or deny the identification.

The catch locations are shown in Fig. 10. This type is collected from near Okinawa I. (About 26°N) to the New Hebrides Is. (about 10°S). A small larva, 41.8 mm, collected from near Bougainville I. (Nov.), indicated that spawning occurred in the Solomon Sea. This type was very rare in the western North Pacific.

## 5. Type A<sub>5</sub>

(Figs. 11 and 12; Appendix 1)

**Diagnosis** Exterilium *Ariosoma*-type larva with 171-177 myomeres characterized by a row of melanophores on the myosepta just below the lateral midline and the last VBV at the 101st-104th myomere.

**Description** 4 specimens examined. The description given below is based on a specimen of 187.0 mm TL (Cat. Shoyo Maru, 1974, No. 47M-1). The other specimens were utilized to show the range of characters.

Measurements in mm: TL 187.0 (41.5-187.0), SL 184.3 (41.0-184.3), head 6.20 (2.70-6.20), snout 2.45 (1.15-2.45), eye 1.60 (0.65-1.60), cleft of mouth 3.50 (1.70-3.50), postorbital 2.45 (0.60-2.45), pre-outer-intestine 179.0 (40.0-179.0), predorsal 178.0 (39.3-178.0), depth just before eye 2.80 (1.20-2.80), at neck 3.40 (1.60-3.40), at pectoral base 6.45 (1.80-6.45), at the end of inner-intestine 6.30 (1.00-6.30), at mid-point between pectoral and the end of inner-intestine 18.3 (5.30-18.3), maximum depth 18.5 (5.50-18.5), outer-intestine length 145.0 (4.10-145.0).

Total myomeres 177 (171-177, mean 174.3), predorsal 164 (149-164, 157.5), pre-outer-intestine 166 (159-166, 162.8), 1st VBV at 12th myomere (8th-14th, 11.8th), VBV just before gall bladder at 22nd (20th-23rd, 21.8th), last VBV at 101st (101st-104th, 102.0th). Anterior margin of gall bladder at 25th myomere (21st-26th, 24.3rd). Each fin obvious, dorsal rays 21, anal 17, caudal 5 + 3 = 8. Teeth 1 + 1 + V + 17/1 + VII + 8 (1 + 0~1 + II~V + 6~17/0~1 + II~VII + 3~8).

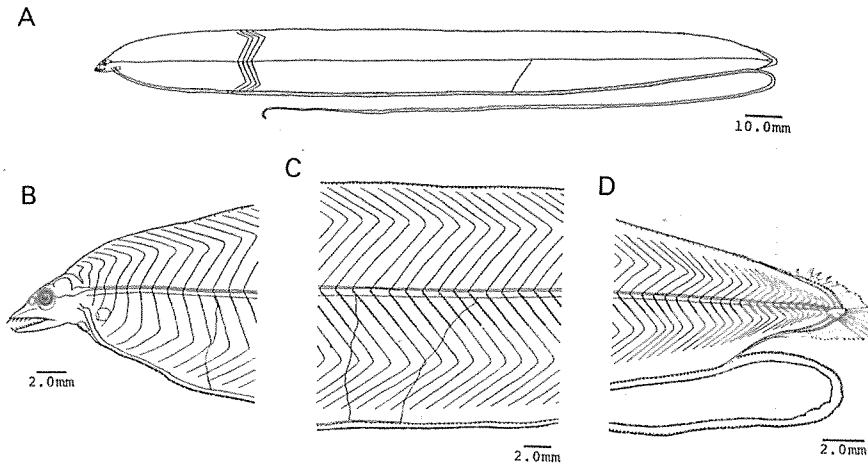


Fig. 11. Type A<sub>5</sub>, 187.0 mm total length.

Body elongate, compressed, depth 9.9% of TL at about midpoint of body. Head short, 3.3% of TL. Snout short, 39.5% of head length. Pectoral fin small, oval, 21.0% of head length, base of fin fleshy with unclear rays. The intestine made a flexion at the 26th myomere. The gall bladder located before the flexion, clear from the both sides. The outer-intestine extended free from the body just before the anal fin (77.8% of TL).

Pigmentation on specimens preserved in Formalin: a short oblique line of minute melanophores on the 5th-177th myosepta just below the lateral midline, forming a row of melanophores on the myosepta, these melanophores are few in number (1~3) anteriorly but increase to about 32-37 in the middle of the body, and again decrease to four or five on each myoseptum posteriorly at the level of the end of inner-intestine; a series of small, diffuse melanophores on the dorsal margin from the 10th to the 155th myomeres; 17 minute spots beneath the heart region; from the heart region to the gall bladder, a regular series of more than 30 small, compact melanophores to each myomere on the body wall of the ventral margin, spots especially numerous beneath the gall bladder region; posterior to this series, minute, compact melanophores switching to the dorsal side of the intestine; a number of scattered minute spots over the posterior half of the dorsal and anal fins; a few minute spots over the base of caudal fin; chorioid pigment present.

**Remarks** This type has not been previously described. The catch locations are shown in Fig. 11. The distribution of this type is restricted to the western Middle Pacific. Two small larvae, 41.5 and 48.7 mm, from off the southern Solomon Is. (Nov.), indicated that spawning occurred in the Solomon Sea or Coral Sea. This type was fairly rare.

