

## Early development of the fishes of the family Gempylidae

### I. Larvae and juveniles of escolar, *Lepidocybium flavobrunneum* (SMITH)

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#### Abstract

Meristic and morphological features of a total of 22 postlarval and juvenile specimens (3.0 - 33.0 mm standard length, SL) referable to the escolar, *Lepidocybium flavobrunneum* (SMITH) of the family Gempylidae were described. They were obtained from ichthyoplankton collections from the western equatorial Pacific and the central South and eastern Indian Oceans.

The postlarval and juvenile escolar are characterized by the 2 spiny projections on the supraoccipital region and the spine on the anterior tip of maxillary. The curved striation seen on the top of head, the heavily pigmented abdominal cavity and the black pigments in the spinous dorsal fin membrane are also important characters which may distinguish them from larval forms of the related species.

The larval and juvenile escolar mainly occur in the tropical and subtropical seas, while the range of adult catches extends roughly between Lat. 40°N and 40°S along the coasts of the continents. Their occurrence is in general limited to areas rather close to oceanic islands and large islands. It is, therefore, suggested that most of their spawning takes place in near-shore areas, not far out into the oceanic region.

#### Introduction

The escolar, *L. flavobrunneum*, is a member of the family Gempylidae and is considered as a littoral deep-water species (PARIN, 1967). Ranging from the tropical to the temperate seas, it sometimes occurs in the tuna longline catch in various localities (KISHINOUE, 1926; MYERS, 1932; KAMOHARA, 1938; SHULTZ and SPRINGER, 1956; MATSUBARA and IWAI, 1958; BARTLETT and BACKUS, 1962; MERRETT, 1968; FOURMANOIR, 1970;

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MAKSIMOV, 1970; PAULIN and HABIB, 1980). With recently developed deep longlining, the escolar is taken more frequently in Japanese water and even a target fish for small scale home-based vessels (WARASHINA, personal comm.).

Brief descriptions of the larval escolar have been given by FOURMANOIR (1970) who examined a specimen 33 mm SL from the central South Pacific through the mid-water trawl survey, and by GORBUNOVA (1977) who identified 3 specimens 7.6–39 mm SL from the western tropical Pacific. However, our understanding on the early life history still remains incomplete, and the revisional work on its larval identification is highly needed.

This paper describes a series of the developmental change of the postlarval and juvenile forms referable to *L. flavobrunneum*, obtained from the Papua New Guinea waters, the eastern seas of the Philippines and the central South and eastern Indian Oceans. The geographical distribution of the larvae is also presented.

### Materials and methods

Two sources were available to obtain the specimens: 1) the Japanese Fisheries Agency R/V Shoyo Maru in the 1973, 1979 and 1981 cruises which provided the majority, and 2) local government training vessels, Tosakaiken Maru and Aomori Maru in the 1960 and 1979 cruises for additional materials (Table 1).

**Table 1.** Capture records of the larval *L. flavobrunneum* collected by larva-net tows.

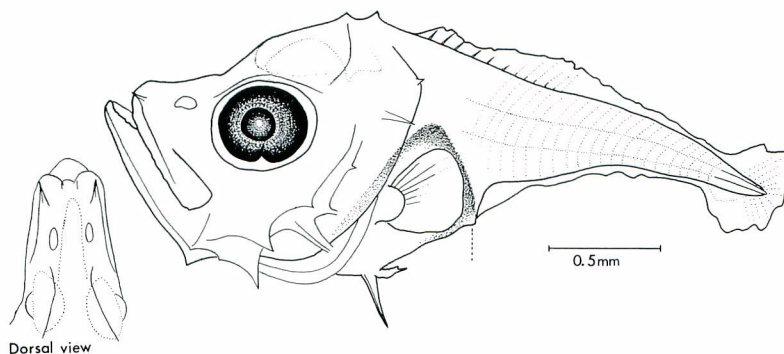
Date	Time	Methods of towing	Locality		No. of specimens	Size range (mm in SL)	Vessels
			Lat.	Long.			
1960 Jun. 9	00:47–00:52	S	27°47' S	78°20' E	2	31.0, 33.0	Tosakaiken Maru
1973 Oct. 21	18:58–19:18	Sb	12°58'5" S	144°53'5" E	4	4.6–5.7	Shoyo Maru
1973 Oct. 22	15:32–15:52	Sb	13°00'0" S	148°01'5" E	6	4.7–6.6	Shoyo Maru
1979 Jan. 19	20:19–20:39	Sb	16°22'0" S	117°22'9" E	8	3.0–3.7	Shoyo Maru
1979 Sep. 27	13:18–13:38	S	16°00' N	132°14' E	1	16.0	Aomori Maru
1981 Jan. 2	07:52–08:12	Sb	3°43'0" N	156°17'0" E	1	8.0	Shoyo Maru

