EARLY STAGES OF MARINE FISHES

IN SOUTHEAST ASIAN REGION

SOUTHEAST ASIAN FISHERIES DEVELOPMENT CENTER

TD/TRB/81

Early Stages of Marine Fishes in Southeast Asian Region

Yoshinobu Konishi

Rangsan Chayakul

Chongkolnee Chamchan

Teerapong Duangdee

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FOREWORD

Contributions of ichthyoplankton researchers in SEAFDEC Member Countries to a series of the regional training workshops on "Larval Fish Identification and Fish Early Life History" co-organized by UNEP/GEF/SCS and SEAFDEC Training Department in 2007 and 2008 are the major sources for development of this book. We realize that one of challenges in ichthyoplankton research in this region is the lack of fish larvae identification guidebook for Southeast Asian waters. During the workshops, we needed to resort to reference books from Australia waters, Japan waters, Western and Central Pacific, California current region and other sources. However, it was found that there are number of ichthyoplankton researchers in this region that published their study in the forms of thesis, proceeding as well as identification book in languages other than English. It is my hope that the compilation of this book will encourage the study of ichthyoplankton research in this region.

On behalf of SEAFDEC, I wish to express my appreciation to authors and contributors that worked very hard to compile and edit this book. I would like also to express my appreciation to the Japanese Trust Fund for the support to publishing of this book.

Dr. Chumnarn Pongsri

Secretary-General

SEAFDEC

PREFACE

The production of marine capture fisheries in the Southeast Asian region in 2007 was 12.4 million tons occupying 19% of the world production. Apparently, the fisheries including its processing products have been a very important food industry in the region. The fisheries industry have also ensured people employment and given the benefit of foreign currency through export of captured fishes and their processing products. Marine capture fisheries production in the region has been yielded largely from the coastal sea areas where nowadays the fisheries resources are evidently depleted. For policy making of the fisheries management to sustain the resources and production, biological information of targeted fishes, namely the spawning area and season, the nursery ground and the recruitment and migration patterns, is indispensable.

In 2007 and 2008, the UNEP/GEF/SCS and SEAFDEC Training Department jointly organized "The Regional Training Workshop on Larval Fish Identification and Fish Early Life History Science" with attendance of young scientists and researchers from the ASEAN-SEAFDEC member countries to facilitate their future research activities on fisheries development and management. In the first workshop from 16 to 31 May 2007, twenty-four participants learned basic knowledge on sampling and identification of fish larvae, and actually identified assigned specimens of larval fishes in family level. The second workshop from 27 May to 14 June 2008 was attended by seventeen participants most of who were same persons in 2007. Each of participants was obliged to provide the workshop with their own larval fish specimens identified by themselves in family level. Each one chose the responsible families and identified larvae of the families including specimens from other participants in lower taxa. They also measured body parts of the larvae, counted fin rays and myomeres, took photos, and illustrated the larvae to present results of their assigned work in last day of the workshop. This monograph was published as the outcome of the two regional training workshops.

We sincerely hope that this monograph will help research activities on deep-sea demersal fisheries exploitation as well as on coastal fisheries resources in the region.

Yoshinobu Konishi
Rangsan Chayakul
Chongkolnee Chamchang
Teerapong Duangdee

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AUTHORS

Dr. Yoshinobu Konishi
Seikai National Fisheries Research Institute
Fisheries Research Agency
1551-8, Taira-machi, Nagasaki-shi, Nagasaki 851–2213, Japan
E-mail: ykoni21080@gmail.com

Mr. Rangsan Chayakul
Department of Fisheries
Kasetsart Campus, Jatuchak, Bangkok 10900, Thailand
E-mail: rangsanch@yahoo.com

Dr. Chongkolnee Chamchang
Department of Fisheries
Kasetsart Campus, Jatuchak, Bangkok 10900, Thailand
E-mail: chamchang@yahoo.com

Mr. Teerapong Duangdee
Department of Marine Science
Faculty of Fisheries, Kasetsart University, Bangkok, 10903, Thailand
E-mail: t.duangdee@gmail.com

EDITORIAL BOARD

Ms. Nawinee Khumthong
Training Department
Southeast Asian Fisheries Development Center
Phrasamutchedi, Samut Prakan, 10290, Thailand
E-mail: nawinee@seafdec.org

CONTRIBUTORS

Mr. Ky Vannarith
Chaktomuk Fisheries Administration
N. 268D, National Road 5, Svay Park, Khan Russey Keo, Phnom Penh, Cambodia
E-mail: kyvannarith@yahoo.com

Dr. Chea Tharith
Inland Fisheries Research and Development Institute
Fisheries Administration
186 Norodom Blvd., Khan Chamcar Morn, P.O. Box 582 Phnom Penh, Cambodia
E- mail: cheatharit@yahoo.com, IFRIC@online.com.kh

Ms. Sasanti Retno Suharti
Research Center for Oceanography
Indonesian Institute of Sciences
Jalan Pasir Putih I, Ancol Timur 14430 Jakarta, Indonesia
E-mail: santi_rs02@yahoo.com

Mr. Edwison Setya Firmana
Directory of Fisheries Resources
Department of Marine and Fisheries
Kantor Pusat, Jl. Harsono RM No. 3 Jakarta, Selatan-12550, Indonesia
E-mail: ikanmalang@yahoo.com , edwisonsf@gmail.com

Mr. Zulkifli bin Talib
Aquatic Ecosystem Research Centre
Department of Fisheries
Kompleks Perikanan Kg. Acheh, 32000 Sitiawan, Perak, Malaysia

Mr. Abd. Haris Hilmi bin Ahmad Arshad
Aquatic Ecosystem Research Centre
Department of Fisheries Malaysia
Kompleks Perikanan Kg. Acheh, 32000 Sitiawan, Perak, Malaysia
E-mail: haris_arshad@yahoo.com

Mr. Ahmad Husin bin Alias
Aquatic Ecosystem Research Centre
Department of Fisheries

Kompleks Perikanan Kg. Acheh, 32000 Sitiawan, Perak, Malaysia

Mr. Joseph Christopher C. Rayos
National Fisheries Research and Development Institute
Bureau of Fisheries and Aquatic Resources
940 Kayumanggi Bld., Quezon Avenue, Quezon City, Philippines
E-mail: josephrayos@yahoo.com

Ms. Suzette B. Barcoma
National Fisheries Research and Development Institute
Bureau of Fisheries and Aquatic Resources
940 Kayumanggi Bld., Quezon Avenue, Quezon City, Philippines
E-mail: suzette_barcoma@yahoo.com

Mr. DM Genise Estremadura
Oceanbio Laboratory
Division of Biological Sciences
University of the Philippines in Visayas
5023 Miagao, Iloilo, Philippines
E-mail: physalius@scientist.com

Ms. Rhoda Servidad
National Marine Fisheries Development Center
Bureau of Fisheries and Aquatic Resources
3rd Flr. PCA Bldg, Elliptical Rd. Diliman, Quezon City, Philippines
E-mail: jadesummer21@yahoo.com

Ms. Jennifer Viron
National Marine Fisheries Development Center
Bureau of Fisheries and Aquatic Resources
3rd Flr. PCA Bldg, Elliptical Rd. Diliman, Quezon City, Philippines
E-mail: jennyviron@yahoo.com

Ms. Patcharee Puntuleng
Chumphon Marine Fisheries Research and Development Center
Department of Fisheries
408 Moo 8, Paknam Sub-district, Muang District, Chumphon Province 86120, Thailand
E-mail: p_puntuleng@hotmail.com , ppuntuleng@yahoo.com

Ms. Kamolrat Phuttharaksa
Eastern Marine Fisheries Research and Development Center
Department of Fisheries
Moo 2, Phe Sub-district, Muang District, Rayong Province 21160, Thailand
E-mail: kamol_phut@yahoo.co.th , emdec2003@yahoo.com

Mr. Paitoon Puewkhao
Andaman Sea Fisheries Research and Development Center
Department of Fisheries
77 Sakdidej Rd., Muang District, Phuket 83000, Thailand
E-mail: afdecfish@yahoo.com

Mr. Kosum Polrong
Phuket Marine Biological Center
Department of Marine and Coastal Resources
51 Sakdidej Rd., Muang District, Phuket 83000, Thailand

Mr. Dao Duy Thu
Research Institute of Marine Fisheries
Fisheries Administration
170 Lelai Street, Haiphong City, Vietnam
E-mail: ddthu@rimf.org.vn

Mr. Pham Quoc Huy
Research Institute of Marine Fisheries
Fisheries Administration
170 Lelai Street, Haiphong City, Vietnam
E-mail: pqhuy@rimf.org.vn

Dr. Natinee Sukramongkol
Training Department
Southeast Asian Fisheries Development Center
Phrasamutchedi, Samut Prakan, 10290, Thailand
E-mail: natinee@seafdec.org

Ms. Siriporn Pangsorn
Training Department
Southeast Asian Fisheries Development Center
Phrasamutchedi, Samut Prakan, 10290, Thailand
E-mail: psiriporn@seafdec.org

(Affiliations and addresses above are at year 2008)

INTRODUCTION

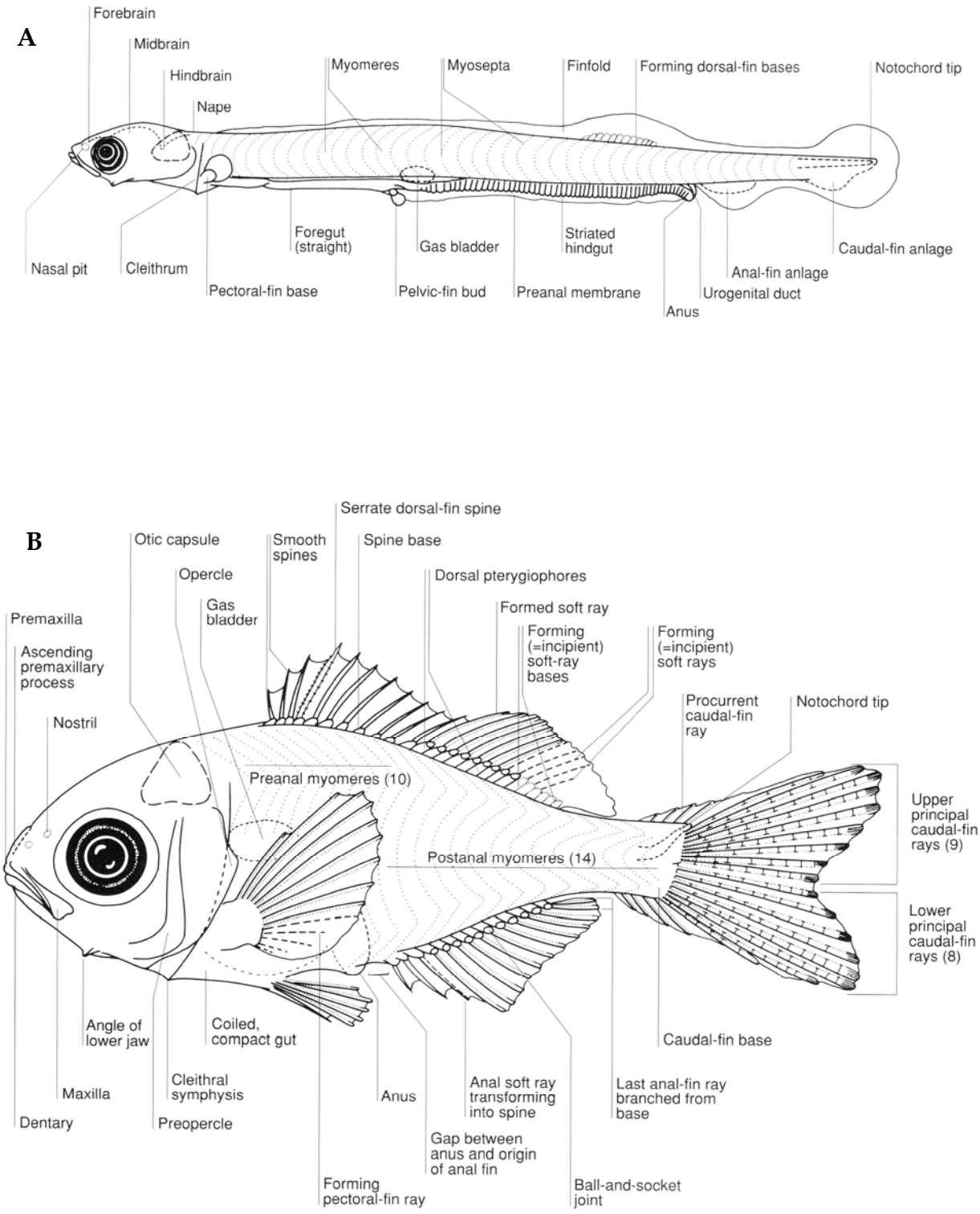
This monograph contains morphological characters of marine fish larvae found in the Southeast Asia region. Seventy-two families in the fourteen orders are selected as the commercially important taxa for the marine capture fisheries in the region. Each chapter of the families consists of a morphological character table, a meristic table in genus level and illustrations.

