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Notosudid Fish Larvae in the Ocean off Southern Japan

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Abstract Notosudid larvae of two genera and five species, *Ahliesaurus brevis, Scopelosaurus smithii, S. mauli, S. harryi* and *S.* "sp. II" of Bertelsen et al. (1976), were recorded from the ocean off southern Japan. Japanese names are given to them, together with tropical Indo-Pacific species *S. hoedti* and except for *S.* "sp. II" whose species name is not erected due to the absence of metamorphosed specimens. The descriptions confirm those given by Bertelsen et al. (1976), providing some additional information, especially concerning the youngest stages. A marked change in larval pigmentation during notochord inflection is shown. A key to the notosudid larvae recorded from the waters off Japan is provided.

Introduction

Notosudid fishes comprise 3 genera and 19 species including 2 unnamed types of larvae (Bertelsen et al., 1976). Only one species, *Scopelosaurus harryi* (Mead, 1953), was reported from the sea around Japan before the world-wide study of Bertelsen et al. (1976), who showed the occurrence of 5 other species in the western North Pacific Ocean: *Ahliesaurus brevis*, *Scopelosaurus hoedti*, *S. smithii*, *S. mauli*, and larvae of *Scopelosaurus* sp. provisionally called *S.* "sp. II" by them.

The notosudid larvae were reported preliminary as unidentified larvae of Scopelosauridae by Tsukahara et al. (1974) and Ozawa (1974, 1976). These studies were based on fish larvae collection in the sea off southern Japan during 3 cruises of the R/V Hakuhō maru, Ocean Research Institute, University of Tokyo (Ocean Research Institute, 1974a, b, 1976). The comprehensive revision of the Notosudidae by Bertelsen et al. (1976) made it possible to identify Hakuhō maru specimens to species. The well preserved and complete ontogenetic series of most of the represented species furnish some additions to descriptions and give, at the same time, an opportunity to provide a separate account of the notosudid larvae recorded from the waters off Japan. Illustrations, descriptions and key for use in ichthyoplankton studies in this area are provided.

Materials and methods

Three cruises of the R/V Hakuhō maru were made from Feb. 20 to Mar. 27, 1973 (KH-73-2), Nov. 21 to Dec. 18, 1973 (KH-73-5), and Jan. 9 to Feb. 7, 1975 (KH-75-1). On these cruises, zooplankton and micronekton were collected using 5 types of nets (for detailed description of the collections see Ocean Research Institute, 1976). Of the sampling procedures, towing speed alone was maintained to be constant at 1.5 knots. Localities of catch in Fig. 1 are shown regardless of types of nets, depths, times, and numbers of samplings. Almost all of the notosudid collections were used in this study: 305 larvae from KH-73-2, 541 from KH-73-5 and 173 including a metamorphosing larva and a juvenile from KH-75-1. They are deposited in the Laboratory of Fisheries Resources, Faculty of Fisheries, Kagoshima University.

After initial preservation in 10% formalin solution on board, the specimens were later transferred to 70% ethanol. In about 20 specimens, from the smallest to largest of each species, the pigmentation, body proportions and meristic characters were studied in detail under a dissecting microscope.

Eyes are narrow horizontally, so the horizontal axis was measured as eye length. Myomeres were counted in representative samples of each species, but were rather difficult to observe in smaller specimens. Some larvae of more than 25 mm in standard length, at which length all vertebrae are os-