S: Horizontal surface tow. Sb: Horizontal subsurface tow.

The conical net of two sizes, 2 m and 1.4 m in diameter, was used. All specimens were collected through the surface and subsurface (about 20–40 m) horizontal tows with the average vessel speed of 2.5 knots for 15 and 20 minutes.

Collections were first preserved in 10% formalin for sorting ashore. Larval fish





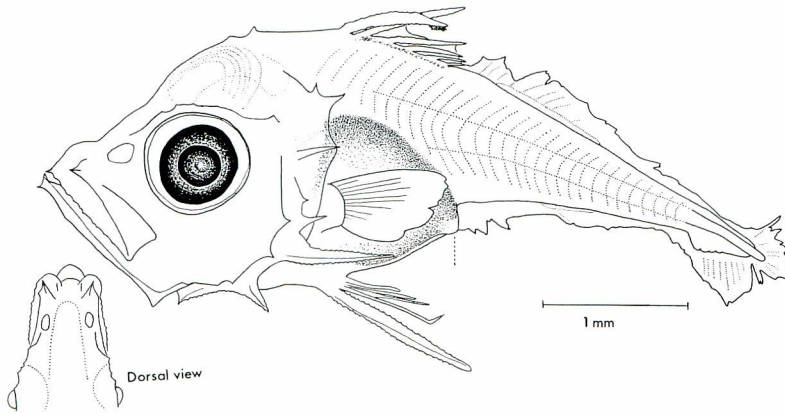
**Fig. 1.** Specimen No.1, postlarva 3.1 mm in standard length.

extending to below front edge of eye. Eye large, horizontal diameter of orbit a little larger than snout length. As shown in Fig. 1, 2 characteristic spiny projections seen on the supraoccipital region and a spine on the anterior tip of maxillary. Supraorbital crest feeble. A faint and very small granule-like pattern on the top of head. A spine on pterotic region. Hind margin of preopercle with 2 rows of spines; two spines in the inner row and 5 in the outer. A feeble spine on opercle. Nostril single, oval in shape. Abdominal cavity triangular in shape. Anus located slightly posterior to middle of body. Six dorsal spines discernible. Pelvic fin poorly developed with a short spine and rudimentary rays. Larval fin fold continuous from anus to dorsal fin through caudal fin. Notochord straight. About 21 myomeres discernible.

Very few pigments on body and head except for eye. Abdominal cavity densely pigmented.

2. Specimen No. 2, postlarva 4.9 mm SL (Fig. 2)

Snout rather short, its front edge square-built in shape as seen in slender tuna larvae in Scombridae (WATANABE *et al.*, 1966). Brain cavity rather broad. Supraorbital crest distinct with 3 spines. The minute granule-like pattern and curved striation faintly seen on the top of head. Three enlarged spines on lower hind margin of preopercle bearing numerous serrations on outer edge. A spine at lower angle of preopercle much larger than others, exceeding diameter of orbit and ending halfway between pelvic fin origin and anus. Pterotic region armed with 2 spines. A single row of small teeth on both jaws. Six relatively strong and serrated dorsal spines counted. Pelvic fin well developed with a long serrated spine followed by 5 soft rays. Length of pelvic spine about twice as long as postorbital length. Few rudimentary hypural bones visible. About 29 myomeres counted.