In character tables, the body shape, gut, gas bladder, head, snout, mouth, eyes, head spination, fin formation and pigment of larvae, and its similar families are described. The distinguishing characters are underlined. The descriptions of 61 families in the 72 families are referred mainly to Leis and Carson-Ewart (2000). The other 11 families are referred to Moser et al. (1984), Okiyama (1988a), Moser (1996), Neira et al. (1998), Richards (2006) and Fahay (2007).

Meristic tables in this monograph indicate the fin-ray and vertebral counts in the genus level. The tables of the 61 families were reproduced from Leis and Carson-Ewart (2000). Genus compositions in the tables cover only those species found in the Indo-Pacific region. However some original tables from Leis and Carson-Ewart (2000) were modified to incorporate the updated fish classification by Nelson (2006) and the distributional information. Regarding the other 11 families, the species compositions only in the Southeast Asia region were checked with Carpenter and Niem (1999) and Carpenter and Niem (2001). Then, their meristic information were collected mainly from both references and Nakabo (2000), and compiled in the genus level.

Illustrations of larvae in this monograph were reproduced mainly from the published books, monographs and papers with permissions of the publishers and/or the authors. Original drawings by Dr. Apichart Termvidchakorn in Thailand and some illustrations by participants of the ASEAN-SEAFDEC Member Countries to the "Regional Training Workshop on Larval Fish Identification and Fish Early Life History Science" collaboratively organized by the UNEP/GEF/SCS and the SEAFDEC Training Department from 26 May to 15 June 2008, are also used. The illustrations to be reproduced were selected in principle from the published issues in the Southeast Asia region. But, in the case of no drawings available from the region, the drawings of the species of which distributions were reported from the region were reproduced from references originated from outside of the region.

We are much grateful to the publishers and authors for their permission to reproduce llustrations.


A
Forebrain
Midbrain
Hindbrain
Nape
Myomeres
Myosepta
Finfold
Forming dorsal-fin bases
Notochord tip
Nasal pit
Cleithrum
Pectoral-fin base
Foregut (straight)
Pelvic-fin bud
Gas bladder
Preanal membrane
Striated hindgut
Anus
Urogenital duct
Anal-fin anlage
Caudal-fin anlage
B
Serrate dorsal-fin spine
Otic capsule
Smooth spines
Spine base
Opercle
Dorsal pterygiophores
Gas bladder
Formed soft ray
Premaxilla
Forming (=incipient) soft-ray bases
Forming (=incipient) soft rays
Ascending premaxillary process
Procurrent caudal-fin ray
Notochord tip
Nostril
Preanal myomeres (10)
Upper principal caudal-fin rays (9)
Postanal myomeres (14)
Lower principal caudal-fin rays (8)
Angle of lower jaw
Coiled, compact gut
Caudal-fin base
Maxilla
Cleithral symphysis
Anus
Anal soft ray transforming into spine
Last anal-fin ray branched from base
Dentary
Preopercle
Gap between anus and origin of anal fin
Forming pectoral-fin ray
Ball-and-socket joint

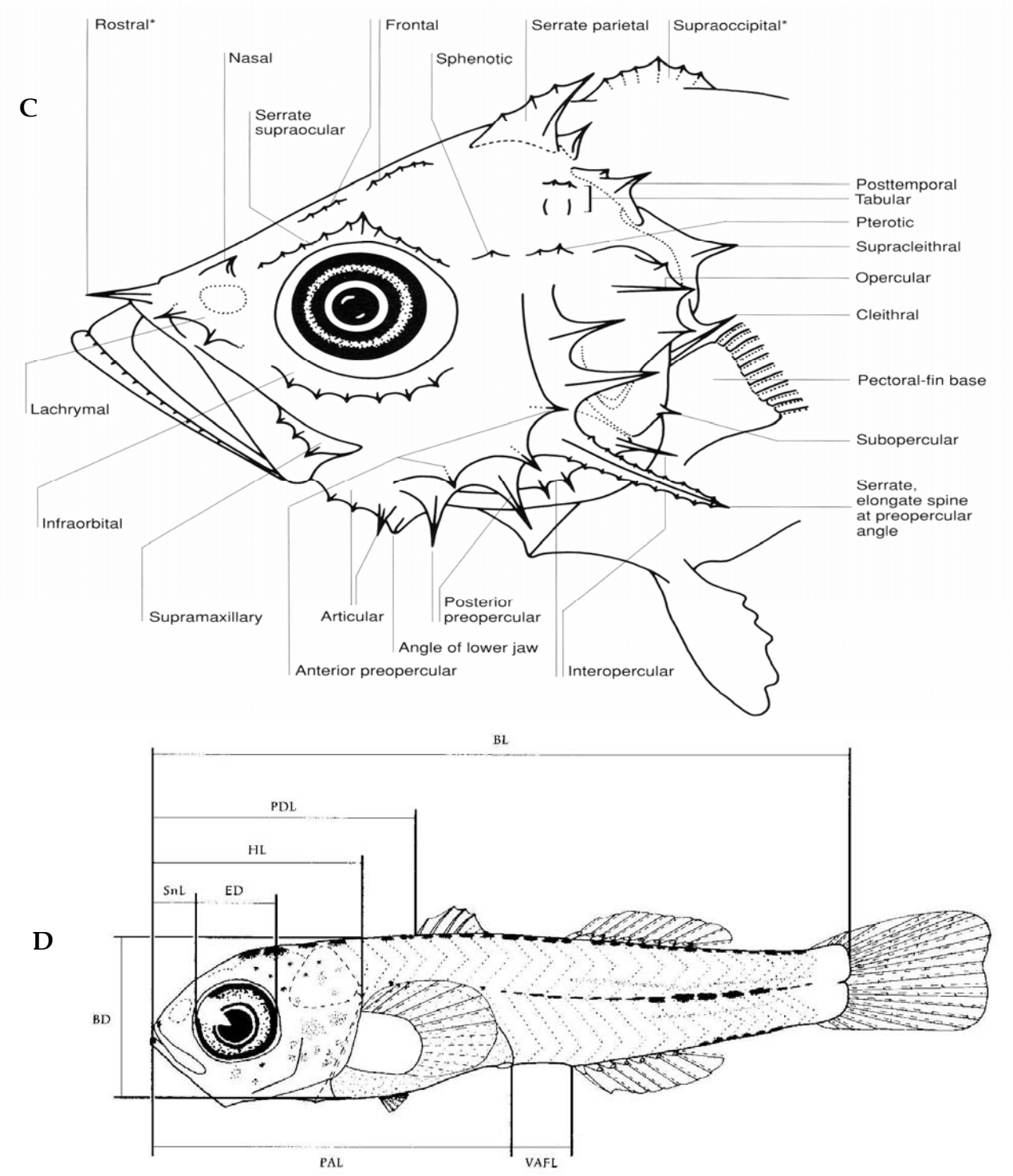


Fig. 1 Major morphological characters and measurements. **A**: hypothetical preflexion larva; **B**: hypothetical postflexion larva; **C**: head spines of a hypothetical larva; **D**: postflexion mullid larva. BD: body depth; BL: body length; ED: eye diameter; HL: head length; PAL: preanal length; PDL: pre dorsal-fin length; SnL: snout length; VAFL: vent to anal-fin length. (**A-C**: Neira et al. 1998; **D**: Leis and Carson-Ewart 2000)

Order: Clupeiformes

Family: Pristigasteridae* (Ilisha, pellona, tardoore, raconda)

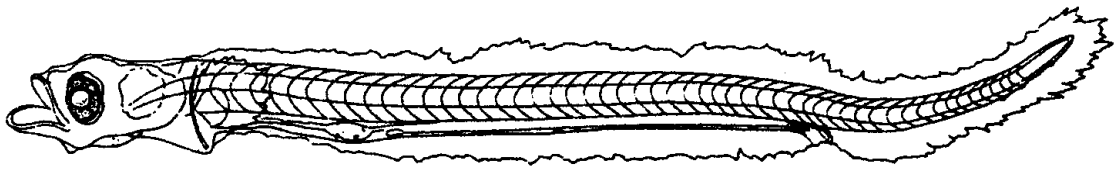
Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Very elongate, gradually becomes deeper and more compressed with growth	Very elongate and slightly compressed	Elongate and compressed, becomes more compressed as transition approaches
Gut	Long and straight through larval stage, reaches to about 80% BL	The striated hindgut covers the posterior about 65% of the gut and its origin moves forward with growth	The anus begins to migrate forward by 17 mm and reaches to about 70% BL in 22 mm. The striated hindgut becomes relatively shorter due to forward extension of the anal-fin base as transition approaches
Gas bladder	No information available	No information available	The large, pigmented gas bladder is present slightly anterior to the mid body in 21.5 mm
Head	Small and slightly trian-gular, becomes relatively lager with growth	Small and triangular	Moderate, triangular and compressed
Snout	Short and slightly concave	Short, and slightly concave and pointed	Short, and slightly concave and pointed
Mouth	Small and oblique, reaches to the anterior edge of the eye through larval stage	The lower jaw protrudes beyond the upper	Teeth are present on the both jaws from about 18 mm
Eyes	Small and narrow	Small and narrow	Small and narrow at least by 21.5 mm
Head spination	None	None	None