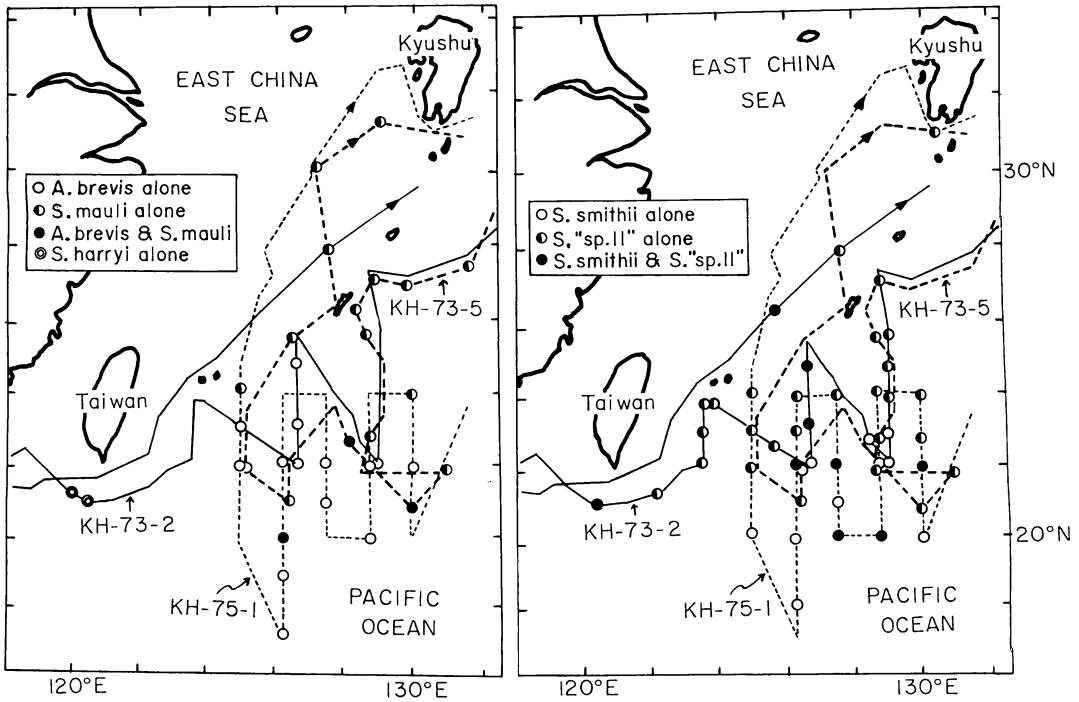

Fig. 1. Cruise tracks of 3 cruises of R/V Hakuhō maru and localities of catch of notosudid larvae.

sified, were stained with alizarin red-S or radiographed. Following Bertelsen et al. (1976) the first preural is not included in the observed number of vertebrae. As the number of myomeres constantly exceeds this vertebral number by two, this addition to the vertebral counts is needed in the comparisons. Gill rakers were counted on the lower branch of the first arch.

Notosudidae Parr, 1928
(as Notosudini, a subfamily of the order Iniomi)
Fude-eso ka: New Japanese name

The larvae of the present collections are allocated to 2 genera and 5 species: *Ahliesaurus brevis*, *Scopelosaurus smithii*, *S. mauli*, *S. harryi* and *S.* "sp. II" of Bertelsen et al. (1976).

The features common to notosudid larvae are described by Bertelsen et al. (1976: 16～18). To those, the shape of corpus cerebelli, with posteriorly protruding wings (Marshall, 1966: fig. 52) (Fig. 6D), may be added, for it seems unique of the family. As stated by Bertelsen et al. (1976), and shown in the key below, the pigment pattern is the only useful distinguishing character in most larvae.

Key to the larval Notosudidae recorded from the waters off Japan

1a A mediolateral series of melanophores on anterior part of body; pre-anus length more than 50% SL (more than 60% in specimens more than 10 mm); 44～48 myomeres ..... *Ahliesaurus brevis*
1b No lateral melanophores on anterior part of body; pre-anus length 35～45% SL; 55～63 myomeres....(*Scopelosaurus*)....2
2a No pigment on tail 3
2b Pigment on tail 4
3a 56～59 myomeres..... *S. hoedti*
3b 60～63 myomeres ..... *S. sp.* (*S.* "sp. II" of Bertelsen et al., 1976)
4a Notochord inflection not yet completed (series of melanophores on base of principal caudal fin rays not developed) 5
4b Notochord inflection completed (a distinct vertical series of melanophores on base of principal caudal fin rays) 6
5a Pigment restricted to posterior part of

caudal peduncle, none on tip of notochord and on caudal finfolds (55～58 myomeres)..... *S. smithii*

5b Pigment on caudal finfolds.....7

6a A dark band of pigment on caudal peduncle at a short distance in front of the vertical series at base of principal caudal rays; a group of melanophores on median part of caudal fin, concentrated in a distinct spot in larger specimens; no melanophores anterior to caudal peduncle 9

6b No band of pigment on caudal peduncle anterior to the vertical series at base of principal caudal fin rays; no distinct median spot on caudal fin; a series of melanophores on procurrent caudal fin rays and finfold behind adipose fin and/or anal fin, anteriormost in larger specimens imbedded between muscles of caudal peduncle; in some specimens pigment on anal fin rays and in the ventral midline or finfold between anus and anal fin.... ..... *S. harryi*

7a Pigment concentrated on dorsal and ventral part of tip of notochord (55～59 myomeres) ..... *S. mauli*

7b Pigment not concentrated along tip of notochord 8

8a Melanophores relatively few (less than about 25), scattered over caudal finfolds and tip of notochord without distinct pattern (60～63 myomeres).... *S.* "sp. II"

8b Melanophores more numerous, on caudal finfolds arranged in lines, anteriorly vertical, posteriorly oblique to nearly horizontal (60～62 myomeres) .... *S. harryi*

9a Band on caudal peduncle consisting of relatively few large melanophores, some large internal below its posterior margin; anterior margin of the band convex .... *S. mauli*

9b Band on caudal peduncle consisting of numerous small melanophores, none internal; anterior margin of the band vertical ..... *S. smithii*

Occurrence and description of the larvae

Ahliesaurus Bertelsen, Krefft and Marshall, 1976

(Type species: *A. berryi* Bertelsen, Krefft and Marshall, 1976)

Fukami fude-eso zoku: New Japanese name

The genus *Ahliesaurus* is easily distinguishable from *Scopelosaurus* in having low numbers of vertebrae (42～50, 53～67 in *Scopelosaurus*) and in the position of the pelvic fins (below or just in front of the dorsal fin origin, distinctively in front in *Scopelosaurus*). The genus contains two species, of which only *A. brevis* has been found north of 15°S in the Indian and Pacific Oceans (Bertelsen et al., 1976).