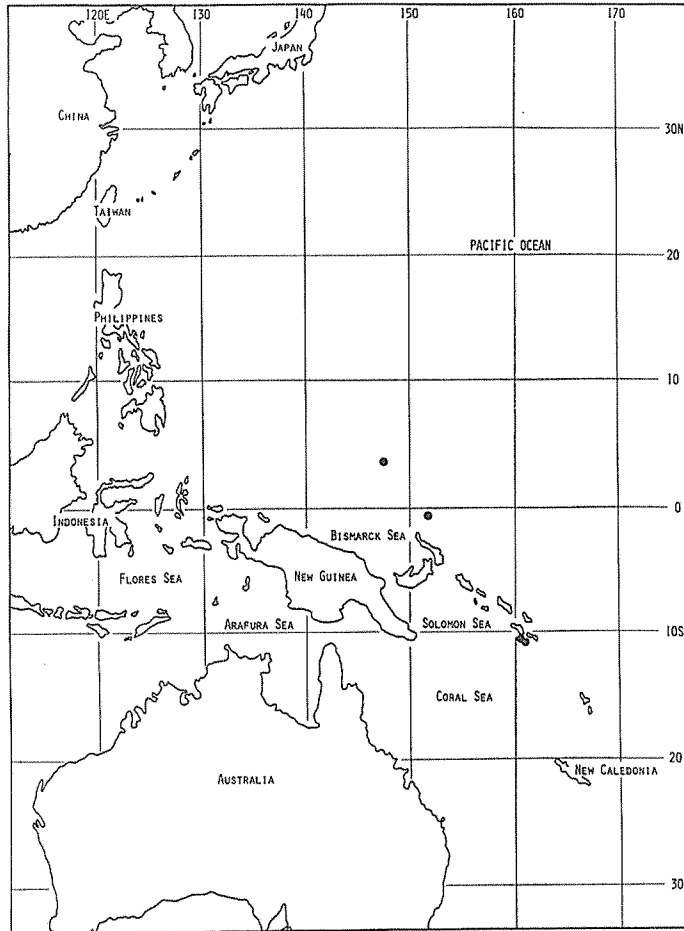


Fig. 12. Station locations of Type A<sub>5</sub>.



6. Type B<sub>1</sub>

(Figs.13 and 14; Appendix 1)

**Diagnosis** Exterilium *Ariosoma*-type larva with 151-154 myomeres characterized by two rows of melanophores on the myosepta along the side of body and no melanophores inside the opercle and along the dorsal side of the lateral midline.

**Description** 7 specimens examined. The description given below is based on a specimen of 155.7 mm TL (Cat. Shunyo Maru, 1965, No. 133M-1). The other specimens were utilized to show the range of characters.

Measurements in mm: TL 155.7 (107.7-195.3), SL 155.0 (106.3-194.0), head 6.50 (4.95-6.50), snout 2.40 (2.00-2.40), eye 1.75 (1.25-1.75), cleft of mouth 3.30 (2.60-3.30), post-orbital 2.45 (1.80-2.45), pre-outer-intestine 148.2 (102.8-186.6), predorsal 147.7 (101.7-185.5), depth just before eye 2.70 (2.30-3.00), at neck 3.40 (2.85-3.50), at pectoral base 5.85 (4.10-6.30), at the end of inner-intestine 4.50 (3.35-6.30), at midpoint between pectoral and the end of inner-intestine 14.5 (11.3-19.3), maximum depth 15.0 (11.3-20.0), outer-intestine length 135.0 (17.3-135.0).

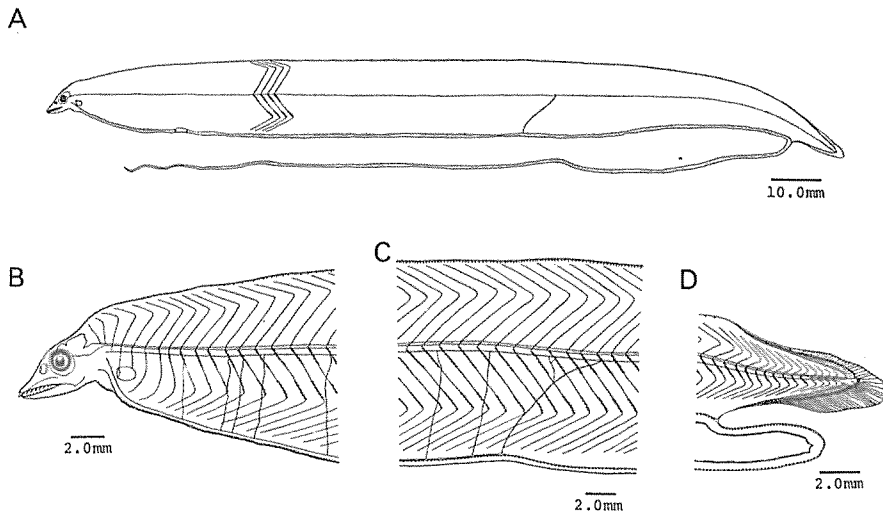


Fig. 13. Type B<sub>1</sub>, 155.7 mm in total length.

Total myomeres 153 (151-154, mean 152.7), predorsal 140 (138-141, 139.8), pre-outer-intestine 140 (140-142, 140.5), 1st VBV at 9-10th myomere (7th-12th, 9.6th), VBV just before gall bladder at 21st (20th-21st, 20.7th), last VBV at 84th (80th-88th, 83.7th). Anterior margin of gall bladder at 23rd myomere (23rd-24th, 23.5th). Each fin obvious, dorsal rays 30, anal 28, caudal 5 + 3 + 1 = 9. Teeth 1 + 1 + VII + 27/1 + XI + 9 (1 + 1 + VI~VII + 11~27/1 + VI~XI + 5~9).

Body elongate, compressed, depth 9.6% of TL at about midpoint of body. Head short, 4.2% of TL. Snout short, 36.9% of head length. Pectoral fin very small, oval,

11.3% of head length, base of fin fleshy with unclear rays. The intestine made a flection at the 24th myomere. The gall bladder located before the flection, clear from the both sides. The outer-intestine extended free from the body just before the anal fin (86.7% of TL).