Fin formation	Anlagen of the dorsal and anal fins appear posteriorly	Incipient rays of the dorsal and anal fins form and increase in number	The dorsal fin nevr has more fin rays than the anal fin. The dorsal fin is entirely anterior to the anus, but in 27 mm the origin of the anal fin is slightly beyond to the posterior dorsal fin. The dorsal fin does not migrate and its origin is located in 56% BL until transition. The anal-fin base is longer than the dorsal fin. Pelvic-fin buds appear at the origin of the striated hindgut in 17-19 mm. A full complement of all fin rays is attained at about 27 mm
Pigment	Lightly pigmented through larval stage. Initially the posterior portion of the anus is distinctly pigmented and melanophores are present on the ventral midline of the foregut and tail	Melanophores appear on the ventral midline of the isthmus. Pigment near the anus becomes small	A row of melanophores appears on the ventral midlines of the hindgut. A few of melanophores aligns on the anal-fin base and internally over the hindgut. Additional pigment appears on the hindbrain, lower jaw tip and caudal fin in 21.5 mm
Similar families	Ammodytidae, Aulostomidae, Chanidae, Chirocentridae, Clupeidae, Creediidae, Engraulidae, Gonorynchidae, Kraemeriidae, Microdesmidae (Microdesminae), Phosichthyidae, Salangidae, Schindleriidae, Synodontidae, Trichonotidae		

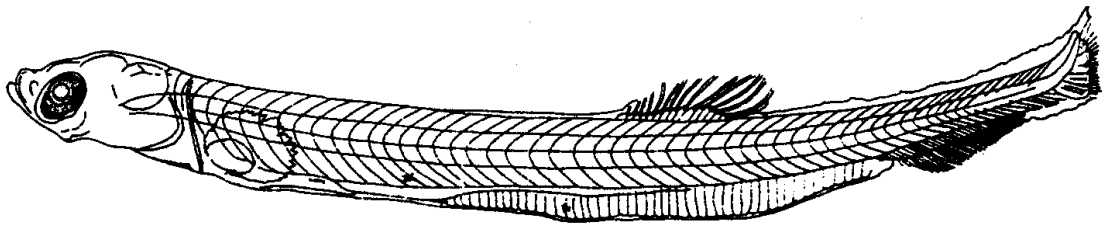
* Above description is based only on available information of *Ilisha elongata* in Okiyama (1988)

Meristic characters of the Southeast Asian pristigasterid genera

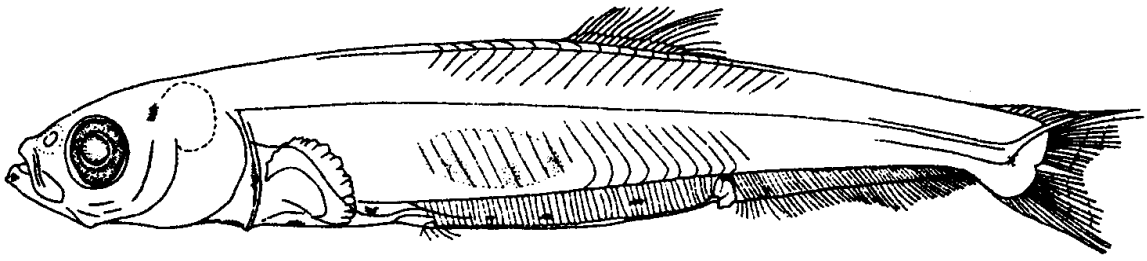
	D	A	P_1	P_2	C	VERTEBRAE
Pelloninae						
Illisha	15-21	35-53	-	6-7	10+9=19	47-52?
Pellona	16-19	34-42	-	6-7	10+9=19	42
Pristigastrinae						
Opisthopterus	14-18	51-65	12-17	0	10+9=19	50-52?
Raconda	0	81-92	-	0	10+9=19	62



a 6.8 mm TL



b 15.0 mm TL



c 21.5 mm TL

Fig. 2 Larvae of *Ilisha elongata* from southwestern South Korea and southern Japan (Takita 1988, redrawn from Uchida et al. (1958))

Order: Clupeiformes

Family: Engraulidae (Anchovies)

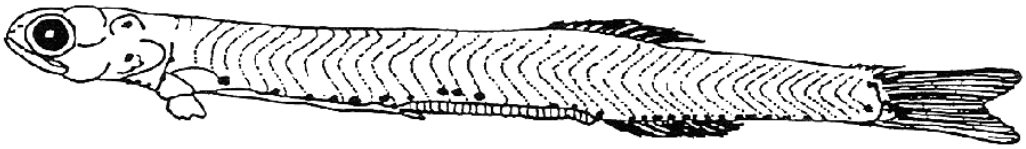
Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Very elongate and cylindrical, becomes moderately compressed by the end of flexion. A cross-hatched pattern of muscle fibers in the myomeres forms and persists until the early postflexion stage	Very elongate and moderately compressed	Initially still very elongate and compressed, thereafter elongate to moderate and becomes more compressed as transition approaches
Gut	Long and straight through larval stage, reaches to 74-81% BL, depending on species. The strongly striated hindgut covers the posterior 40-65% of the gut, depending on species, and originates at the level of the posterior margin of the gas bladder	The origin of the striated hindgut begins to move anteriorly and consequently is located anterior to the gas bladder by 9.4-11.5 mm in postflexion	Anus begins to migrate anteriorly by 14-16 mm and reaches to 60-70% BL from 23 mm
Gas bladder	Gas bladder does not appear yet	Apparent and inflated only at night, located near the mid body with its origin at myomeres 11-17, and does not move with the anterior movement of the anus	Obscured by body musculature from about 18 mm
Head	Small, ovate and slightly depressed	Small, ovate and slightly depressed	Cylindrical by 12-15 mm, and then becomes moderate in size and laterally compressed after about 15-19 mm
Snout	Short and slightly concave	Short and slightly concave	Convex and slightly pointed from about 8-10 mm, and becomes bulbous from 15.5-21 mm
Mouth	Small and terminal, reaches to the anterior half of the eye. Minute teeth appear on both jaws	Small and terminal, reaches to the anterior half of the eye	Moderate to large in size, reaches beyond the eye and the pectoral fin in some *Thryssa* by 18-25 mm, and becomes inferior due to the bulbous snout from 16-21 mm
Eyes	Large to moderate, and slightly narrow to round	Large to moderate, and slightly narrow to round	Moderate to small and round
Head	None	None	None

Spination			
Fin formation	Posteriorly-located dorsal- and anal-fin anlagen appear, thereafter the incipient rays form	Incipient rays of the dorsal and anal fins increase in number	All dorsal- and anal-fin rays are present by 8-12 mm. The dorsal fin never has more fin rays than the anal fin. The posterior 2-7 bases of the dorsal-fin rays lie posterior to the anus in *Encrasicholina*, *Engraulis* and *Stolephorus*. In *Thryssa* the dorsal fin is entirely anterior to the anus. The dorsal fin migrates anteriorly by about 5-8 myomeres after 18-23 mm. The anal fin is always longer than the dorsal fin in *Thryssa*, but in other genera the anal-fin base is initially shorter than the dorsal fin until 18-23 mm, thereafter becomes longer. Pelvic-fin buds appear just anterior to the gas bladder at about 11mm, and all rays are present by 18 mm in *Encrasicholina* but not until 27 mm in *Engraulis*. Pectoral-fin rays begin to form at 19 mm and all rays are present after 23 mm
Pigment	Lightly pigmented through larval stage. A row of melanophores appears on the ventral midlines of the isthmus, hindgut and tail. The foregut has a row of melanophores dorso-laterally. A few melanophores appear at the notochord tip	Most species develop pigment dorsolaterally on the gas bladder. The pigment on the ventral midline of the hindgut disappears during the flexion or early post-flexion except *Thryssa* in which it persists until at least 20 mm	Some species have melanophores on the operculum, on the brain, along the cleithrum, on the dorsal- and anal-fin bases, on the dorsal midline of the tail, on the caudal fin, laterally on the caudal peduncle, and internally above the hindgut
Similar families	Ammodytidae, Aulostomidae, Chanidae, Chirocentridae, Clupeidae, Creediidae, Gonorynchidae, Kraemeriidae, Microdesmidae (Microdesminae), Phosichthyidae, Pristigasteridae, Salangidae, Schindleriidae, Synodontidae, Trichonotidae		

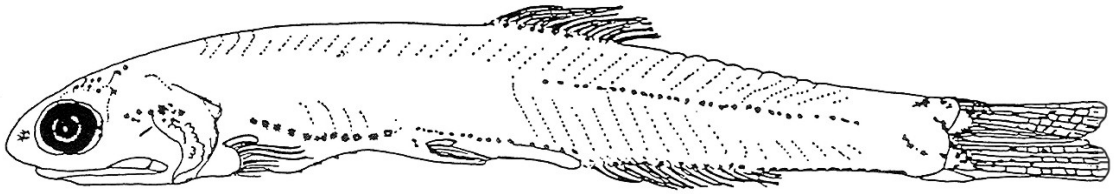
Meristic characters of the Indo-Pacific englaulid genera (modified from Leis and Carson-Ewart (2000))

	D	A	P_1	P_2	C	VERTEBRAE
Coilinae						
Coilia	13-17	62-117	11-29	6-10	19	(14-21) + (46-61) = 60-76
Papuengraulis	5-6	53-60	-	7	19	-
Setipinna	13-15	48-64	11-15	7	19	(15-18) + (31-37) = 46-54
Thryssa	11-17	26-49	10-14	7	19	(12-21) + (22-28) =39-46 [a]
Engraulinae						
Encrasicholina	11-16	14-21	12-17	7	19	(21-25) + (17-21) = 41-44
Engraulis	13-17	14-22	15-18	7	19	43-47
Stolephorus	13-18	17-25	11-17	7	19	(18-23) + (18-21) = 38-43

[a] 45-48 for *Thryssa purava* possibly distributed only in Myanmar.