Ahliesaurus brevis Bertelsen, Krefft and Marshall, 1976

Fukami fude-eso: New Japanese name

In the western Pacific this species has not been reported previously from north of about 15°N (Bertelsen et al., 1976). Within the sampling area of this study it occurred mostly in southern part (Fig. 1). The present material comprises 42 larvae of 8 to 30 mm SL and a metamorphosing larva of 34.2 mm. All characters are in full agreement with the description given by Bertelsen et al. (1976). The main larval features in this study can be summarized as follows.

From the smallest to largest larvae, pigmentation is basically identical (Fig. 2), and the melanophores along the midline of the body and those scattered over the caudal region are typical of the species. Before the completion of the hypural plate (about 10 mm SL) a few melanophores along the upper border of the bending notochord are appreciated (Fig. 2A).

Body parts differ especially in the eye and pre-anus proportions from other notosudid larvae (Fig. 3); eyes 10 to 15% of head length (HL), and pre-anus length 61 to 67% SL (according to Bertelsen et al., (1976), this proportion is less, 50 to 63%, in specimens less than 10 mm). The low number of vertebrae is one of the diagonostic characters of the species. In 15 specimens 45 to 47 myomeres were observed with the following variation: 1 with 45 myomeres, 7 with 46 and 7 with 47; 2 vertebral countings: 1 with 45 and 1 with 46. Thirteen or 14 gill rakers were found in larvae more than 23 mm SL (Fig. 4).

Metamorphosing larva: The material contains a single metamorphosing specimen (34.2

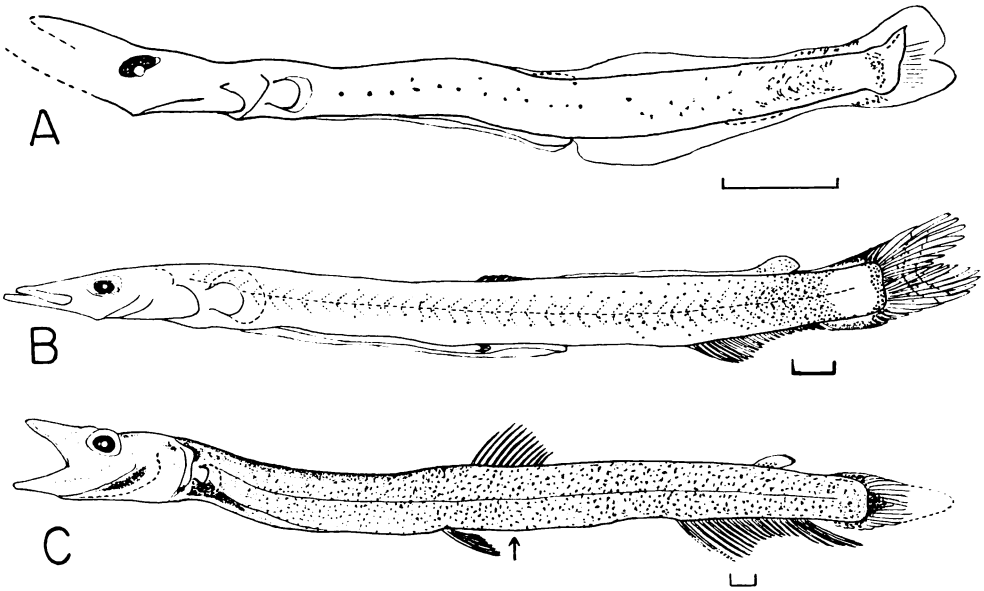

Fig. 2. Larvae of *Ahliesaurus brevis*. A, ca. 8 mm SL; B, 22.0 mm; C, metamorphosing larva, 34.2 mm. Scales indicate 1 mm. Arrow indicates position of anus.

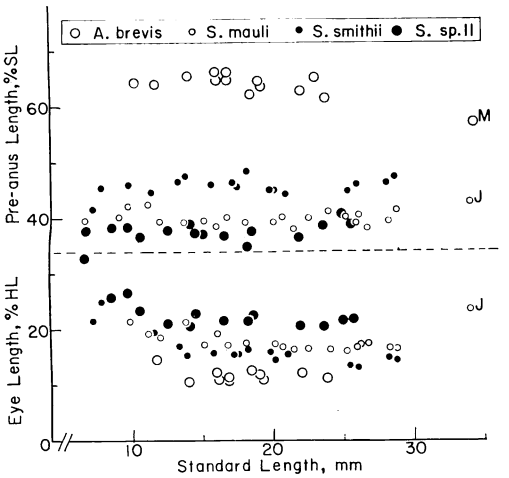

Fig. 3. Proportions of pre-anus length in SL and of eye length in head length (HL) in notosudid larvae. Abbreviations: M, metamorphosing larva; J, juvenile.