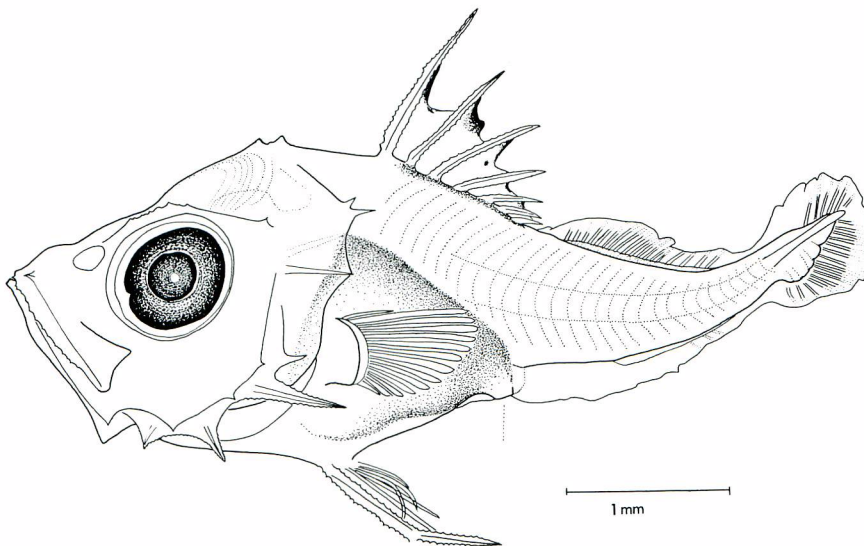
**Fig. 2.** Specimen No.2, postlarva 4.9 mm in standard length.

A few black pigments scattered in row along spinous dorsal fin base. Black pigments newly appearing on distal part of spinous dorsal fin membrane.

3. Specimen No.3, postlarva 5.4 mm SL (Fig. 3)

General shape of body resembling preceding specimen. A spine on anterior tip of maxillary distinct. Nostril of a large single pore situated nearer to eye than to tip of snout. Larval fin fold still persisting. About 21 caudal rays discernible.

Black pigments on abdominal cavity noticeable.



**Fig. 3.** Specimen No. 3, postlarva 5.4 mm in standard length.

## 4. Specimen No. 4, postlarva 5.7 mm SL (Fig. 4)

About 20 soft dorsal and 10 anal rays counted. Last several rays of soft dorsal fin slightly widely spaced from preceding ones, showing a sign of finlets though still connected with membrane. Nine dorsal spines counted. Caudal fin more developed with 17 principal rays. Tip of notochord upturned completely. Anus shifting slightly backward and abdominal cavity more elongate.

Body pigmentation remaining nearly unchanged except for dorsal part where pigments spread more anteriorly to just behind supraoccipital region.

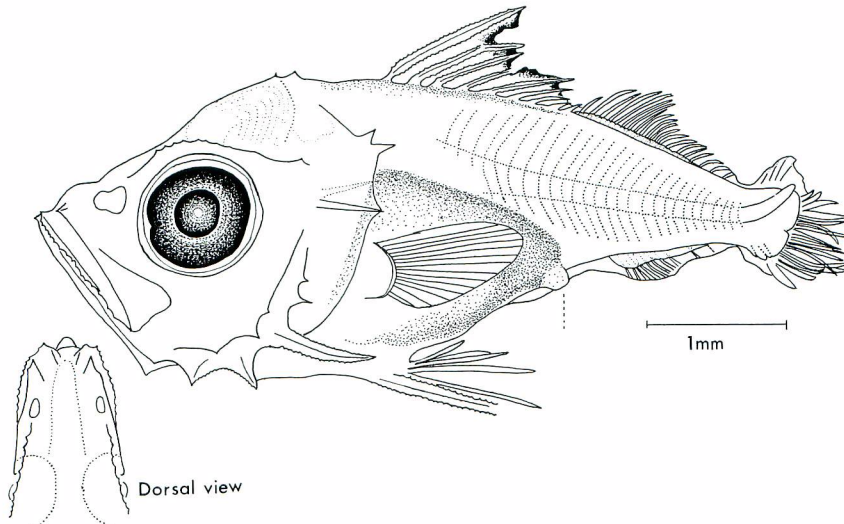


Fig. 4. Specimen No. 4, postlarva 5.7 mm in standard length.