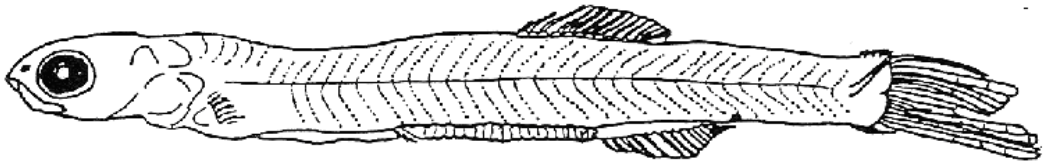


a 19.5 mm TL

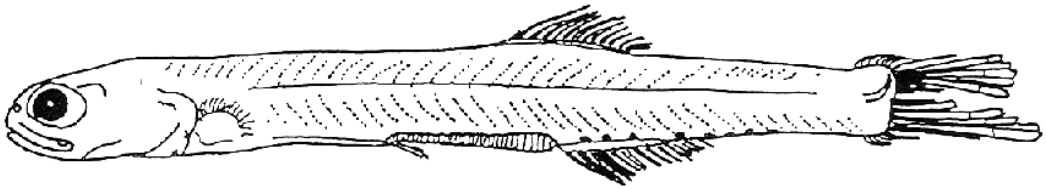


b 33.2 mm TL

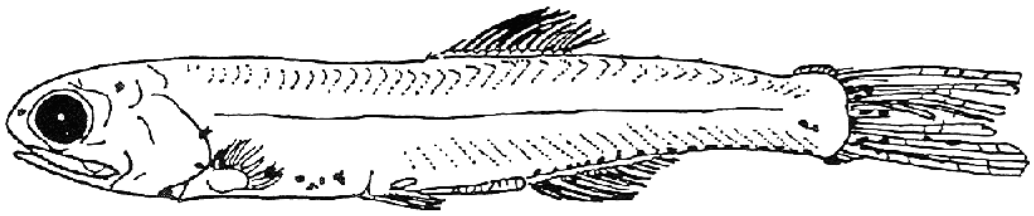
Fig. 3 Larvae of *Encrasicholina* sp. from the Gulf of Thailand (Chayakul 1996)



a 13.6 mm TL

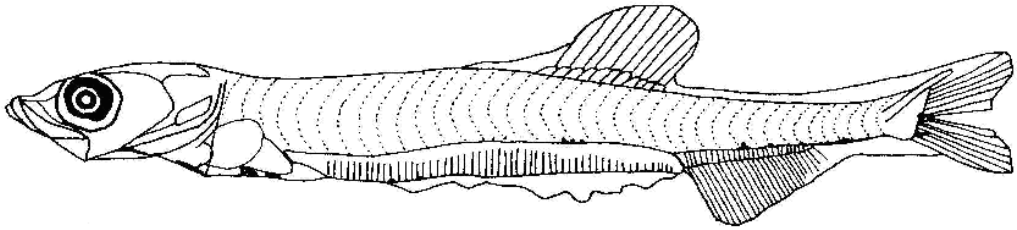


b 18.2 mm TL

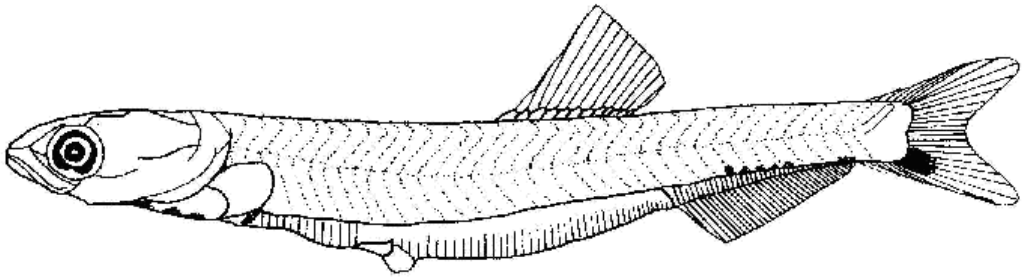


c 20.1 mm TL

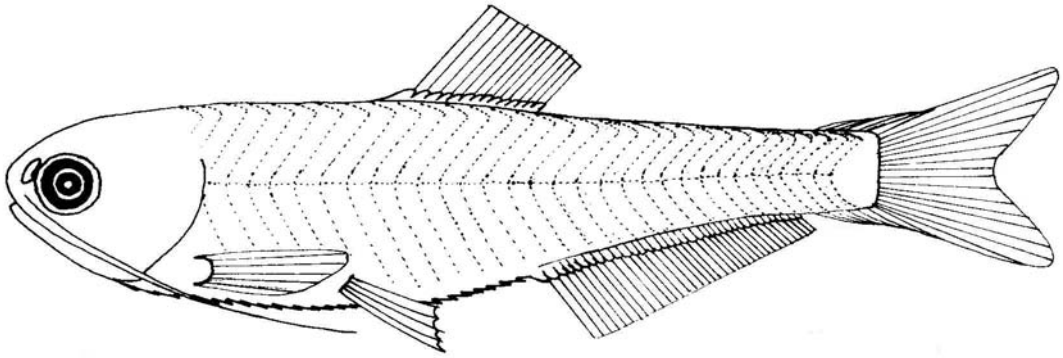
Fig. 4 Larvae of *Stolephorus* sp. from the Gulf of Thailand (Chayakul 1996)



a 7.05 mm TL



b 11.35 mm TL



c 29.26 mm TL

Fig. 5 Larvae of *Thryssa setirostris* from the Andaman Sea (Termvidchakorn and Paphavasit 1999)

Order: Clupeiformes

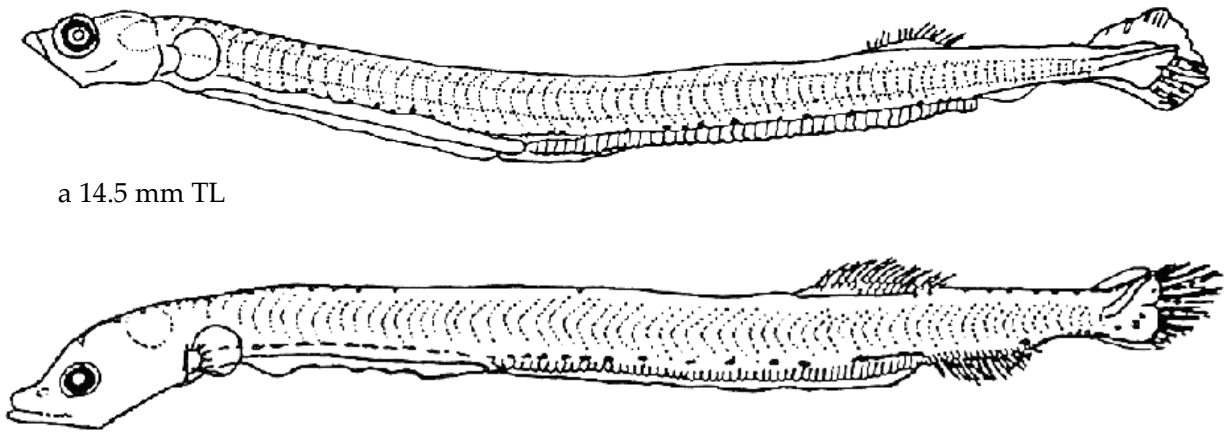
Family: Chirocentridae (Wolf herrings)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Very elongate. A cross-hatched pattern of muscle fibers in the myomeres forms	Very elongate	Very elongate
Gut	Long and straight, reaches to 83% BL in 6.8 mm	Long and straight, reaches to 80% BL in 14.5 mm	Long and straight, reaches to 78% BL in 20.5 mm
Gas bladder	No information available	No information available	No information available
Head	Small	Small	Small
Snout	Short and slightly concave	Short and slightly pointed	Moderate and pointed
Mouth	Small and oblique. Teeth are present	Small	Small, and the lower jaw protrudes beyond the upper
Eyes	Moderate and round	Moderate and round, become smaller after the flexion stage	Small and round
Head spination	None	None	None
Fin formation	Anlagen of the dorsal and anal fins appear posteri-orly, thereafter the incipient rays form	Incipient rays of the dorsal and anal fins increase in number	The dorsal and caudal fins well develop. The origin of the anal fin is slightly beyond to the posterior dorsal fin (about 3 myomeres). The pectoral-fin rays form, but pelvic-fin buds do not appear yet in 20.5 mm
Pigment	Lightly pigmented through larval stage. A row of melanophores is present on the dorsal midline from the head to anterior trunk, and dorsolaterally on the gut	Melanophores on the dorsal midline of the body extends backward	Melanophores on the dorso-lateral gut are obscure. Additional pigment appears on the caudal-fin base
Similar families	Ammodytidae, Aulostomidae, Chanidae, Creediidae, Engraulidae, Fistulariidae, Gonorynchidae, Kraemeriidae, Microdesmidae (Microdesminae), Notosudidae, Paralepididae, Phosichthyidae, Pristigasteridae, Salangidae, Schindleriidae, Stomiidae (Chauliodontini), Synodontidae, Trichonotidae		

* Above description is based only on four specimens in 6.8 mm TL (preflexion), 14.5 mm SL (flexion), and 19.8 mm SL and 20.5 mm TL (postflexion) from Okiyama (1988) and Chayakul (1996).

Meristic characters of the Southeast Asian chirocentrid genus

	D	A	P_1	P_2	C	VERTEBRAE
Chirocentrus	16-19	29-37	13-15	6-8	10+9	(42-45)+(27-31) = 69-75



a 14.5 mm TL

b 19.8 mm TL

Fig. 6 Larvae of *Chirocentrus* sp. from the Gulf of Thailand (Chayakul 1996)

Order: Clupeiformes

Family: Clupeidae (Herrings, sardinellas, sardines, shads, sprats)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Very elongate and cylindrical. A cross-hatched pattern of muscle fibers in the myomeres forms only in Alosinae, Clupeinae and Dussumieriini (lack in Spratelloidini), and persists until the end of flexion	Elongate (Alosinae) to still very elongate (Clupeinae, Dussumieriinae), gradually becomes deeper and more compressed with growth	Elongate and compressed
Gut	Very long and straight through the larval stage, reaches to 74-86% BL (Alosinae), 83-90% BL (Clupeinae), 87-94% BL (Dussumieriini), 81-88% BL (Spratelloidini). The foregut is much shorter than the hindgut (Alosinae, Dussumieriini) or the both are of approximately equal length (Clupeinae, Spratelloidini). The hindgut is distinctly striated except Spratelloidini (weak or absent). The anus begins to migrate anteriorly at about 8 mm BL in Alosinae	The anus begins to move anteriorly at about 12-18 mm and reaches to 74-77% BL by 18-33 mm in Clupeinae	The anus begins to move anteriorly at about 20 mm and reaches to 79-84% BL at 28 mm in Dussumieriini. The anterior movement begins at 13-19 mm in Spratelloidini (only 1-2 myomeres migration)
Gas bladder	Conspicuous over the anterior portion of the hindgut after the late preflexion or early flexion stage in Clupeinae and Spratelloidini (only larvae sampled in black). Alosinae have no gas bladder through larval stage	Conspicuous over the middle portion of the hindgut after the late flexion or early postflexion stage in Dussumieriini (only larvae sampled in black)	In Dussumieriini the gas bladder slightly moves posteriorly after 17 mm
Head	Small, and slightly (Alosinae, Clupeinae, Spratelloidini) or strongly (Dussumieriini) depressed, becomes larger and more compressed with growth	Small, and slightly (Alosinae, Clupeinae, Spratelloidini) or strongly (Dussumieriini) depressed	Moderate and compressed by about 8 mm (Alosinae), 15-20 mm (Clupeinae, Spratelloidini), 28 mm (Dussumieriini)