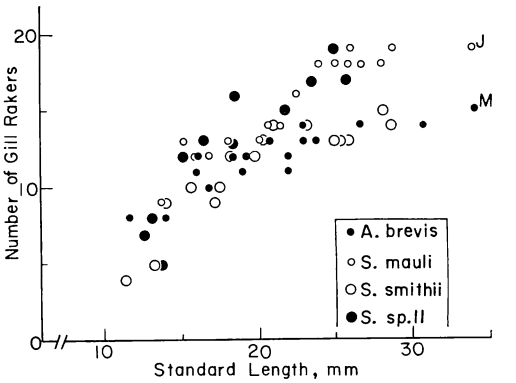

Fig. 4. Development of gill rakers on the lower branch of first arch in larvae of 4 notosudids. Abbreviation as in Fig. 3.

mm SL, Fig. 2C). Body, as well as mouth cavity, uniformly speckled with melanophores; opercle and peritoneum blackish. Head a little damaged and maxilla lost; eyes becoming round and having lost choroid tissue. Pectoral fins still pedunculated, but upper 7 rays differentiated. Pelvics lengthened, their tips reaching anus. The median anal rays shorter than those in front and behind, forming a concave outline of the fin characteristic of the family. Body proportions (in % of SL) nearly as in larvae: snout about 10, body depth 9.8, pelvics 9.8, pre-pelvic 49, pre-dorsal 53, pre-anus 57, and pre-anal 77. Meristic counts: gill rakers on the 1st arch 0+1+15, pyloric caeca 6, dorsal 11 and anal 20.

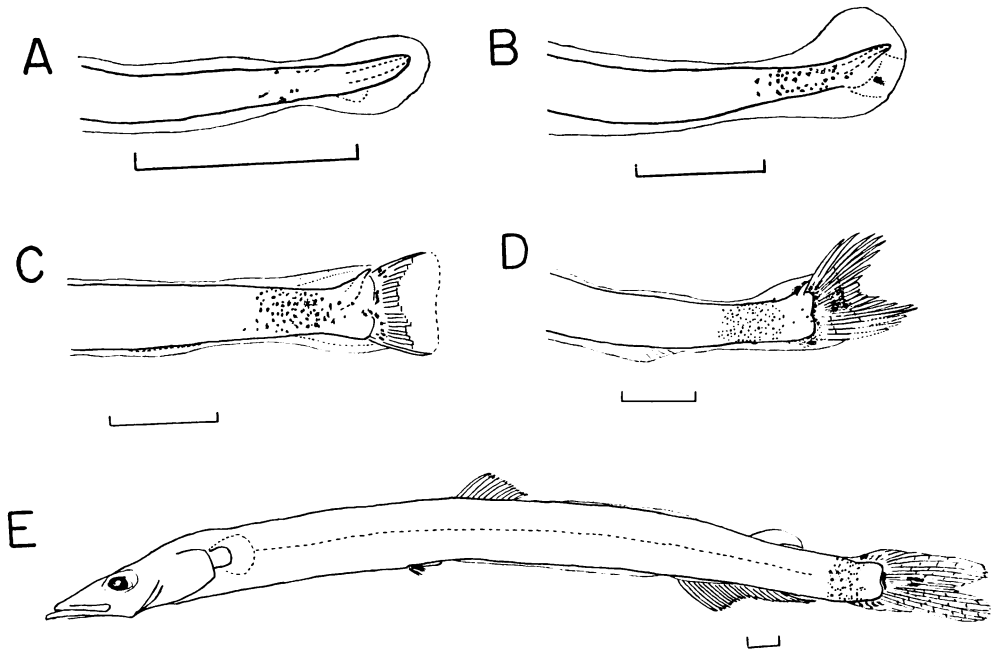

Fig. 5. Larvae of *Scopelosaurus smithii*. From A to D only caudal parts are shown: A, 4.7 mm SL; B, 7.7 mm; C, 9.8 mm; D, 11.4 mm; E, 26.0 mm. Scales indicate 1 mm.

Scopelosaurus Bleeker, 1860
(Type species: *S. hoedti* Bleeker, 1860)
Fude-eso zoku: New Japanese name

Scopelosaurus smithii Bean, 1925
Fude-eso: New Japanese name

The species has been recorded in the tropical and subtropical regions of all oceans, but not previously north of 20°N in the western Pacific (Bertelsen et al., 1976). In this study it was distributed somewhat southwardly (Fig. 1). The present material comprises 61 larvae, 5 to 30 mm SL. The smallest larvae identified by Bertelsen et al. (1976) are 6 mm.

The pigment pattern of the larvae of the present material is in full agreement with that of the larvae from other parts of the Pacific Ocean described by Bertelsen et al. (1976: fig. 29A~E) and differs in the same details as those from the Atlantic specimens (Bertelsen et al., 1976: fig. 29F~I). In larvae less than 6 mm SL, melanophores which are widely set and indistinct are limited to the caudal peduncle in front of the developing hypural plate (Fig. 5A); these melanophores, increasing in number with growth, form the broad band typical of the species. By the completion of notochord inflection, pigments appear along the caudal fin base, on the posterior procurrent caudal rays, and on the median caudal fin rays (Fig. 5B–D). The final pigment pattern can be referred to in the key above and in Fig. 5E.