## 5. Specimen No. 5, postlarva 6.6 mm SL (Fig. 5)

Head and trunk still fairly large and deep. Caudal short and tapering sharply. Fins more developed with 22 soft dorsal, 17 anal and 15 pectoral rays discernible. Two rudimentary anal spines recognized. Pelvic fin I,5 and inner most soft ray attached to abdomen by basal membrane. Longest preopercular spine slightly reduced in size, its tip falling a little short of pelvic origin.

Black pigments on dorsal part spreading more posteriorly. Black pigments on spinous dorsal fin membrane more concentrated.

## 6. Specimen No. 6, early juvenile 16.0 mm SL (Fig. 6)

Body slender. Head length nearly as long as distance from tip of snout to dorsal fin origin. Interorbital region nearly flat. Armatures on head relatively reduced in size.

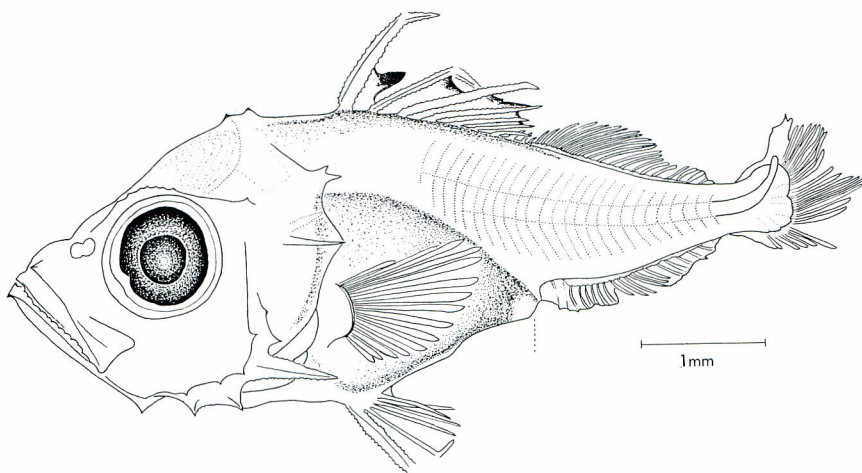


Fig. 5. Specimen No. 5, postlarva 6.6 mm in standard length.

Two spiny projections on the supraoccipital region and a spine on the anterior tip of maxillary still visible. The curved striation on the top of head unrecognizable in this stage. Nostril divided already into two apertures. Dorsal fin having 11 serrated spines and about 18 soft rays followed by 5 finlet-like rays. Anal fin originating slightly behind the level of 1st soft dorsal ray and preceded by 2 smooth edged spines. Second anal spine about twice as long as first one. Anal fin also followed by 4 finlet-like rays. Pectoral fin rather long, extending to below 7th dorsal spine. Principal caudal rays 9 + 8. In this specimen, serrated pelvic spine damaged, but still fairly developed.

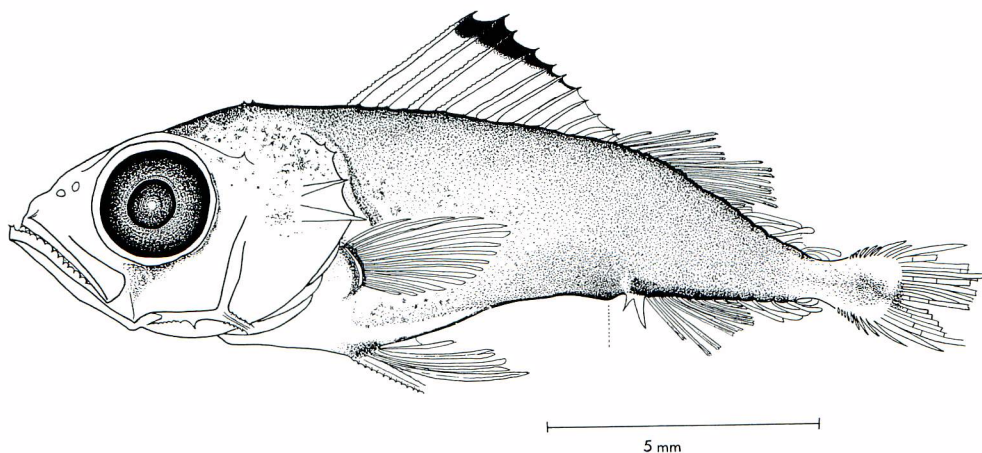


Fig. 6. Specimen No. 6, early juvenile 16.0 mm in standard length.