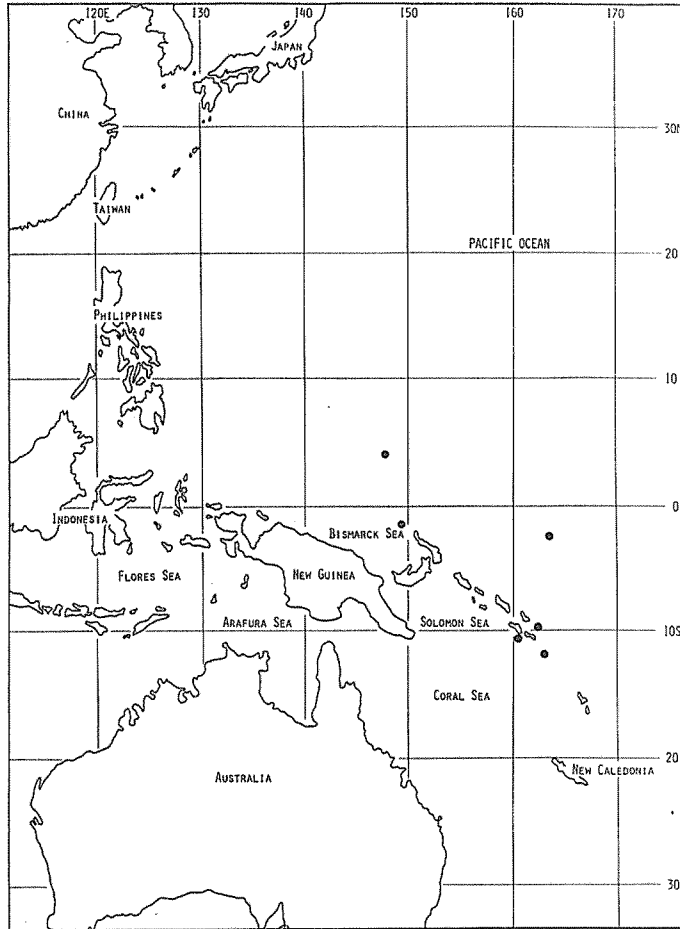


Fig. 14. Station locations of Type B<sub>1</sub>.

Pigmentation on specimens preserved in Formalin: an oblique line of minute, compact melanophores on the 4th-153rd myosepta just below the lateral midline, reaching 29-32 in number at the midpoint of body, and similar melanophores on the 8th-138th myosepta above the lower flection point of myomere, reaching a maximum of about 18 minute spots, both forming rows of melanophores on the myosepta; a series of small melanophores on the dorsal margin from the 9th to the 138th myomeres; about 50 minute spots beneath the heart region; from the pectoral region to the 24th myomere, a regular series of more than 20 small, compact melanophores to each myomere on the body wall of the ventral margin; posterior to this series, minute melanophores switching to the dorsal side of the intestine; a scattering of minute spots over the base of the dorsal, anal, and caudal fins; chorioid pigment present.

**Remarks** This type has previously not been described. The myomere component of both this type and Type B<sub>2</sub> which will be described next, were closely related to the vertebral components of *Ariosoma nigrimanus* NORMAN (76 + 78 = 154) from the Gulf of Aden<sup>18)</sup> and *Bathymyrus smithi* CASTLE (70~74 + 80~81 = 150~155) from the Mozambique Channel.<sup>19)</sup> However, as no metamorphosing specimens of both types were available, a conclusive identification was not possible.

The catch locations are shown in Fig. 14. The distribution of this type is restricted to the western Middle Pacific. This type was relatively rare.

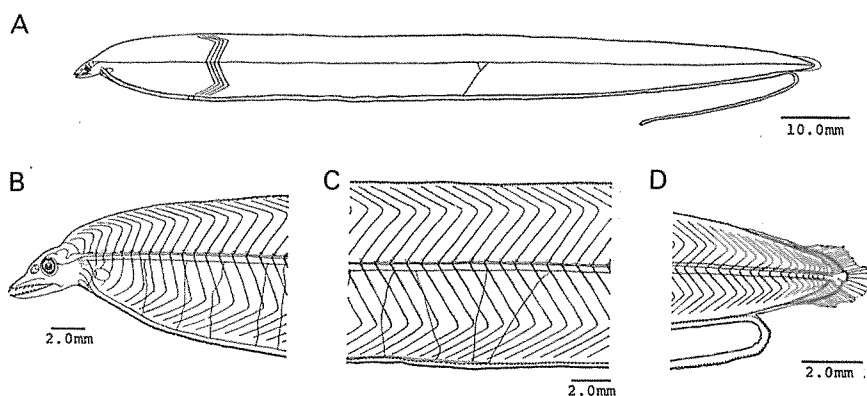


Fig. 15. Type B<sub>2</sub>, 110.1 mm in total length.

### 7. Type B<sub>2</sub>

(Figs. 15 and 16; Appendix 1)

**Diagnosis** Exterilium *Ariosoma*-type larva with 158 myomeres characterized by two rows of melanophores on the myosepta along the side of the body and scattered melanophores inside the opercle and along the just dorsal side of the lateral midline.

**Description** 1 specimen examined. 110.1 mm TL (Cat. Shunyo Maru, 1965, No.23M-1).

Measurements in mm: TL 110.0, SL 109.2, head 5.10, snout 2.10, eye 1.15, cleft of mouth 2.95, postorbital 1.95, pre-outer-intestine 106.0, predorsal 105.3, depth just before eye 2.15, at neck 2.45, at pectoral base 4.20, at the end of inner-intestine 3.15, at midpoint between pectoral and the end of inner-intestine 10.1, maximum depth 10.3, outer-intestine length 14.0.

Total myomeres 158, predorsal 147, pre-outer-intestine 148, 1st VBV at 7-8th myomere, VBV just before gall bladder at 20-21st, last VBV at 75th. Anterior margin

of gall bladder at 21st myomere. Each fin obvious, dorsal rays 16, anal 10, caudal 4 + 3 = 7. Teeth 1 + 1 + V + 12/1 + VI + 6.

Body elongate, compressed, depth 9.4% of TL at one third of TL posteriorly. Head short, 4.6% of TL. Snout short, 41.2% of head length. Pectoral fin very small, oval, 21.6% of head length, base of fin fleshy with unclear rays. The intestine made a flection at the 22nd myomere. The gall bladder located before the flection, clear from the both sides. The outer-intestine damaged.