Throughout the larval stage, the length of the eye in % of HL is the least among the *Scopelosaurus* species here treated; it decreases from about 20 to 15% during early development and remains constant beyond 15 mm SL (Fig. 3). In contrast, pre-anus length has the highest proportion, about 45% of SL, among these species (Fig. 3).

Myomeres 55 to 57 in examination of 13 specimens (1 with 55, 9 with 56 and 3 with 57); 53 (1 specimen) or 54 (3 specimens) vertebrae; gill rakers in 10 specimens of more than 18 mm SL, 13~15 (Fig. 4). These counts are in good agreement with those by Bertelsen et al. (1976).

Scopelosaurus mauli Bertelsen, Krefft and Marshall, 1976
Maoru fude-eso: New Japanese name

Scoqelosaurus mauli has been found in trop-

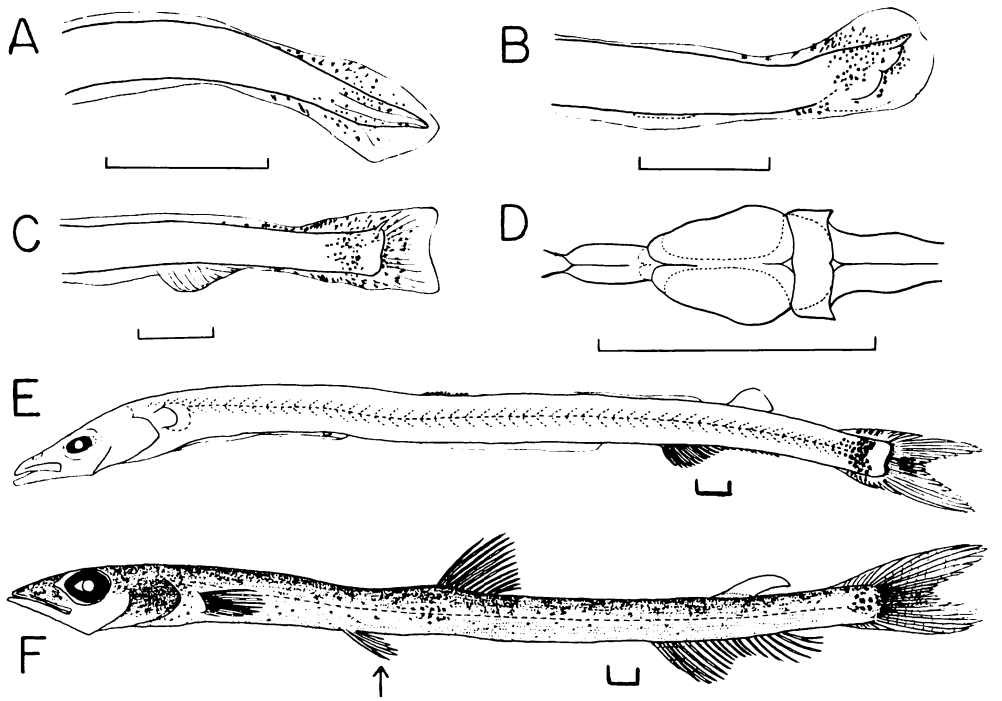

Fig. 6. Larvae (A～E) and juvenile (F) of *Scopelosaurus mauli*. From A to C only caudal parts are shown; A, 6.6 mm SL; B, 9.0 mm; C, 12.0 mm; D, dorsal view of brain of C; E, 26.8 mm; F, 34.0 mm. Scales indicate 1 mm. Arrow indicates position of anus.

ical and subtropical waters in the western parts of the oceans. Bertelsen et al. (1976) reported numerous specimens from the western Atlantic, few from the Indian Ocean and only two from the Pacific, one from north of New Guinea and a single larva from off the Pacific coast of Japan.

A total of 419 larvae, 4～30 mm SL, and one juvenile, 34.0 mm were collected on the cruises here treated. They occurred typically in the northern parts of the study area (Fig. 1). The smallest larvae identified are 5 mm in the material of Bertelsen et al. (1976).

As in *S. smithii*, pigmentation is confined to the caudal peduncle and fin parts throughout the larval stages. The young larvae show 2 groups of dermal melanophores (Fig. 6A): (a) small and densely arranged melanophores around the rear part of the notochord; (b) anterodiagonally expanded melanophores on the larval finfolds of the caudal peduncle, anteriorly large and in a line, posteriorly smaller and scattered. During the notochord inflection (Fig. 6B), a pigment group (c) appears at the base of the developing caudal fin, gradually spreading posteriorly. By the completion of hypural plate (Fig. 6C), a few large internal melanophores (group d) are usually present under the posterior part of the group (a). The final pigment pattern (see the key above and Fig. 6E) differs from that of *S. smithii* in the features of the groups (a) and (d).