Snout	Short and concave in Alosinae, Clupeinae and Spratelloidini, but very long and broad in Dussumieriini	Short and concave in Alosinae, Clupeinae and Spratelloidini, very long and broad in Dussumieriini	Moderate, and pointed or rounded from about 10 mm in Alosinae, about 13 mm in Sparatelloidini, by about 17-20 mm in Clupeinae, but still broad and long in Dussumieriini
Mouth	Small, reaches to about the anterior edge of the pupil in Alosinae and Clupeinae or the anterior edge of the eye in Spratelloidini, but in Dussumieriini very large and reaches to the posterior edge of the pupil. The lower jaw projects slightly beyond the upper in Alosinae, Clupeinae and Spratelloidini. Minute (Clupeinae, some Spratelloidini) or very large (Dussumieriini) teeth develop. No teeth form in Alosinae through larval stage	Small and reaches to the anterior edge of the pupil or eye (Alosinae, Clupeinae, Spratelloidini), or large and reaches to the posterior edge of the pupil (Dussumieriini)	Both jaws in Clupeinae are about equal from 17-20 mm. In Dussumieriini the mouth and teeth become relatively smaller from about 25 mm
Eyes	Small (Dussumieriini), small to moderate (Clupeinae, Spratelloidini) and slightly narrow or oblique elongate, but in Alosinae large and round to slightly ovoid	Small (Dussumieriini), small to moderate (Clupeinae, Spratelloidini), large (Alosinae) and distortedly round	Small (Dussumieriini) to moderate (Alosinae, Clupeinae, Spratelloidini), becomes rounded just before transition
Head spination	None	None	None
Fin Formation	Alosinae and Clupeinae: dorsal-fin anlage forms posteriorly at about 5-6 mm, thereafter the incipient rays develop (sometimes during flexion in Clupeinae). Dussumieriini: anal-fin anlage appears just prior to the dorsal fin. Spratelloidini: posteriorly-located dorsal- and anal-fin anlagen closely appear at once (a gap vertical to the	Alosinae and Clupeinae: anal-fin anlage appears. Dussumieriini: incipient rays of the dorsal and anal fins develop	Incipient anal-fin rays in Alosinae and Clupeinae, and incipient rays of the dorsal and anal fins in Spratelloidini develop. All rays of the dorsal and anal fins are present at 8-10 mm in Alosinae, 12-20 mm in Clupeinae, 19-25 mm in Dussumieriini and 11-12 mm in Spratelloidini. Dorsal and anal fins are located posteriorly, and the dorsal-fin

	posterior margin of the dorsal fin and the origin of the anal fin increases due to anterior migration of the dorsal fin at postflexion)		base is wholly anterior to the anal fin. The dorsal fin migrates anteriorly, and its body sizes depend on taxa (Alosinae, Spratelloidini < Clupeinae < Dussumieriini). The position of the dorsal fin relative to the anus and anal fin is relatively stable in Alosinae, Dussumieriini and some Clupeinae or changes in Spratelloidini and some Clupeinae. Pelvic-fin buds appear ventral to the dorsal-fin origin in Alosinae, the origin of the gas bladder in Clupeinae, between the posterior margin of the gas bladder and the dorsal-fin origin in Dussumieriini, and the posterior margin of the gas bladder in Spratelloidini. All rays of the pelvic fin are present at 12 mm in Alosinae, at 18-24 mm in Clupeinae, 34-45 mm in Dussumieriini and 14-18 mm in Spratelloidini. Pectoral-fin rays appear in Clupeinae, Dussumieriini and Spratelloidini (Alosinae develop no ray through larval stage), and all rays are present at 18-20 mm in Clupeinae, 24-32 mm in Dussumieriini and about 20 mm in Spratelloidini
Pigment	Light pigmented through larval stage. Mostly melano-phores appear along the isthmus (at postflexion in Spratelloidini), dorso-laterally on the foregut and ventral midline of the hindgut. Pigment develops on the notochord tip in Clupeinae and Dussumieriini, and on the	Melanophores appear on the caudal-fin base and/or rays in Clupeinae, Dussumierini and Sparatelloidini (at postflexion in Alosinae)	Melanophores appear on the dorsal and/or ventral midline of the caudal peduncle. Anal- and/or pelvic-fin bases are pigmented in Clupeinae and Spratelloidini. A series of internal pigment spots appears over the hindgut in Alosinae and some Clupeinae. Linear pigment develops ventrolaterally

	cleithrum in Dussumieriini. A series of 6-13 large spots on the lateral trunk and a series of melanophores in the gut membrane appear in Dussumieriini		along the myosepta in the tail and trunk in some Spratelloidini. Gas bladder, brain, operculum, pectoral- and dorsal-fin bases, jaw tips are pigmented in some species
Similar families	Ammodytidae, Aulostomidae, Chanidae, Chirocentridae, Creediidae, Engraulidae, Gonorynchidae, Kraemeriidae, Microdesmidae (Microdesminae), Phosichthyidae, Pristigasteridae, Salangidae, Schindleriidae, Synodontidae, Trichonotidae		

Meristic characters of the Indo-Pacific clupeid genera (modified from Leis and Carson-Ewart (2000))

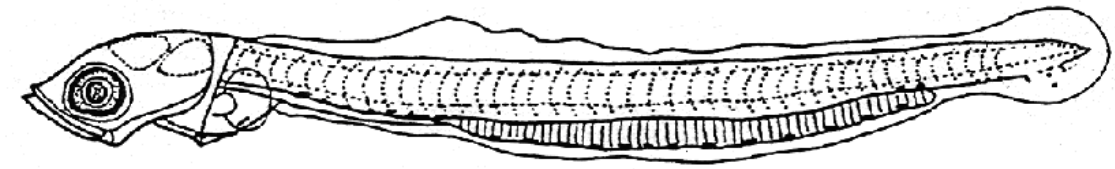
	D	A	P_1	P_2	C	VERTEBRAE
Alosinae						
Hilsa	16-19	17-22	13-15	8	19	42-44
Tenualosa	17-20	15-23	15-16	8	19	41-43
Clupeinae						
Amblygaster	15-20	15-22	16-17	8	19	44-45
Escualosa	15-17	17-21	-	7	19	41
Herklotsichthys	17-21	13-23	14-17	8	19	39-45
Sardinella	16-20	14-23	13-16	7-9	19	44-49
Dorosomatinae						
Anodontostoma	17-21	17-25	15-16	8	19	42-43
Clupanodon	15-16	21-28	-	8	19	44-49
Nematalosa	15-19	18-26	15-18	8	19	44-49
Dussumieriinae						
Dussumieriini						
Dussumieria	18-23	14-18	14-16	8	19	54-57
Etrumeus	18-22	9-13	15-17	8-9	19	48-55
Spratelloidini						
Spratelloides	10-14	9-14	10-15	8	19	42-51
Pellonulinae						
Clupeoides [a]	13-18	15-22	11-13?	7-8	-	-
Corica [a]	15-17	13-16+2	-	8	-	-
Ehirava [b]	14-16	12-18	-	8	19	40
Hyperlophus [c]	12-18	16-27	13?	6-7	-	-
Spratellomrpha [d]	16	16	-	8	19	44

[a] Freshwater and brackish water fish known from the Southeast Asia region (the pellonulinine *Clupeichthys* are freshwater fish in the region).

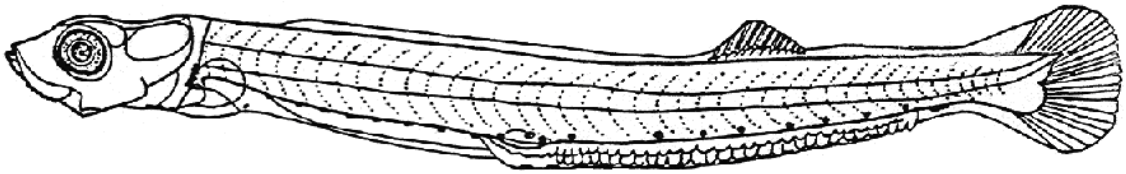
[b] Only *E. fluviatilis* is reported from southern India and Sri Lanka (freshwater, brackish, marine).

[c] Known only from Australia (brackish and marine).

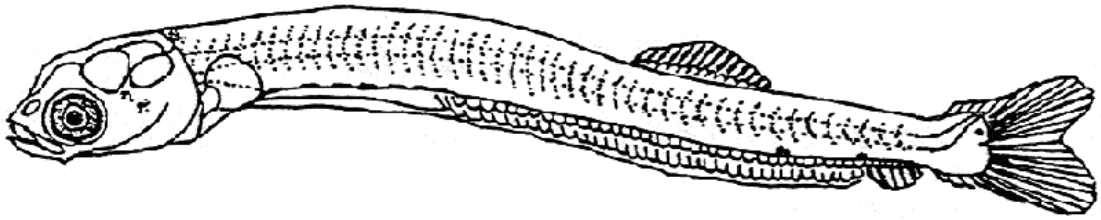
[d] Only *S. bianalis* is reported from the western Indian Ocean (brackish, marine).



a 5.20 mm TL

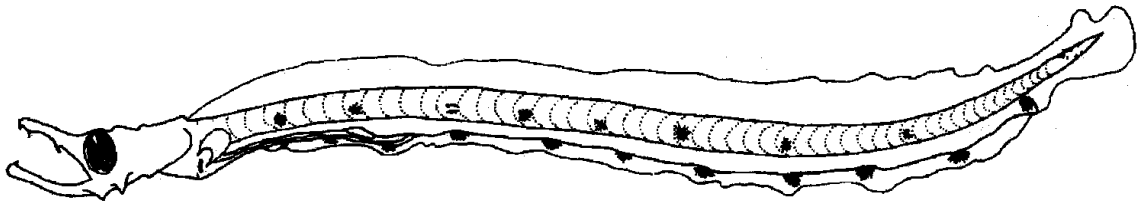


b 9.90 mm TL

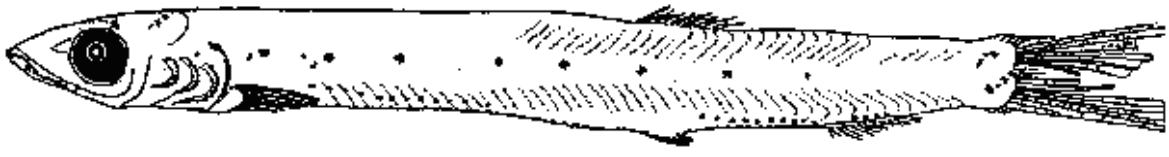


c 13.80 mm TL

Fig. 7 Larvae of Clupeidae sp. from the Gulf of Thailand (Chamchang 1986)



a 9.8 mm SL



b 39.2 mm TL

Fig. 8 Larvae of *Dussumieria* sp./spp. from the South China Sea (a: Zulkifli et al. 2006) and the Gulf of Thailand (b: Chayakul 1996)