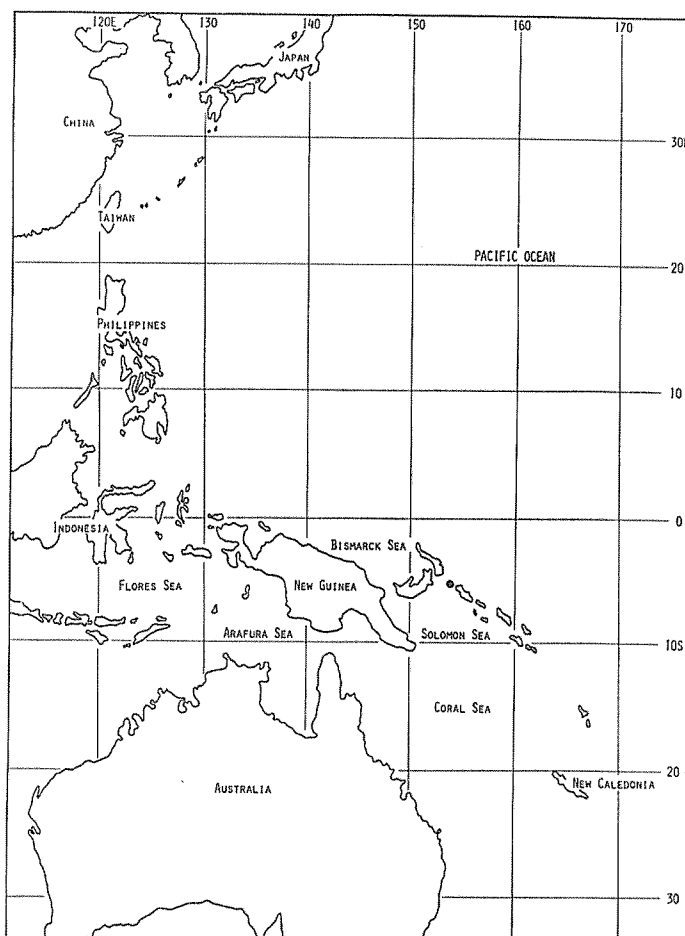


Fig. 16. Station location of Type B<sub>2</sub>.

Pigmentation on specimens preserved in Formalin: an oblique line of minute, compact melanophores on the 3rd-154th myosepta just below the lateral midline, reaching 16-19 in number at the midpoint of body, and similar melanophores on the 6th-115th myosepta above the lower flection point of myomere, reaching a maximum of about 7 minute spots, both forming rows of melanophores on the myosepta; minute spots on the 1st-124th myomere along the just dorsal side of the lateral midline with one to four per myomere; a series of small melanophores on the dorsal margin from the 11th to the 137th myomeres; many minute spots beneath the heart region; from the pectoral

region to the 21st myomere, a regular series of small, compact melanophores, more than 40 to each myomere on the body wall of the ventral margin; posterior to this series, minute melanophores switching to the dorsal side of the intestine; about 20 minute spots between the pectoral base and inside the opercle; a number of scattered small spots over the base of the dorsal, anal and caudal fins; chorioid pigment present.

**Remarks** This type has not been previously described. As discussed above, the myomere component of this type is closely related to the vertebral component of both *Ariosoma nigrimanus*<sup>18)</sup> and *Bathymyrus smithi*,<sup>19)</sup> but no evidence was available either to confirm or deny this identification.

The catch location is shown in Fig. 16. This type was very rare.

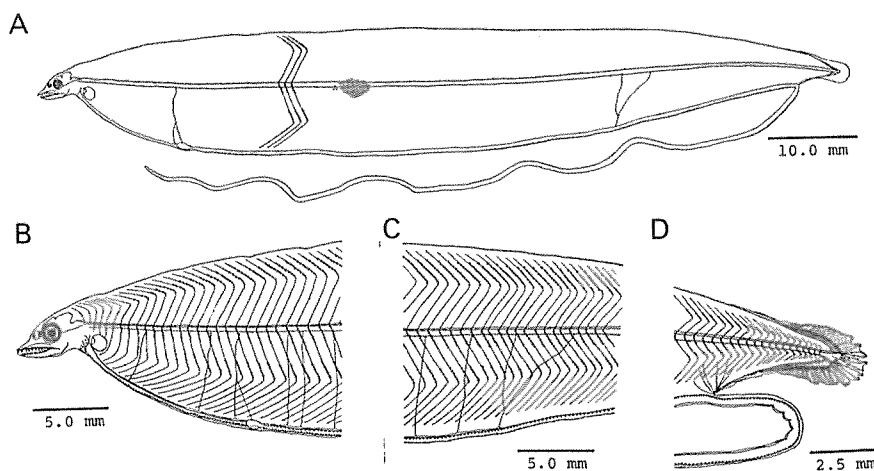


Fig. 17. Type C<sub>1</sub>, 91.4 mm in total length.

#### 8. Type C<sub>1</sub>

(Figs. 17 and 18; Appendix 1)

*Leptocephale* 6 (part); BLACHE, 1963: 12, figs. XV and XVI.<sup>16)</sup>

*Leptocephalus scalaris* (part); CASTLE, 1964: 16, figs. 5E-5I.<sup>6)</sup>

*L. Cynoponticus ferox* (part); BLACHE, 1968: 702, figs. 8 and 9.<sup>17)</sup>

*Leptocephalus scalaris*; CASTLE, 1969: 64.<sup>13)</sup>

*L. Bathymyrus* sp.; CASTLE, 1970: 9.<sup>20)</sup>

Type B; SOCOLOVSKII, 1975: 134, fig. 7.<sup>5)</sup>

*L. Parabathymyrus* sp.; BLACHE, 1977: 108, fig. 34.<sup>11)</sup>

**Diagnosis** Exterilium *Ariosoma*-type larva with 146-156 myomeres characterized by three rows of melanophores on the myosepta along the side of the body and a patch of melanophores at the level of the 30th-50th myomeres.