Small differences seem present in the features of pigmentation between Atlantic and Pacific specimens. In the Atlantic specimens, the transverse band of pigment (group a) is dominated by two very distinct horizontal short series of large melanophores close to the lateral midline of the caudal peduncle (Bertelsen et al., 1976: fig. 39A～D). This pattern is indistinct or absent in the present material (Fig. 6C, E, F) as well as in the Indo-Pacific specimens described by Bertelsen et al. (1976: fig. 39E, F).

Proportions of eye length and pre-anus length of the larvae (Fig. 3) are intermediate between *S. smithii* and *S.* "sp. II". Myomeres were counted in 15 specimens, 6 of which

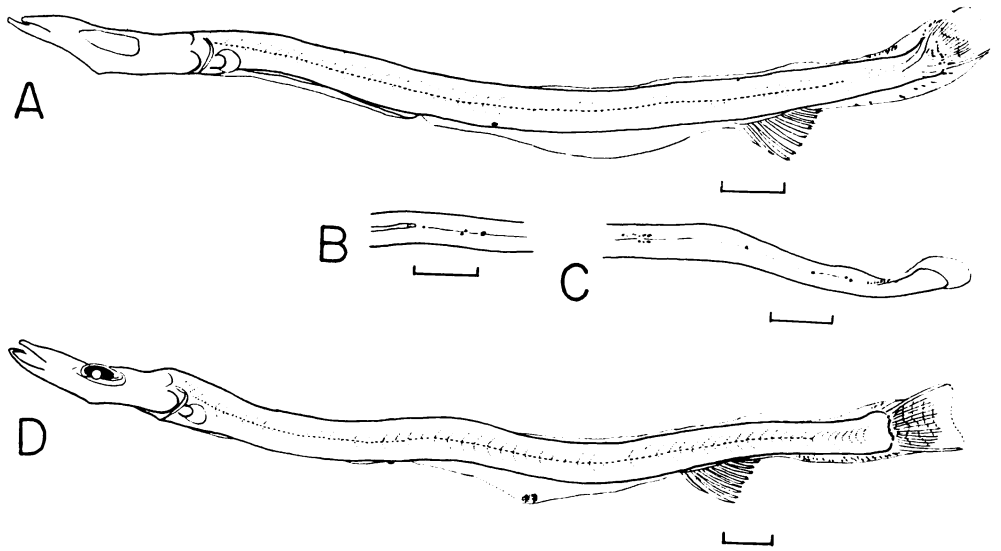

Fig. 7. Larvae of *Scopelosaurus harryi*. A~C, 15.0 mm SL: B, ventral view of the anus region; C, dorsal view of the posterior third of the body. D, 18.9 mm SL. Scales indicate 1 mm.

had 56, 8 had 57 and 1 had 59; in 5 vertebral counting, 3 were 55 and 2 were 56. 18 or 19 gill rakers on the lower branch of the 1st arch in specimens beyond 14 mm SL (Fig. 4).

Juvenile specimen (Fig. 6F): The material contains a single juvenile specimen (34.0 mm SL). Body as well as head covered with pigment, darker dorsally than ventrally; remains of the larval melanophores on caudal peduncle distinguishable; gill covers nearly black, mandible and cheek unpigmented. Eyes of the shape characteristic to metamorphosed specimens of the family; large, egg-shaped, with elliptical pupil, and a prominent lenseless space (aphakic aperture) coupled with a well-formed temporal fovea. Contour of anal fin concave. Meristic characters: gill rakers on the 1st arch 1+1+19; dorsal 11; anal 19; pectoral 13; vertebrae 56.

Scopelosaurus harryi (Mead, 1953)

Harii fude-eso: Changed Japanese name (Ueno (1971) called this species Harii hadaka-eso in Japanese. As the family Paralepididae is "hadaka-eso ka" in Japanese, it seems proper to change the Japanese name of this species.)

Scopelosaurus harryi is mainly a North Pacific species inhabiting a broad belt across the ocean between latitudes of about 20° and 60°N. The few records from the West Pacific include the juvenile holotype (Mead, 1953) and a few larvae from the area here treated (Bertelsen et al., 1976).

Only two larvae, 15.0 and 18.9 mm SL, of the present material can be referred to this species. In both specimens a vertical series of close-set melanophores at the base of caudal fin rays, a series of antero-diagonally expanded melanophores on the anal-caudal finfold and very faint pigment on the tip of the anterior rays of the anal fin are recognized. The 15 mm specimen (Fig. 7A~C) has furthermore i) a series above the tip of the notochord, ii) a series in the finfold behind the adipose fin, iii) in front of this, scattered melanophores along the dorsal midline of the posterior third of the body and iv) melanophores along the ventral midline just behind the anus. The 18.9 mm specimen (Fig. 7D) lacks these additional pigments, except for two melanophores in the midline of the finfold between the anus and anal fin.