Pigmentation on bases of dorsal, anal and pectoral fins and on pelvic fin origin denser than other parts. Top of head heavily pigmented, but no pigments on forebrain. A round pigment patch on caudal peduncle extending onto caudal rays. Additional pigments appearing along hind margin of orbit and on infraorbital and postorbital regions. Distal part of fin membranes for first 7 dorsal spines heavily pigmented. No pigments on lower part of opercle, anterior portion of abdomen, and on snout and lower jaw.

7. Specimen No. 7, juvenile 33.0 mm SL (Fig. 7)

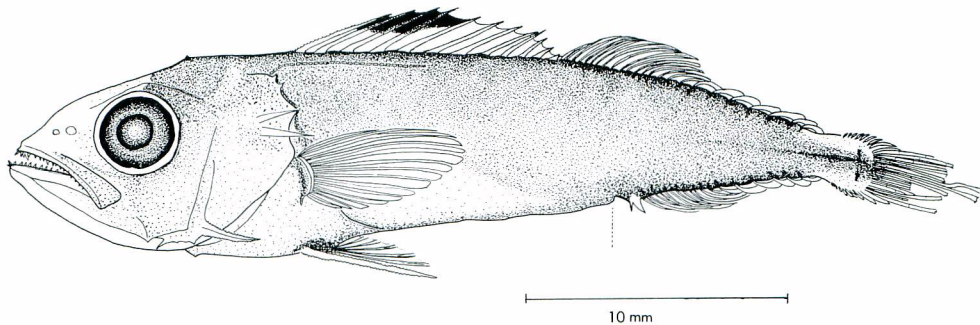


Fig. 7. Specimen No. 7, juvenile 33.0 mm in standard length.

Body more slender than preceding specimen. Armatures on head reduced in size. Spine on the anterior tip of maxillary already unrecognizable. Spiny projections on the supraoccipital region vestigial. Two fangs on each side of upper jaw near tip of snout. A pair of curved canine teeth on tip of upper and lower jaws. A single row of irregular sized canine teeth on lateral side of both jaw; those on lower jaw slightly larger than those on upper one. Vomer and palatine furnished with a row of canine teeth. Dorsal fin rays XII,24; anal fin rays II,19; posterior 5 of dorsal and 4 of anal fin rays more widely spaced than in preceding ones so as to just form finlets, although still connected by membrane (Fig. 8). Dorsal and pelvic spines still having serrations on outer edge. Only

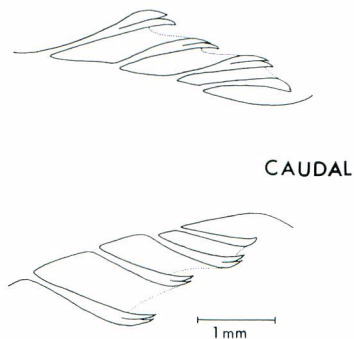


Fig. 8. Outline of dorsal and anal finlets of juvenile *L. flavobrunneum* (33 mm SL).



front part of lateral line recognized. Lateral line starting at upper corner of gill opening and passing along and near spinous dorsal fin base. Vertebral count  $16 + 15 = 31$ .

A conspicuous pigment row on mid-lateral portion of caudal peduncle. No pigments still on tip of snout and lower jaw.

### Identification

Specimens used in this study are divided into the two size groups: postlarvae 3.0-8.0 mm SL and early juvenile and juveniles 16.0-33.0 mm SL. They have the well developed and serrated dorsal and pelvic spines, the preopercular spination and the general body appearance characteristic of the larval gempylids, as indicated by Voss (1954).