**Description** 20 specimens examined. The description given below is based on a specimen of 91.4 mm TL (Cat. ORI KH-73-5, No. B-15-3). The other specimens were utilized to show the range of characters.

Measurements in mm: TL 91.4 (75.0-259.6), SL 90.3 (74.8-257.8), head 5.50 (4.70-8.65), snout 2.00 (1.65-3.00), eye 1.40 (1.30-2.10), cleft of mouth 2.90 (2.50-3.75), postorbital 2.10 (1.90-3.65), pre-outer-intestine 85.7 (70.7-244.5), predorsal 85.7 (71.0-244.0), depth just before eye 2.25 (1.95-3.60), at neck 2.90 (2.60-4.50), at the end of inner-intestine 3.90 (2.90-12.7), at midpoint between pectoral and the end of inner-intestine 14.0 (11.0-35.3), maximum depth 14.2 (11.5-37.0), outer-intestine length 82.0 (42.0-312.0).

Total myomeres 149 (146-157, mean 153.1), predorsal 133 (131-140, 135.7), pre-outer-intestine 133 (131-142, 137.5), VBV just before gall bladder at 21st myomere (19th-23rd, 20.7th), last VBV at 98th (92nd-98th, 95.8th). Anterior margin of gall bladder at 21st (19th-23rd, 20.7th). Each fin obvious, dorsal rays 21, anal 23, caudal 5+3+1 = 9. Teeth 1 + 1 + VII + 11/1 + VIII + 5 (0~1 + 0~1 + V~VIII + 10~22/1 + IV~IX + 5~16).

Body elongate, compressed, comparatively deep, depth 15.5% of TL at about midpoint of body. Head short, 6.0% of TL. Snout short, 36.4% of head length. Pectoral fin small, 17.3% of head length, oval, base of fin fleshy with unclear rays. The intestine made a flexion at the 22nd myomere. The gall bladder located before the flexion, clear from the both sides. The outer-intestine extended free from the body just before the anal fin (89.7% of TL).

Pigmentation on specimens preserved in Formalin: a row of a short, oblique line of minute melanophores on the 5th-149th myosepta below the lateral midline, with 18 to 22 spots in these lines in the middle of the body; a row of similar melanophores on the 9th-149th myosepta above the lower flexion point of myomere, reaching 18-20 in number at the midpoint of body; a row of up to 35 similar melanophores on the 8th-148th myosepta above the upper flexion point of myomere: these forming three rows of melanophores on the myosepta; in the lateral midline of the 44th-50th myomeres, an oval patch of numerous, minute melanophores, 61.8% and 40.0% of head length in horizontal and vertical diameters, respectively; minute spots on the 10th-53rd myomeres along the just dorsal side of the lateral midline with one spot per myomere; 10 minute spots beneath the heart region; from the pectoral region to the 53rd myomere, a regular series of more than 20 small, compact melanophores to each myomere on the body wall of the ventral margin; posterior to this series, minute melanophores switching to the dorsal side of the intestine, more than 10 to each myomere; 2 minute spots (others 0-19) between the pectoral base and the tip of opercle; scattered small spots over the base of the dorsal, anal and caudal fins; chorioid pigment present.

**Remarks** These larvae agree in almost all details with both Type B (Anagoinae) from the Kuroshio waters<sup>5)</sup> and *L. Parabathymyrus* sp. from the Gulf of Guinea.<sup>11)</sup> CASTLE<sup>6)</sup> described the exterilium-type larvae *Leptocephalus scalaris* from the Solomon Sea. Meristic and morphometric characteristics in his description agreed with our observation for both this type and Type C<sub>2</sub> which will be described next. Later,

CASTLE<sup>20)</sup> suggested that those larvae might belong to *Bathymyrus* ALCOCK. The last VBV at myomere of *L. scalaris*, however, is located far more posterior to the first caudal vertebra in the adult of *Bathymyrus smithi* (70-74).<sup>7,12)</sup>

Asano<sup>14)</sup> reported *Anago anago* (TEMMINCH et SCHLEGEL) from the coastal waters of Japan. The first caudal vertebra of this species (84-95) is far back compared to other members of the Anagoinae and the total vertebral count of this species (149-159) is closely related to the number of myomeres for both our Types C<sub>1</sub> and C<sub>2</sub>. There is a possibility that Type C<sub>1</sub> and/or C<sub>2</sub> may develop into *A. anago*, but as no metamorphosing specimens of these types were available, a conclusive identification was not possible.