Except for the greater anterior extension of the middorsal series of melanophores in the 15 mm specimen, the observed characters fall within the variation described by Bertelsen et al. (1976) in *S. harryi* and the closely related Atlantic species *S. lepidus*. The pig-

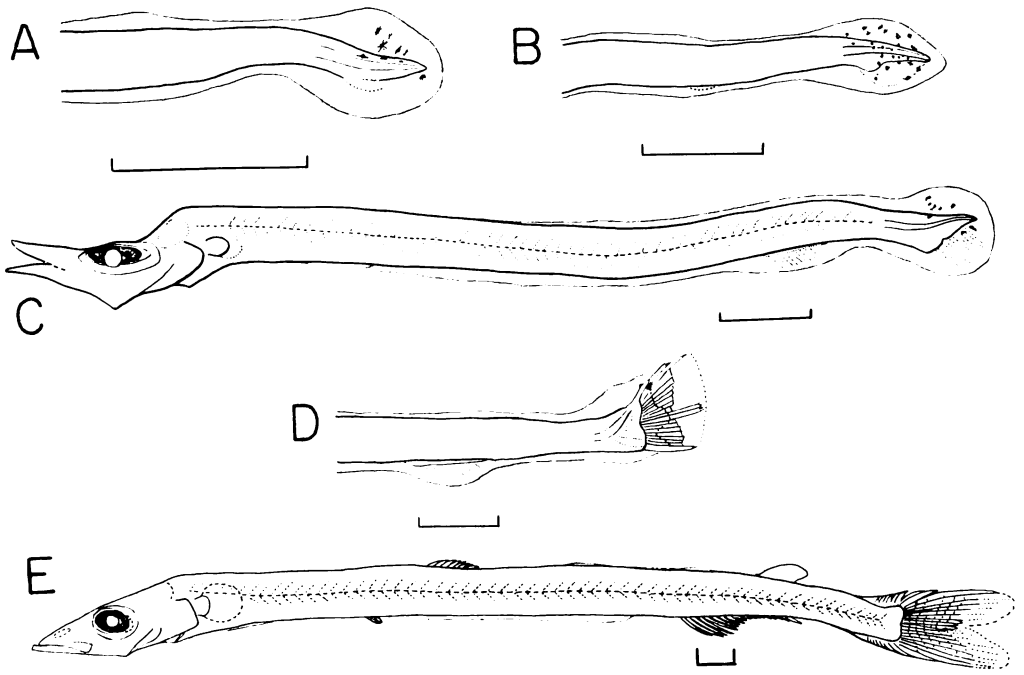

Fig. 8. Larvae of *Scopelosaurus* "sp. II". In A, B and D only caudal parts are shown: A, 6.6 mm SL; B, 8.5 mm; C, 10.5 mm; D, 12.6 mm; E, 24.7 mm. Scales indicate 1 mm.

ment on the anal fin and in the ventral midline in front of the anal fin has been observed in these species of *Scopelosaurus*. As the migration of the mediodorsal and/or medioventral melanophores to an intermediate position between the muscles of the two body halves, characteristic of *S. harryi* and *lepidus*, occurs at lengths of at least 20 mm, this character is not developed in the two small specimens here treated.

Eye length in a 18.9 mm specimen 20.7% HL, in % of horizontal diameter 37.5; preanus length 44.9% SL in a 15 mm specimen and 43.6 in another. Myomeres 62 and 61. The complete number of fin rays and gill rakers are not yet developed.

Scopelosaurus sp. (*S.* "sp. II" of Bertelsen et al., 1976)

This species differs from all other species, except for *S. meadi*, in that it lacks pigmentation and has 57～60 vertebrae and 18～19 gill rakers on the 1st arch. *S. meadi* is widely distributed in all oceans, but only south of about 19°S. Within the present study area, this species was caught most uniformly and densely of all 5 species (Fig. 1). 492 specimens of 3 to 28 mm SL, or about half of the larvae of the present material are allocated to *S.* "sp. II". Since larvae less than 26 mm were not contained in the material of Bertelsen et al. (1976), they are described here for the first time.

In most stages the larvae are completely unpigmented except for the eye, as described by Bertelsen et al. (1976), but it was found that transitory melanophores on the tail are developed during the notochord inflection.

All larvae less than 5 mm SL have no pigment. A few larvae of 5 to 6 mm develop a pigmentation on the upper caudal finfold around the tip of the notochord. In larvae of 6 to 7 mm, the notochord begins to bend, and some melanophores appear in almost all specimens (Fig. 8A). As the inflection proceeds they increase in number and spread both on the finfolds and the tip of the tail (Fig. 8B). However, even when the pigmentation is fully developed, the melanophores are relatively few and confined to the tail region: those on the finfolds are relatively large, and those around the notochord small. At about the

middle stage of the notochord inflection, caudal fin rays start to differentiate, and simultaneously melanophores tend to disappear (Fig. 8C). The pigment has faded away completely in most specimens when the notochord inflection is completed at a length of 12～13 mm; in some specimens in this stage, remains of pigment are still present at the tip of the notochord (Fig. 8D). Throughout the later development, the larvae are completely unpigmented (Fig. 8E).