Order: Gonorynchiformes

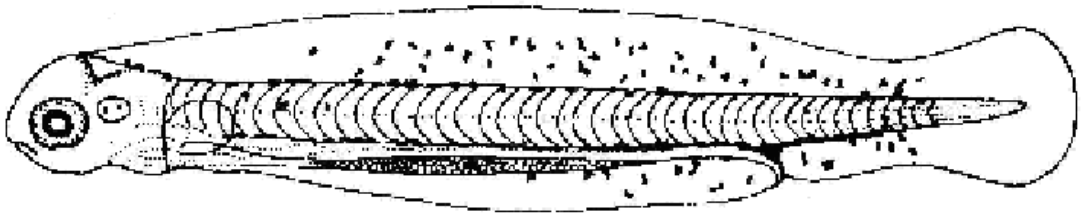
Family: Chanidae (Milkfish)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Initially very elongate and later elongate like clupeiform larvae. Cross-hatched muscle fibres in the myomeres are absent through larval stage	Elongate and somewhat laterally compressed	Elongate and moderately compressed
Gut	Very long and straight, reaches to about 80% BL. The hindgut is not striated through larval stage	Very long and straight, reaches to about 80% BL	Very long and straight, reaches to about 80% BL
Gas bladder	Very small over the anterior portion of the hindgut	Small over the anterior portion of the hindgut	Conspicuous over the anterior portion of the hindgut
Head	Small and elongate	Small and elongate	Small, elongate and slightly depressed
Snout	Short and somewhat concave	Short and somewhat concave	Short and slightly round
Mouth	Terminal and small, reaches to the anterior edge of the eye. A small knob forms at the dentary symphysis. Both jaws have no teeth through life	Terminal and small, reaches to the anterior edge of the eye. The knob at the symphysis becomes prominent	Terminal and small, reaches to the anterior edge of the eye
Eyes	Large and slightly elongate, become relatively smaller with growth	Large to moderate and slightly elongate	Moderate and round
Head spination	Absent	Absent	Absent
Fin formation	Membranous pectoral-fin buds are present	Anlagen of the dorsal and anal fins form posteriorly	All rays of the dorsal and anal fins are present by about 9 mm (anal-fin origin is approximately ventral to the last dorsal-fin-ray base). Pectoral- and pelvic-fin formation is late after 14 mm when the dorsal-fin base begins to migrate anteriorly
Pigment	Lightly pigmented through larval stage. Paired melanophores are present dorsolaterally on the gut. Dorsal midline of the trunk and tail is variably pigmented.	A single row of melanophores forms along the ventral midline of the foregut. Melanophores are present on the caudal-fin rays	Melanophores along the ventral midline of the gut extend to the middle of the hindgut. Additional melanophores develop middorsally on the hindbrain and mid-

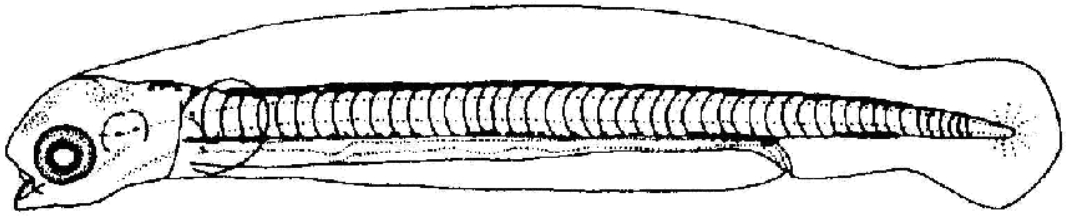
	Ventral midline of the tail is pigmented		laterally on the trunk and tail
Similar families	Clupeidae, Engraulidae, Gonorynchidae, Phosichthyidae (*Vinciguerria*, *Pollichthys*), Pristigasteridae, Schindleriidae, Synodontidae		

Meristic characters of the Indo-Pacific chanid genus (Leis and Carson-Ewart, 2000)

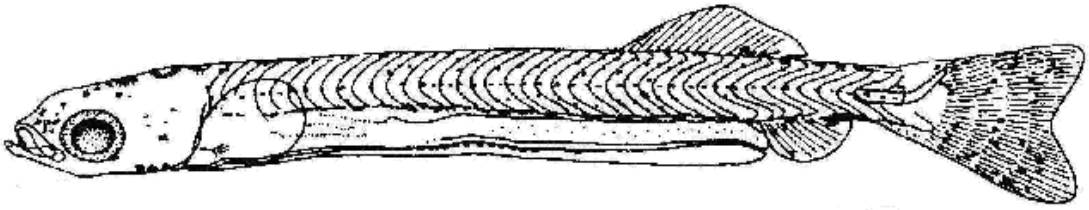
	D	A	P_1	P_2	C	VERTEBRAE
Chanos	13-18	8-11	14-18	8-12	10+9	40-46



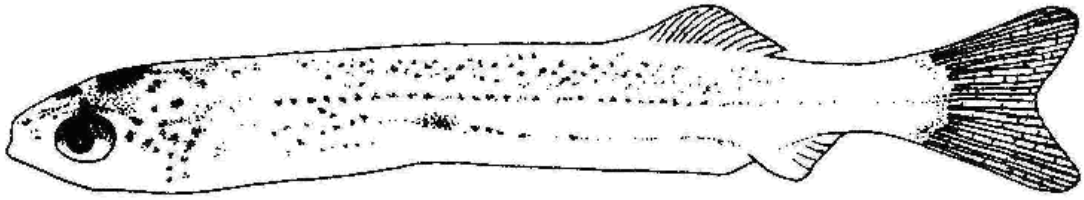
a 5.1 mm TL (rearing, 2 days after hatching)



b 5.2 mm TL (rearing, 3 days after hatching)



c 11.2 mm TL (rearing, 28 days after hatching)



d 14.13 mm TL (rearing, 31 days after hatching)

Fig. 9 Larvae of *Chanos chanos* from the Philippines (Vastone et al. 1983)

Order: Siluriformes

Family: Plotosidae (Eeltail catfishes)

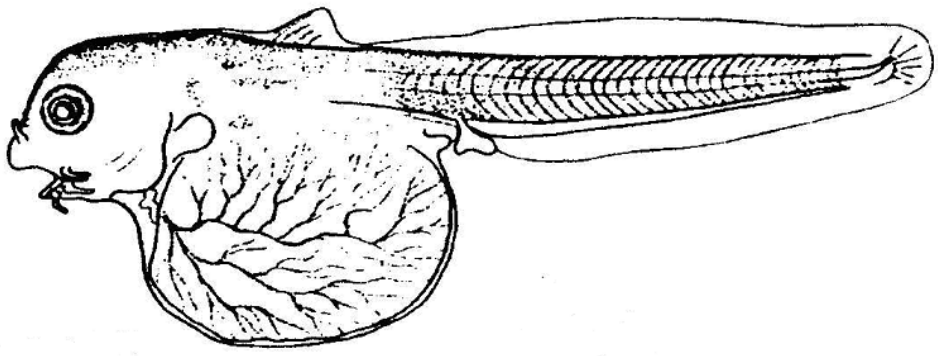
Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Elongate with a large, round yolk sac	Elongate with a reduced yolk sac	Elongate and tapering in the tail. Yolk sac disappears due to the complete absorption
Gut	Anus is located at the mid body through larval stage. Urogenital papilla bud is present as a dendritic appendage just posterior to the anus	The dendritic appendage becomes like sucker	The dendritic appendage becomes bifurcate
Gas bladder	No information available	No information available	No information available
Head	Moderate and round	Moderate and steep in dorsal profile	Moderate and triangular
Snout	Short and round. Barbel buds are present near the nostril, at the mouth corner and on the lower jaw	Short and slightly round. Each of 4 paired barbels becomes prominent	Long and triangular. Barbels become longer
Mouth	Inferior, reaches to the mid pupil	Inferior, reaches to the mid pupil	Slightly inferior, reaches to the anterior margin of the eye
Eyes	Small and round	Small and round	Small and round
Head spination	Absent	Absent	Absent
Fin formation	Pectoral-fin buds are present at the upper margin of the yolk sac	Anlage of the first dorsal fin and pelvic-fin buds form first, later the anal-fin anlage appears	Formation of the second dorsal fin is late. Anal and second dorsal fins have a long fin-base and are continuous with the caudal fin each other. Until about 18 mm all fins have a full complement
Pigment	Very poor or absent	Fine melanophores cover dorsally on the head, and laterally on the trunk and tail	Whole body is heavily pigmented with two yellow stripes along the dorsolateral and ventrolateral body
Similar families	Ariidae, Macrouridae, Ophidiidae		

Meristic characters of the Southeast Asian plotosid genera

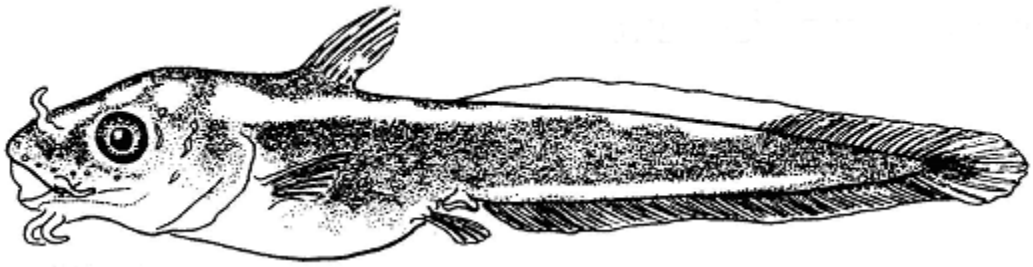
	D [a]	A	P_1 [a]	P_2	C	VERTEBRAE
Euristhmus	-	-	-	-	-	-
Paraplotosus	I+(97-130) [b]	78-102	I, 11-15	12-15	-	-
Plotosus	I. 4-5+85-132	68-106	I, 10-14	10-13	-	-

[a] The first elements of the first dorsal and pectoral fins are a spiny soft ray.

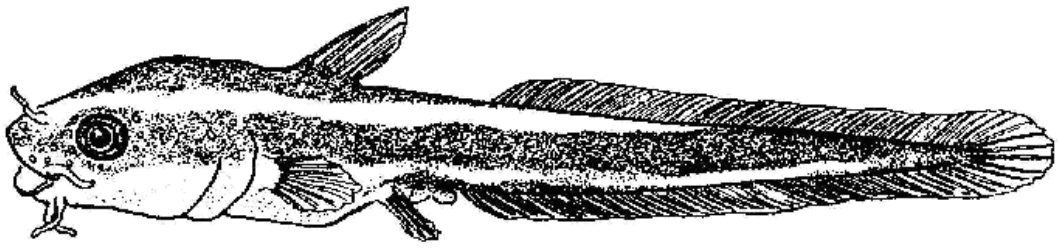
[b] Fin-ray count in parenthesis indicates a total number of soft rays of the first and second dorsal fins.



a 10.4 mm TL (rearing, 4 days after hatching)



b 15.4 mm TL (rearing, 10 days after hatching)



c 18.0 mm TL (rearing, 15 days after hatching)

Fig. 10 Larvae of *Plotosus lineatus* from southern Japan (Moriuchi and Dotsu 1973)