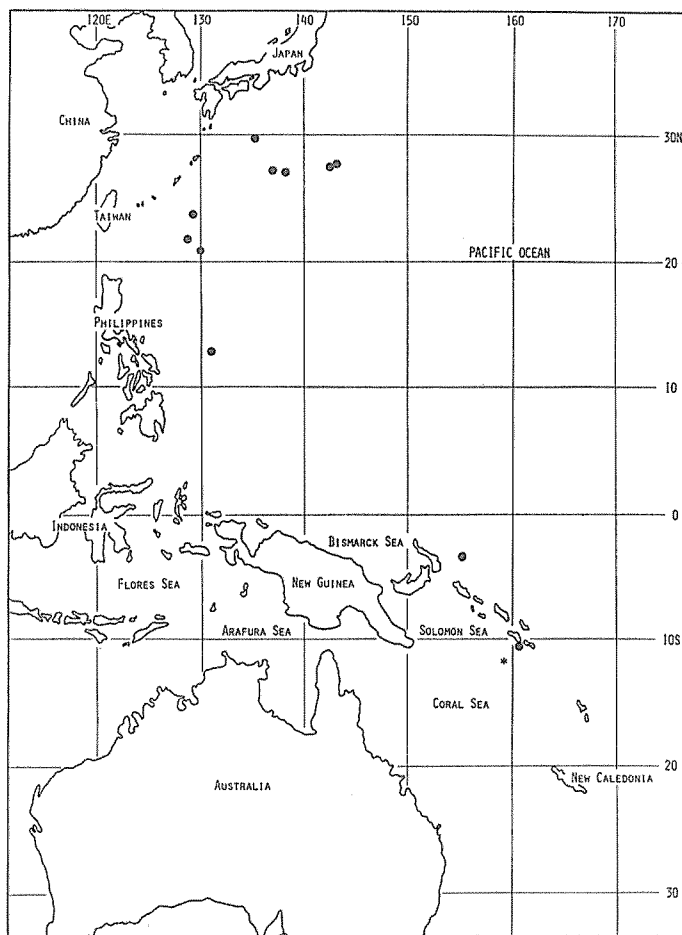


Fig. 18. Station locations of Type C<sub>1</sub>. Asterisk shows the capture location of *Leptocephalus scalaris* (108.8 mm TL) by CASTLE<sup>7)</sup>

Dr. D. G. SMITH suggested that *L. scalaris* is referable to *Ariosoma anale* in the western Atlantic, and the latter probably is *Ariosoma meeki* (JORDAN and SNYDER) in the waters of Japan, which was treated by ASANO<sup>14)</sup> as *Anago anago* (personal communication).

The catch locations are shown in Fig. 18. This type occurred in both the western North and western Middle Pacific, and was relatively common.

9. Type C<sub>2</sub>

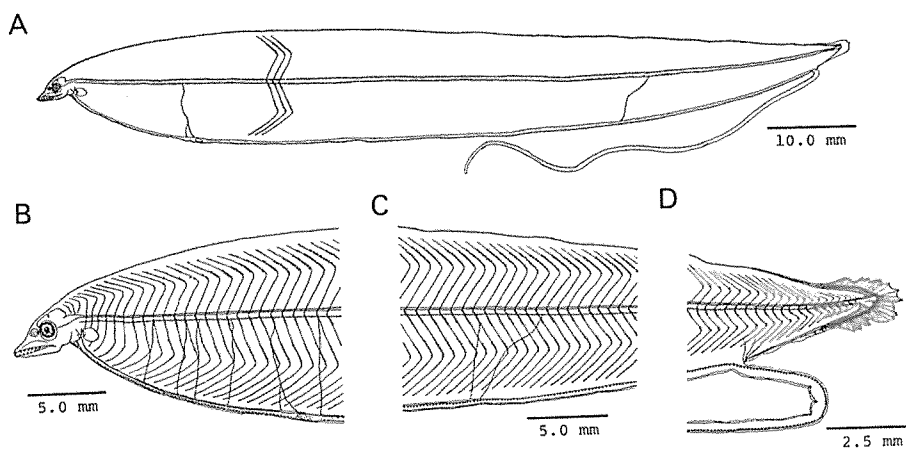
(Figs. 19 and 20; Appendix 1)

*Leptocephalus scalaris* (part); CASTLE, 1964: 16.<sup>6)</sup>Type Б ; SOCOLOVSKII, 1975: 134, fig. 7.<sup>5)</sup>

**Diagnosis** Exterilium *Ariosoma*-type larva with 148-161 myomeres characterized by three rows of melanophores on the myosepta along the side of the body and no patch of melanophores on the midlateral body surface.

**Description** 348 specimens examined. The description given below is mainly based on a specimen of 92.4 mm TL (Cat. ORI KH-73-2, No. 10-1-1). The other specimens were utilized to show the range of characters.

Measurements in mm: TL 92.4 (25.1-235.9), SL 91.7 (25.0-234.0), head 4.60 (2.25-7.70), snout 1.95 (1.00-2.60), eye 1.05 (0.60-1.95), cleft of mouth 2.50 (1.25-3.80), postorbital 1.60 (0.70-3.30), pre-outer-intestine 88.8 (23.8-220.8), predorsal 88.6, depth just before eye 2.10 (1.15-3.65), at neck 2.60 (1.30-4.85), at the end of inner-intestine 3.20 (1.00-11.7), at midpoint between pectoral and the end of inner-intestine 11.8 (3.35-31.0), maximum depth 12.5 (3.75-33.0), outer-intestine length 46.0 (2.80-141.5).

Fig. 19. Type C<sub>2</sub>, 92.4 mm in total length.

Total myomeres 153 (148-161, mean 155.8), predorsal 138 (131-148, 140.6), pre-outer-intestine 138 (131-148, 140.6), VBV just before gall bladder at 22-23rd myomere (17th-24th, 21.0th), last VBV at 97th (89th-103rd, 96.1st). Anterior margin of gall bladder at 24th (19th-25th, 22.7th). Each fin obvious, dorsal rays 14, anal 13, caudal 4 + 3 + 1 = 8. Teeth 1 + 1 + VI + 10/1 + VII + 8 (0~1 + 0~1 + II~VIII + 5~25/0~1 + 0~IX + 4~12).

Body elongate, compressed, comparatively deep, depth 13.5% of TL at one third of TL posteriorly. Head short, 4.9% of TL. Snout short, 42.4% of head length. Pectoral fin small, 17.4% of head length, oval, base of fin fleshy with unclear rays. The intestine



made a flection at the 25th myomere. The gall bladder located before the flection, clear from the both sides. The outer-intestine extended free from the body just before the anal fin (49.8% of TL).