Proportion of the eye is significantly larger than in the other species here treated (Fig. 3); it decreases from 30 to 20% HL during early growth and remains constant beyond 12 mm SL; vertical diameter of eye in % of the horizontal is about 40 in 10 mm larvae, and increases constantly to about 55 in 25 mm larvae. Pre-anus length is about 35 to 41% SL, constant throughout larval stages, and the least among the species here treated (Fig. 3).

The larvae have the highest number of myomeres (60～63) among the 5 species here treated: of 39 specimens, 3 with 60 myomeres, 18 with 61, 12 with 62 and 6 with 63; all vertebrae, ossified only in the largest 28 mm specimen, 59. Definite rays of dorsal and anal fin in larvae more than about 24 and 22 mm SL, respectively; of these, 3 had 11 dorsal rays; 2 had 17 anal rays and 3 had 18. Gill rakers on the lower branch of the 1st arch seem definite, 17 to 19, beyond 23 mm SL.

Remarks: The observed characters seem in quite good agreement with those given for "sp. II" by Bertelsen et al. (1976). They found 57～60 vertebrae in 5 specimens, corresponding to 59～62 myomeres (here 60～63 in 50 specimens), 18～19 gill rakers on the 1st arch in 5 specimens (here 17～19 in 4 specimens) and the same length of head (17～20% SL). The only major difference is in the shape of the eye which, in the specimens examined by Bertelsen et al. (1976), had a vertical diameter of more than 70% of the horizontal in the specimens of 26～43.5 mm (here increasing from 40% at 10 mm to 55% at 25 mm). However, besides the change with age, this shape may be dependent on the condition of preservation.

As the pigmentation observed in specimens of about 6 to 13 mm was absent in some specimens of this size, and furthermore, when present very similar to that of *S. harryi* of a similar size, the myomere counts of the pigmented larvae were compared with those of the unpigmented of similar and larger sizes (Table 1). Because of the difficulty in counting those of the smallest larvae, only specimens of above 8 mm are included. As can be seen, the myomere numbers of the pigmented larvae are in complete agreement with those of the unpigmented ones, and slightly larger than those observed by Bertelsen et al. (1976) in 19 specimens of *S. harryi* (58～60, average 59.1 vertebrae, corresponding to 60～62, av. 61.1 myomeres). This shows that the observed pigmentation is transitory and that the specimens represent "sp. II".

Table 1. Myomere counts of pigmented and unpigmented *Scopelosaurus* "sp. II" larvae at different developmental stages.

Pigment	Notochord bending	SL (mm)	n	Range	Average
present	incomplete	8.8～12.0	9	61～63	62.0
absent	incomplete	9.5～12.2	6	60～63	61.7
absent	completed	13.7～15.7	5	61～63	61.8
absent	completed	16.3～25.7	9	61, 62	61.3

The large material of *S.* "sp. II" larvae now available confirms the existence of a separate Northwest Pacific species of *Scopelosaurus*. However, giving a valid name and taxonomic position to this species should be postponed until metamorphosed specimens are available.

Scopelosaurus hoedti Bleeker, 1860
Hikari fude-eso: New Japanese name

Nothing indicates that specimens of the only other species with unpigmented larvae known from the northern Pacific, *S. hoedti*, are absent in the material at hand. According to Bertelsen et al. (1976), this Indo-Pacific species is found most numerously in the tropical waters between 20°N and 20°S, but their records include some larvae from the area here treated. However, the larvae are clearly distinguishable from *S.* "sp. II" in having lower numbers of myomeres (54～57 vertebrae or 56～59 myomeres). As they lack transitional pigmentation, they could be expected to be present among the unpigmented

9.5～12.2 mm larvae with a bending notochord, treated in Table 1, but, as shown, their myomere numbers are in full agreement with those of the other *S.* "sp. II". The reason for this absence of *S. hoedti* in the present material is uncertain but might be due to the time of collection as related to spawning season, and/or the fact that, according to Bertelsen et al. (1976), the larvae of *S. hoedti* tend to inhabit greater depths (mainly 50～100 m) than those of most other species (*A. brevis*, *S. smithii* and *S. mauli* mainly in 0～50 m).

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日本南方外洋域における Notosudidae フデエソ科(新称)の仔魚

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日本南方外洋域から採集されたフデエソ科仔魚標本において，以下の2属と5種を認め，形態的特徴を記載した：*Ahliesaurus brevis* フカミフデエソ属フカミフデエソ(新称)，*Scopelosaurus smithii* フデエソ属フデエソ(新称)，*S. mauli* マオルフデエソ(新称)，*S. harryi* ハリーフデエソ(改称) および *S.* "sp. II". 最後者は種名を与えられていないので和名を命名しなかった．なお，tropical Indo-Pacific な種である *S. hoedti* をヒカリフデエソと新称した．仔魚の形態的特徴は Bertelsen et al. (1976) の記載に一致した．そして彼らの記載にいくつかの補足，特に 25 mm 以上の仔魚のみ知られていた *S.* "sp. II" の早期仔魚について，を加えた．脊索後端の屈曲時に仔魚色素の変化が示された．日本近海から記録されたフデエソ科仔魚の検索を作成した．

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