The juvenile specimens larger than 16 mm SL have the number of fin rays, spines and vertebrae that corresponds to the full adult complement of *L. flavobrunneum*. They have, in addition, the dorsal and anal finlets and also the fewer dorsal spines than many species of the Gempylidae. The following 10 species of this family have the dorsal and anal finlets: *L. flavobrunneum*, *Ruvettus pretiosus* COCCO, *Thyrsitops lepidopoides* CUVIER, *Thyrsites atun* EUPHRASEN, *Rexea prometheoides* (BLEEKER), *Rexea solandri* (CUVIER), *Promethichthys prometheus* (CUVIER), *Nealotus tripes* JOHNSON, *Nesiarchus nasutus* JOHNSON, and *Gempylus serpens* CUVIER (KAMOHARA, 1938; MATSUBARA and IWAI, 1952; GREY, 1953; MATSUBARA and IWAI, 1958; PARIN and BEKKER, 1972; NAKAMURA, 1977). Of these, the first two, *L. flavobrunneum* and the oilfish, *R. pretiosus*, have the fewer dorsal spines than the remaining group, and differ from each other in having the keel on the caudal peduncle or scaly keel on the belly. The present juvenile specimens do not develop the keel as yet but already attain to the full adult complement in the meristic characters. They have 9-12 dorsal spines (13-15 in *Ruvettus*), 4-5 dorsal and anal finlets (2 in *Ruvettus*) and  $16 + 15$  vertebrae ( $16 + 16$  in *Ruvettus*).

In the postlarval specimens smaller than 8 mm SL, the number of fin rays, spines and vertebrae does not deserve specific characters. They are, however, distinguished from the following larval gempylids previously reported, in having the characteristic spiny projections on the supraoccipital region and the spine on the anterior tip of maxillary which can be traced back from the early juvenile to postlarval stages: *Neopinnula orientalis*, *T. atun*, *R. prometheoides*, *P. prometheus*, *N. tripes*, *N. nasutus*, *G. serpens*, and *D. multistriatus* (VOSS, 1954; STRASBURG, 1964; YEVSEYENKO and SEREBRYAKOV, 1974; GORBUNOVA, 1977; NAKAMURA and PAXTON, 1977; NISHIKAWA and NAKAMURA, 1978; ROBERTSON and MITO, 1979).

Individuals of these two size groups have in each other the nearly equal number of vertebrae or myomeres as well as a continuous developmental change in the external appearance and body pigmentation. These observations lead me to a conclusion that they are all referable to *L. flavobrunneum*.

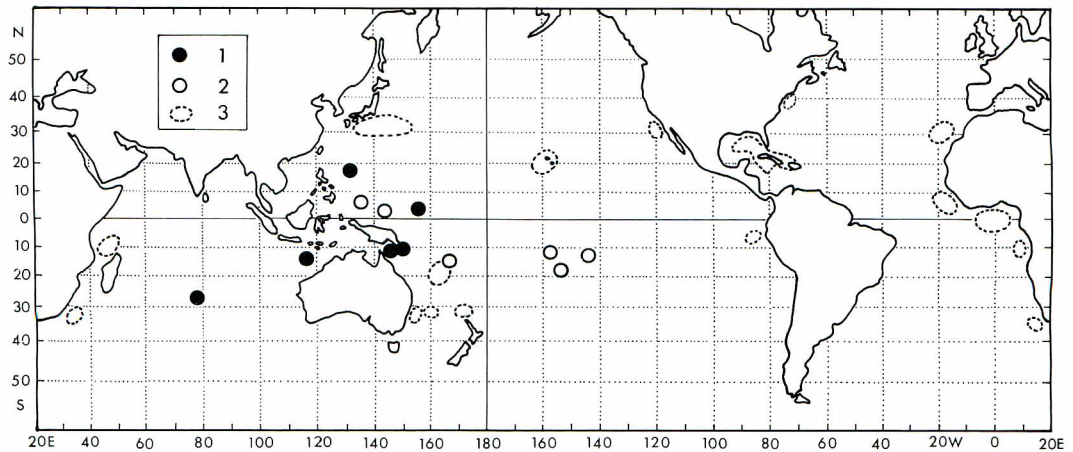
Among a number of morphological characters examined for the larval specimens, the spiny projections on the supraoccipital region and the spine on the anterior tip of maxillary are possibly the two most outstanding features in the early stage of this species. These have never been discussed for other larval gempylids previously. The descriptions FOURMANOIR (1970) and GORBUNOVA (1977) gave to their larval and juvenile specimens do not refer to these characters. The spine on the anterior tip of maxillary, according to my observation, is also seen in some species of this family, but not so noticeable as in larval escolar.