Pigmentation on specimens preserved in Formalin: a row of a short, oblique line of minute melanophores on the 5th-153rd myosepta below the lateral midline, with 13 to 15 spots in these lines in the middle of the body; a row of similar melanophores on the 11th-150th myosepta above the lower flection point of myomere, reaching 8-10 in number at the midpoint of body; a row of up to 15 similar melanophores on the 10th-147th myosepta above the upper flection point of myomere: these forming three rows of melanophores on the myosepta; 3 minute spots beneath the heart region; from the pectoral region to the 28th myomere, a regular series of small, compact melanophores, more than 20 to each myomere on the body wall of the ventral margin; posterior to this series, minute melanophores switching to the dorsal side of the intestine, more than 10 to each myomere; 2 minute spots between the pectoral base and the tip of opercle, but some

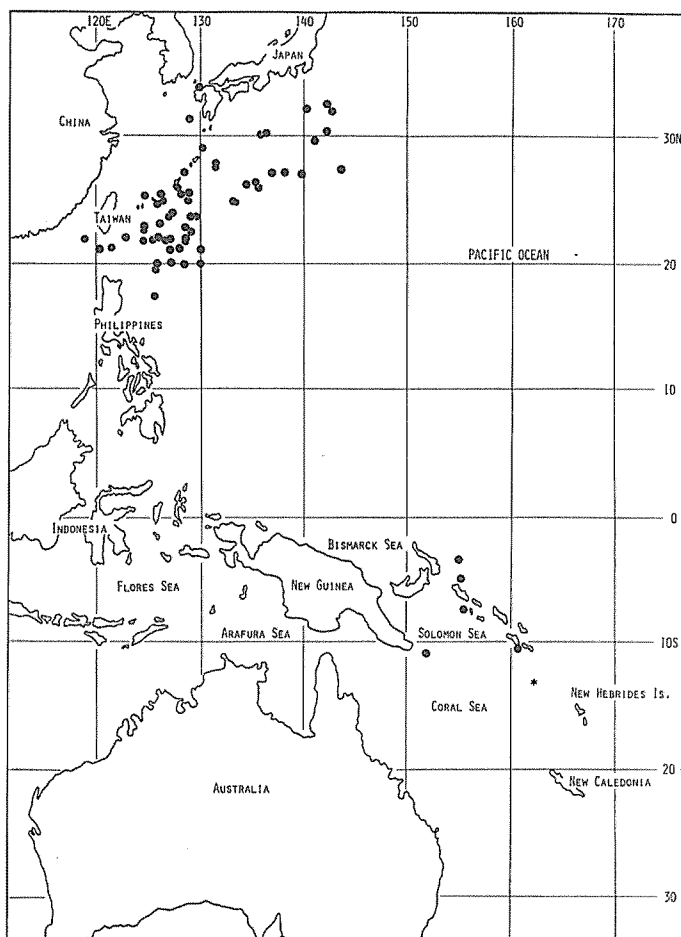


Fig. 20. Station locations of Type C<sub>2</sub>. Asterisk shows the capture location of *Leptocephalus scalaris* (51.1 mm TL) by CASTLE.<sup>6)</sup>

have no spots; a number of scattered small spots over the base of the dorsal, anal, and caudal fins; chorioid pigment present. This specimen has no melanophores along the just dorsal side of the lateral midline, but some have a minute spot per myomere on the 6th-32nd myomeres.

**Remarks** SOCOLOVSKII<sup>5)</sup> previously described this larval type. CASTLE<sup>6)</sup> reported that the larvae for our Type C<sub>1</sub> and C<sub>2</sub> are the same species (*Leptocephalus scalaris*), considering the midlateral patch of melanophores being absent in the small specimen (51.5 mm) and occurring only in the larger specimen (108.0 mm). However, we have two series of larvae: one has a midlateral patch of melanophores (Type C<sub>1</sub>, 75.0-259.6 mm) and the other has no midlateral patch (Type C<sub>2</sub>, 25.1-235.9 mm). Therefore, we divided these larvae into two distinct types.

The catch locations are shown in Fig. 20. This type occurred in both the western North and western Middle Pacific, and especially, was very common in the waters around Japan and Taiwan. Our materials of small larvae (about 20 to 30 mm) off southern Kyushu (Dec.), off eastern Taiwan (Nov.), and near the Solomon Is. (Nov.) indicated that spawning occurred in those waters.

## DISCUSSION

In the present survey, a total of 2,635 tows were made in the western North and Middle Pacific, in which 395 exterilium *Ariosoma*-type larvae were collected from 163 tows over a vast area. Table 1 shows the results of collections in respect of day and night, and water layers. Most larvae were collected from the surface and middle layers at night. The larvae were collected rarely during day from three layers. For more information on their vertical distribution, it will be necessary to use the opening-closing larval net.

Table 1. Number of nets towed and larvae collected at the surface, middle layer and deep layer during the day and night

	Day			Night		
	Surface*1	Middle*2 layer	Deep*3 layer	Surface	Middle layer	Deep layer
Number of nets towed	464	423	76	693	689	20
Positive net	0	9	4	51	100	4
Negative net	464	414	72	642	589	16
Number of larvae collected	0	11	5	145	227	7

\*1 wire length, 0 - 45 m

\*2 wire length, 75 - 200 m

\*3 wire length, 300 - 5000 m

The metamorphosing larvae which would link the larva to the adult were not found in the present collection. Before drawing an entire picture of their early life histories, the metamorphosing larvae must be examined.

Two or three types (our Type A<sub>1</sub>, C<sub>1</sub> and/or C<sub>2</sub>) of the exterilium *Ariosoma*-type larvae have been known from the eastern Indian Ocean,<sup>13)</sup> one type (Type A<sub>1</sub> or A<sub>2</sub>) from the Red Sea<sup>18)</sup> and three types (Type A<sub>3</sub>, C<sub>1</sub> and C<sub>2</sub>) from the Atlantic.<sup>11,16,17,20)</sup> Type A<sub>3</sub> seems to be relatively common in the Atlantic, while fairly rare in our collection. Type C<sub>1</sub> and/or C<sub>2</sub> were relatively common in the eastern Indian Ocean as well as in the western North and Middle Pacific.