Order: Aulopiformes

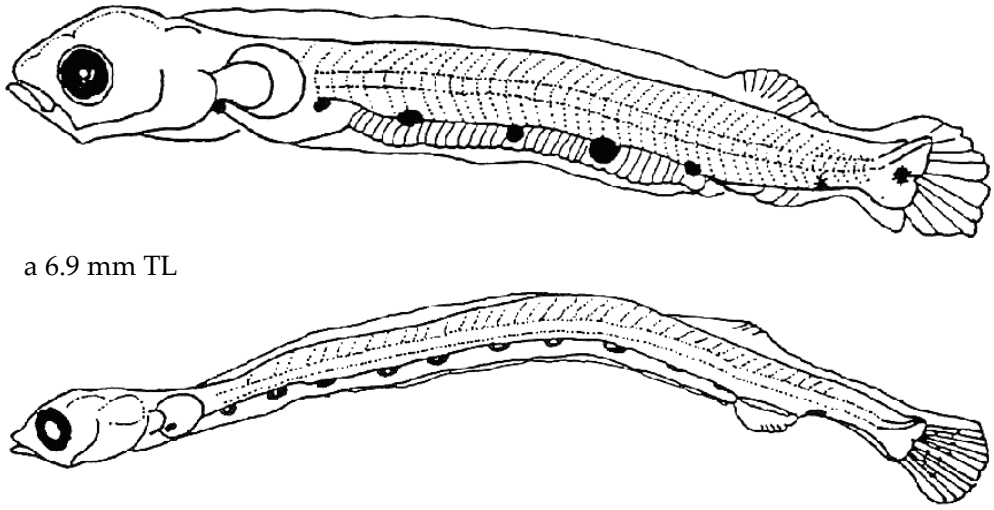
Family: Synodontidae (Lizardfishes, bombay ducks)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Elongate to very elongate	Very elongate and somewhat round in cross section	Very elongate and round in cross section
Gut	Long and straight with a rugate hindgut, reaches to 70-90% BL	Long and straight with a rugate hindgut, reaches to 70-90% BL	Long and straight with a rugate hindgut, reaches to 70-90% BL
Gas bladder	Inapparent	Inapparent	Inapparent
Head	Moderate to small and slightly round, becomes smaller with growth	Small and slightly round	Small and dorsoventrally flattened
Snout	Short and round, becomes longer with growth	Short and somewhat pointed	Moderate and pointed
Mouth	Terminal and moderate in size, reaches to the anterior margin of the pupil. Tiny villiform teeth form in both jaws	Terminal and large, reaches to the mid eye	Terminal and large, reaches to the mid eye or beyond it
Eyes	Small to large and round to narrow	Small to large and round to narrow	Small to large and round to elongate
Head spination	Absent	Absent	Absent
Fin formation	Membranous pectoral-fin buds are present. A prominent preanal fin fold forms only in synodontine larvae at preflexion and flexion stages	Anlage of the anal fin forms posteriorly. Pelvic-fin buds form near the mid body in *Harpadon* or anterior to the mid body in others (at postflexion in some species)	Anal-, pelvic- and pectoral-fin rays form. Dorsal-fin anlage appears at about the mid body and the rays form. Adipose fin becomes apparent as a remnant of the dorsal fin fold. Full completion of all fins is achieved at latest by 20 mm. Sequence of fin completion: C-A-D-P_1, P_2
Pigment	Several paired, large, peritoneal pigment spots form dorsolaterally along the gut. Usually pigment develops in the ventral midline of the tail and notochord tip	Paired peritoneal pigment spots increase in number (less than 13). Usually anlage of the anal fin and the caudal-fin base are pigmented	Paired peritoneal pigment spots are still prominent. Usually anal- and caudal-fin bases are pigmented
Similar families	Argentinidae, Chanidae, Clupeidae, Engraulidae, Gonorynchidae, Microstomatidae (Bathylaginae), Notosudidae, Paralepididae, Pseudotrichonotidae, Schindleriidae,		

	Scopelarchidae

Meristic characters of the Indo-Pacific synodontid genera (Leis and Carson-Ewart, 2000)

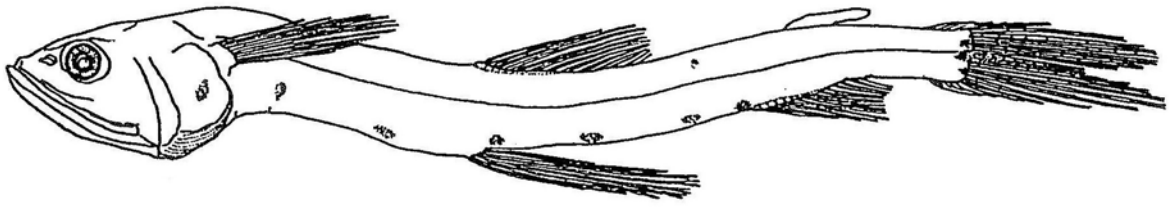
	D	A	P_1	P_2	C	VERTEBRAE
Harpadontinae						
Harpadon	10-15	11-15	10-13	9	10+9	39-56
Saurida	10-13	9-13	11-16	9	10+9	43-67
Synodontinae						
Synodus	10-15	8-15	10-15	8	10+9	49-65
Trachinocephalus	11-13	14-16	11-13	8	10+9	54-58



a 6.9 mm TL

b 11.7 mm TL

Fig. 11 Larvae of Synodontidae spp. from the Gulf of Thailand (Chayakul 1996)



a 25.2 mm SL

Fig. 12 Larva of *Harpadon nehereus* from southern Japan (Okiyama 1984)

Order: Gadiformes

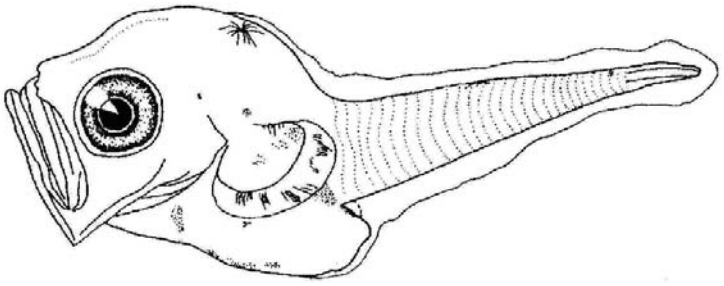
Family: Bregmacerotidae (Codlets)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Moderate and laterally compressed with hump-backed appearance, becomes elongate with growth	Moderate and laterally compressed with hump-backed appearance	Elongate and laterally compress with the long tail
Gut	Coiled and deep, extends near the mid body	Coiled and deep, extends near the mid body	Coiled, becomes slender. Anus is located near the mid body
Gas bladder	Conspicuous and located over the anterior portion of the gut, becomes larger with growth	More conspicuous and enlarged	Conspicuous
Head	Moderate in size, becomes relatively smaller with growth due to elongation of the tail. Lower jaw angle is prominent	Moderate in size. Lower jaw angle is prominent	Moderate and round
Snout	Concave in dorsal profile and triangular-shaped	Slightly concave in dorsal profile and triangular	Dorsally round and blunt
Mouth	Large and strongly oblique, reaches to the anterior edge of the eye. Teeth are present on the lower jaw	Large and strongly oblique, reaches to the mid eye. Upper jaw bears teeth	Large and oblique, reaches to the mid eye or beyond it
Eyes	Large and round, becomes smaller with growth	Moderate and round	Small and round
Head spination	None	None	None
Fin formation	Pelvic-fin anlage appears in the jugular, and the rays form. First, a detached ray of the dorsal fin develops at the level of the pectoral base, and thereafter the remaining dorsal- and anal-fin anlagen form oppositely. Paddle-like pectoral-fin buds with a narrow peduncle appear well above the lateral midline	Incipient rays of the dorsal, anal, pectoral and caudal fins form (dorsal- and anal-fin bases are quite long). First dorsal-fin ray and pelvic-fin rays become elongate	First dorsal-fin ray moves anteriorly from the pectoral base to the head. Long pelvic-fin rays extend well beyond the anus. Pectoral fin with a normal peduncle is located near the lateral mid-line. All fins form completely at latest by 12mm. Sequence of fin completion: D_1-P_2-D_2, A-P_1
Pigment	Nearly absent to heavy depending on species and	Pigment increases in number on the head and tail in some	Pigment heavily covers nearly all body in some species

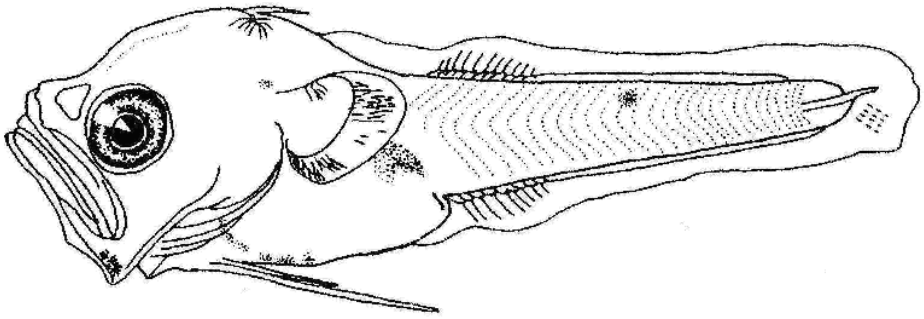
	stage of development. Mostly melanophores appear on the gas bladder, and lateral pigment forms on the tail. Lower jaw angle is pigmented in some species	species	
Similar families	Sciaenidae, Stylepholidae		

Meristic characters of the Indo-Pacific bregmacerotid genus (Leis and Carson-Ewart, 2000)

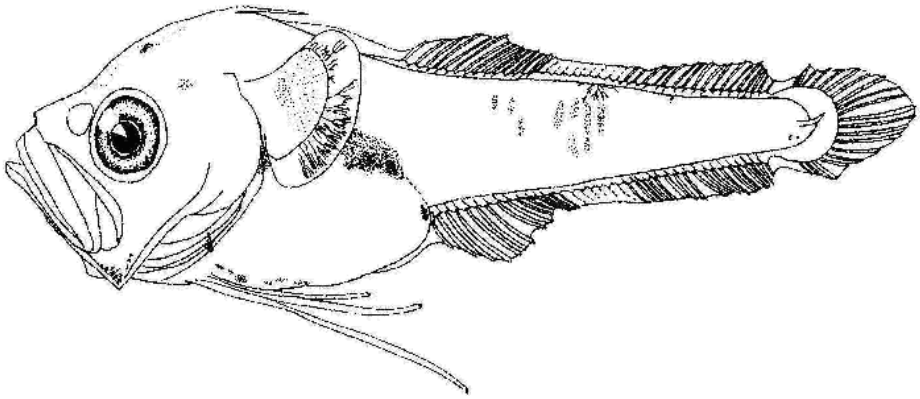
	D	A	P_1	P_2	C	VERTEBRAE
Bregmaceros	1+34-65	42-69	16-21	5-7	32-36	43-59



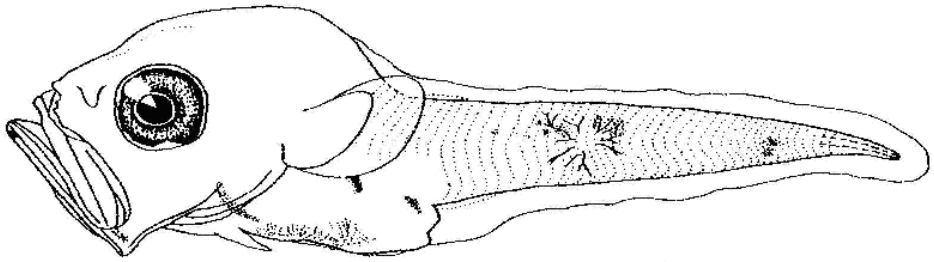
a 2.5 mm SL (type 1)



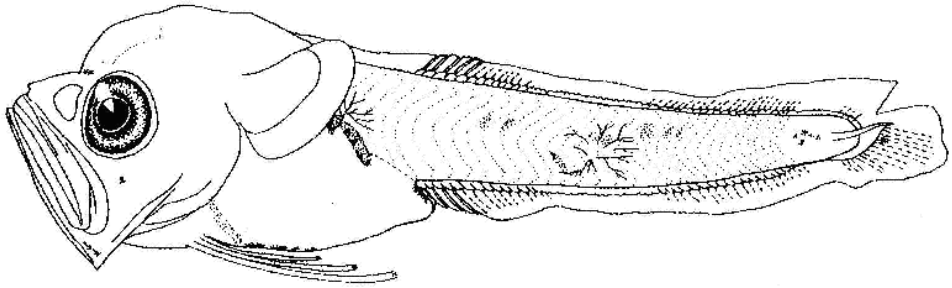
b 4.3 mm SL (type 1)