A similar spiny projection on the supraoccipital region is reported by SHA *et al.* (1966) and WOLLAM (1970) for the scomberomorphs such as *Scomberomorus niphonius* (CUVIER and VALENCIENNES), *S. cavalla* (CUVIER) and *S. maculatus* (MITCHILL), member of the Scombridae, the related family of the Gempylidae.

### Occurrence and distribution of escolar

The adult escolar occur incidentally in the catches of the tuna longline and other coastal fisheries (SMITH, 1849; WAITE, 1903; KISHINOUE, 1926; MYERS, 1932; KAMOHARA, 1938; MUNRO, 1949; SHULTZ and SPRINGER, 1956; MATSUBARA and IWAI, 1958; BARTLETT and BACKUS, 1962; KURODA, 1963; LEIM and SCOTT, 1966; MERRETT, 1968; FOURMANOIR, 1970; MAKSIMOV, 1970; FITCH and SCHULTZ, 1978; PAULIN and HABIB, 1980). Fig. 9 shows the locations of capture of larvae and the general range of the adult catches, including the present specimens and those from the literatures.

The adult escolar are caught in the tropical and temperate waters roughly between Lat. 40°N and 40°S in the world oceans. Their range, however, is limited to the coastal areas, not reported to occur in the off-shore pelagic waters. The larval and juvenile escolar are obtained in the tropical and subtropical areas. The 22 larval and juvenile specimens herein examined have been taken in areas where the surface water temperatures range from 26.9° to 29.2°C. All have occurred close to islands scattering in the tropical Indo-western Pacific, except for 2 juvenile specimens (31.0 and 33.0 mm SL) from a single tow conducted in the mid oceanic region of the central South Indian Ocean. As a whole, therefore, it seems that the spawning of the escolar mostly takes place in



**Fig. 9.** Locations of capture of *L. flavobrunneum*. 1; Present specimens examined. 2, Larval specimens in literatures. 3. Adult specimens in literatures.

the vicinity of oceanic islands or the coasts of large islands.

Of 22 specimens examined, all postlarvae were taken from subsurface collections and all juveniles from surface collections (Table 1). These results may suggest the different vertical distribution of larvae and juveniles.

### Acknowledgements

I thank crew of the R/V Shoyo Maru and of the local government vessels for obtaining materials and data used in this study. I also thank Drs. S. KIKAWA, S. UEYANAGI and I. IKEDA of Far Seas Fisheries Research Laboratory, and Dr. M. OKIYAMA of Ocean Research Institute, University of Tokyo, for their valuable suggestions and critical reading of the manuscript. Mr. M. KATO translated Russian papers, and Dr. N. OKUMOTO and Mrs. C. NISHIKAWA made some literatures available, who helped me a great deal. I wish to thank Mrs. M. HARUTA and Mrs. S. SAWAIRI for sorting collections and assistance.

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## クロタチカマス科魚類の初期生活史

I. アブラソコムツ *Lepidocybium flavobrunneum*  
(SMITH) の後期仔魚および稚魚

西 川 康 夫

## 摘 要

水産庁調査船および地方公庁船のマグロ稚仔調査により採集されたクロタチカマス科の仔稚魚について、各形質の特徴および成長に伴う形態変化を検討した。その結果、西部太平洋の赤道付近と中部インド洋から得られた 22 個体がアブラソコムツ, *L. flavobrunneum* と同定された。

本種の仔稚魚は上後頭骨部に 2 個の棘状突起と主上顎骨の先端部に 1 棘がある点で従来報告されているクロタチカマス科の他種の幼、稚仔から容易に識別される。更に、本種の後期仔魚には頭頂部に特徴的な **striation**、腹腔部および背鱗棘条部には発達した黒色素胞の分布がみとめられる。これらの特徴も本種の仔魚期および稚魚期の識別形質として重要である。

アブラソコムツ稚仔の採集域は 1 例を除いていずれも大陸の沿岸あるいは島嶼周辺水域であった。仔稚魚の採集状況ならびに成魚の分布状態からみて本種の主産卵域は熱帯および亜熱帯水域の大陸沿岸や島嶼周辺水域と考えられる。