#### ACKNOWLEDGMENTS

We are deeply grateful to Ocean Research Institute, University of Tokyo; Far Seas Fisheries Research Laboratory; Nansei Regional Fisheries Research Laboratory; Faculty of Fisheries, Kagoshima University, for giving us the invaluable opportunity to do this study. We also give thanks to officers and crew of the R/V Hakuho Maru, R/V Shunyo Maru, R/V Shoyo Maru, R/V Shin-ei Maru No. 53 and T/S Kagoshima Maru for collecting the materials. We wish to express our thanks to Dr. David G. SMITH, Marine Biomedical Institute, Galveston, Texas, Mr. Jack T. MOYER, Tatsuo TANAKA Memorial Biological Station, and Mr. James H. UCHIYAMA, Honolulu Laboratory, National Marine Fisheries Service, U.S. Department of Commerce, for their critical reading of the manuscript and valuable comments. The present work was supported financially in part by a grant of Ito Foundation for the Advancement of Ichthyology to the senior author.

#### REFERENCES

- 1) Ichthyological Society of Japan ed.: Dictionary of Japanese fish names and their foreign equivalents. Sanseido, Tokyo, 848 pp. (1981).
- 2) K. UCHIDA: *Zool. Mag.*, **44** (519), 23–24 (1932).
- 3) T. TAKAI: *J. Shimonoseki Univ. Fish.*, **8** (3), 209–555 (1959).
- 4) A. OCHIAI, T. IKEGAMI and Y. NOZAWA: *Japan. J. Ichthyol.*, **25** (3), 205–210 (1978).
- 5) A. S. SOCOLOVSKII: *Transactions of TINRO*, **96**, 129–135 (1975).
- 6) P. H. J. CASTLE: *Zool. Publ., Victoria Univ. Wellington*, (37), 1–45 (1964).
- 7) P. H. J. CASTLE: *Ichthyol. Bull., Rhodes Univ.*, Grahamstown, (33), 685–726 (1968).
- 8) P. JESPERSEN: *Dana Rep.*, (22), 127 pp. (1942).
- 9) P. H. J. CASTLE: *Zool. Publ., Victoria Univ. Wellington*, (33), 1–14 (1965).
- 10) O. TABETA and T. TAKAI: *Bull. Japan. Soc. Sci. Fish.*, **41** (2), 137–145 (1975).
- 11) J. BLACHE: *Faune Tropicale XX. O.R.S.T.O.M.* 1–381 (1977).
- 12) D. G. SMITH: NOAA Technical Report MF Circular 424, 39pp. (1979).
- 13) P. H. J. CASTLE: *Cah. O.R.S.T.O.M., Ser. Oceanogr.*, **7** (2), 53–88 (1969).
- 14) H. ASANO: *Bull. Misaki Mar. Biol. Inst.*, Kyoto Univ., **1**, 1–143 (1962).
- 15) U. D'ANCONA: *Mem. R. Com. Talassogr. Ital.*, (146), 1–146 (1928).
- 16) J. BLACHE: *Cah. O.R.S.T.O.M., Ser. Oceanogr.*, (5), 5–23 (1963).
- 17) J. BLACHE: *Bull. Inst. Fondam. Afr. Noire, Ser. A Sci. Nat.* **30** (2), 690–736 (1968).
- 18) J. R. NORMAN: *Sci. Res. John Murray Exped.*, **7** (1), 1–116 (1939).\*
- 19) P. H. J. CASTLE: *Spec. Publ. Dept. Ichthyol., Rhodes Univ.*, (4), 1–12 (1968).
- 20) P. H. J. CASTLE: *Arch. Fischereiwiss.*, **21** (1), 1–21 (1970).

\* This paper was referred from CASTLE (1968): reference No.7.









## 北西および中部太平洋におけるアナゴ科魚類の

## 葉形幼生に関する研究 — I

外腸をもつ *Ariosoma*-type 幼生

望岡典隆・角田俊平・多部田 修

黒潮海域からニューカレドニア周辺海域に至る西部太平洋域 ( $36^{\circ}\text{N}\sim 26^{\circ}\text{S}$ ,  $115\sim 177^{\circ}\text{E}$ ) に出現するアナゴ科の *Ariosoma*-type 幼生は、外腸の有無によって2つのグループに分けられる。本研究では外腸をもつ幼生について、形態と地理的分布を明らかにした。これらの幼生は体側の筋隔上に体軸に沿って並ぶ小黒色素胞列の数 (1~3列) によって次の3グループに分けられた。

1) 体側の小黒色素胞列は1列 (Type  $A_1\sim A_5$ )。このグループは背縁部の小黒色素胞の有無によってさらに2グループに分けられる。背縁部に小黒色素胞をもたない幼生 (Type  $A_1$ ) は体側の筋節上に散在する小黒色素胞を有する。背縁部に小黒色素胞をもつグループは総筋節数と最終垂直血管の位置によって4タイプ (Type  $A_2\sim A_5$ ) に類別される。

2) 体側の小黒色素胞列は2列 (Type  $B_1, B_2$ )。このグループは鰓蓋の内側と体側正中線直上部の小黒色素胞の有無によって2タイプに類別される。

3) 体側の小黒色素胞列は3列 (Type  $C_1, C_2$ )。このグループは体側の正中線付近の黒色素叢の有無によって2タイプに類別される。

これら9タイプはそれぞれ種に相当し、ゴテンアナゴ亜科 (*Bathymyrinae*) に属すると考えられる。これらのうち、Type  $A_2, A_4, A_5, B_1, B_2$  は本研究によって初めて記載され、Type  $A_1, A_2, A_4$  は北西太平洋から初記録である。また、各タイプの筋節数構成より、腹椎と尾椎の数が知られているゴテンアナゴ亜科の親魚との関連について論じた。各タイプの地理的分布図を示し、小型の幼生が採集されたタイプについては、産卵場の推定を行った。これらの幼生は主として、夜間の表層と中層 (ワイヤー長、75~200 m) で採集され、昼間の各層の曳網ではほとんど採集されなかった。