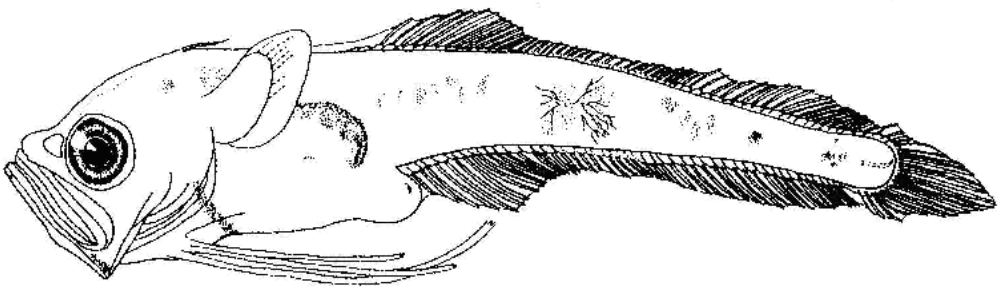
c 6.5 mm SL (type 1)



d 3.02 mm SL (type 2)



e 4.3 mm SL (type 2)



f 8.5 mm SL (type 2)

Fig. 13 Larvae of *Bregmaceros* spp. from the South China Sea (Zulkifli et al. 2006)

Order: Lophiiformes

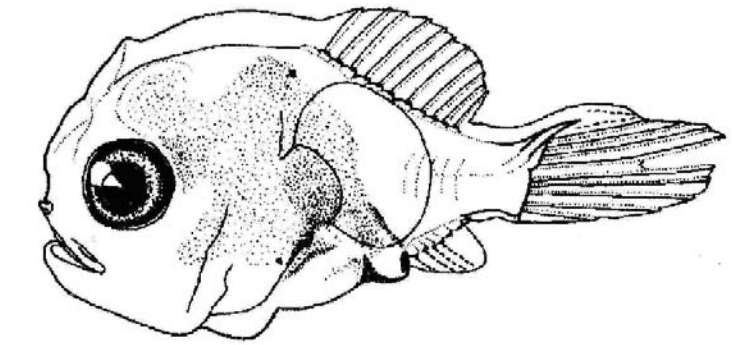
Family: Antennariidae (Frogfishes)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Deep and robust. The head and trunk are covered by an inflated, transparent dermal sac. Small scales in the form of spinules begin to form on the head and trunk in some species (the entire body including the median fins is covered by the spinous scales at postflexion)	Deep and robust in the head and trunk	Deep and robust in the head and trunk. The subdermal space becomes smaller and disappears. Soft dermal papillae form on the body in some species which have no spinous scales
Gut	Coiled and triangular, reaches to about the mid body. Preanal length becomes longer with growth	Coiled and downward inflated, reaches beyond the mid body	Coiled and downward inflated, reaches beyond the mid body
Gas bladder	Not visible	Not visible	Not visible
Head	Large and deeply round with a steep profile	Large and round with a steep profile	Large and round. The dorsal profile becomes less steep
Snout	Short, blunt and broadly convex	Short, blunt and broadly convex	Short, blunt and broadly convex
Mouth	Small and oblique, reaches anterior to the eye	Small and oblique, reaches to the anterior margin of the eye	Moderate to large, become nearly vertical by settlement
Eyes	Round and large, becomes smaller with growth	Round and large to moderate	Round and moderate
Head spination	None	None	None
Fin formation	Paddle-shaped pectoral-fin buds form	Anlagen of the soft dorsal fin and short anal fin appear, and thereafter dorsal-fin spines begin to form in the thickening dermal sac. Incipient rays of the caudal and pectoral fins begin to form. Peduncle of the pectoral fin becomes elongate	Pelvic-fin buds appear, and the rays form. First two and third dorsal spines initially form dorsal to the anterior margin of the eye and above the otic capsule, respectively, and thereafter move dorsally on the snout and eye. First dorsal spine become filamentous and is swollen distally (this swelling forms the fishing lure before settlement). Tips of the dorsal-, anal- and pelvic-fin elements project beyond the dermal

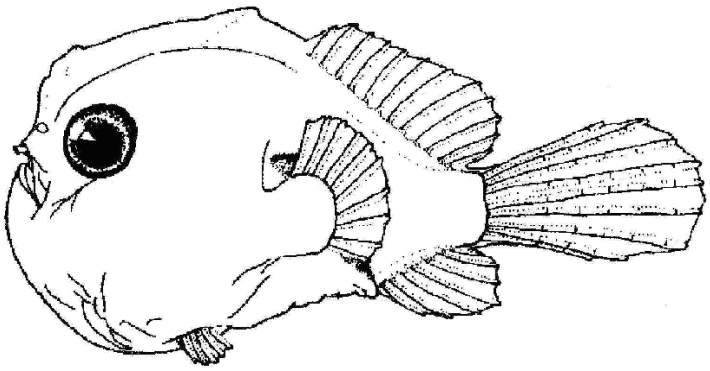
			sac. Caudal fin becomes elongate. All fins form completely at latest by about 12 mm
Pigment	Lightly pigmented through the larval stage. Internal melanophores appear over the gut	Additional internal pigment spreads onto the head and tail in some species	External pigment appears on the body including fins shortly before settlement
Similar families	Chaunacidae, Lophiidae, Ogcocephalidae, other lophiiform families, Scorpaenidae, tetraodontiform families		

Meristic characters of the Indo-Pacific antennariid genera (Leis and Carson-Ewart, 2000)

	D	A	P_1	P_2	C	VERTEBRAE
Antennarius	III+11-14	6-10	8-14	I, 5	9	18-20
Antennatus	III+11-13	6-8	9-12	I, 5	9	19
Histrio	III+11-13	6-8	9-11	I, 5	9	18-19
Histiophyrne	III+13-16	6-9	8-9	I, 5	9	20-23
Lophiocharon	III+12-13	6-8	8-9	I, 5	9	19
Nudiantennarius	III+12	7	9	I, 5	9	19
Tathicarpus	III+10-11	7	6-7	I, 5	9	18



a 2.3 mm SL



b 3.8 mm SL

Fig. 14 Larvae of Antennariidae spp. from the South China Sea (Zulkifli et al. 2006)

Order: Mugiliformes

Family: Mugilidae (Mullets)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Elongate to moderate and compressed	Moderate and compressed	Moderate, but becomes somewhat deeper. Robust and squarish in cross-section in some species
Gut	Initially straight, later coiled, and reaches to 55-65% BL	Coiled, reaches to 65-70% BL	Coiled, reaches to 65-70% BL
Gas bladder	Small over the anterior portion of the gut	Small over the anterior portion of the gut	Somewhat large, sometimes obscure by pigment
Head	Moderate	Moderate to large and round	Moderate to large and round
Snout	Short and concave	Short and slightly concave	Short and slightly convex
Mouth	Slightly oblique or nearly horizontal, reaches to the anterior edge of the pupil	Oblique or nearly horizontal, reaches to the anterior edge of the pupil	Oblique or nearly horizontal, reaches to the anterior edge of the eye
Eyes	Large and round	Moderate to large and round	Moderate to large and round
Head spination	Absent	Absent	Weak serrations are present on the infraorbital in some taxa
Fin formation	Pectoral-fin buds form	Anlagen of the 2nd and 1st dorsal fins (the former appears first) and anal fin form in the posterior half of the body. Later, incipient rays of both fins appear and the pelvic fin buds develop in the abdomen	Spinous dorsal fin and pectoral-fin rays develop. Full completion of all fins is achieved at latest by 10 mm. Sequence of fin completion: C-D_2, A-D_1-P_2-P_1
Pigment	Moderately to heavily pigmented through larval stage, generally spreads with body growth. Melanophores are usually present along the dorsal and lateral midlines of the trunk and tail, along the ventral midline of the tail, on the dorsal surface of the gut, gas bladder and brain, and on the snout tip	Mostly, melanophores along the lateral midline of the trunk and tail form a prominent stripe. Some taxa have additional stripes dorsolaterally and ventrolaterally, and have melanophores along the lower jaw, gular region, branchiostegal membrane and along the ventral midline of the gut	Whole body except fins is heavily pigmented. Some species have pigment on the dorsal fins and the caudal-fin base. In life, body is silver laterally and ventrally, and dark dorsally
Similar families	Callionymidae, Exocoetidae, Gobiidae, Latidae, Leptobramidae, Mullidae, Toxotidae		

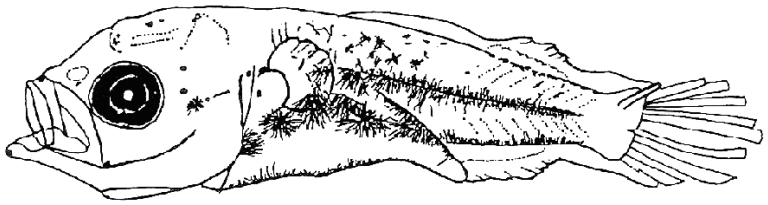
Meristic characters of the Indo-Pacific mugilid genera (modified from Leis and Carson-Ewart (2000))

	D [a]	A	P_1 [b]	P_2	C	VERTEBRAE
Agonostominae						
Agonostomus [c]	IV+9-11	II, 9-10	i, 15-16	I, 5	8+7	11-12+13=24-25
Cestraeus	IV+9-10	III, 9-10	i, 18-20	I, 5	8+7	11+13 = 24
Mugilinae						
Crenimugil	IV+9-10	III, 8-10	i, 15-17	I, 5	8+7	11+13 = 24
Liza	IV+9-11	III, 8-11	i, 13-18	I, 5	8+7	(10-11) + (13-14) = 24
Mugil	IV+9-10	III, 8-9	i, 15-17	I, 5	8+7	(11-12) + (12-13) = 24
Neomyxus	IV+10-11	II, 10-11	i, 14-15	I, 5	8+7	11+13 = 24
Oedalechilus	IV+8-9	III, 8-9	i, 15-18	I, 5	8+7	11+13 = 24
Rhinomugil	IV+8-9	III, 8-9	i, 13-16	I, 5	8+7	11+13 = 24
Valamugil	IV+9-11	III, 8-10	i, 14-19	I, 5	8+7	11+13 = 24

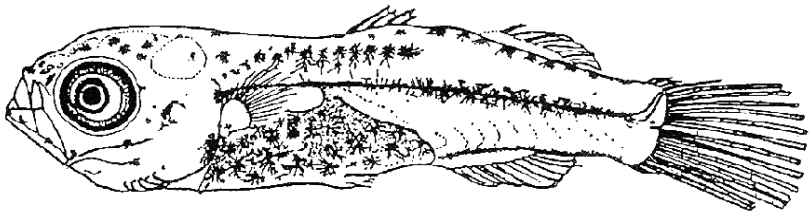
[a] The first element of the second dorsal fin is an unsegmented ray.

[b] "i" refers to an unsegmented marginal spur which is closely applied to the first segemented ray.

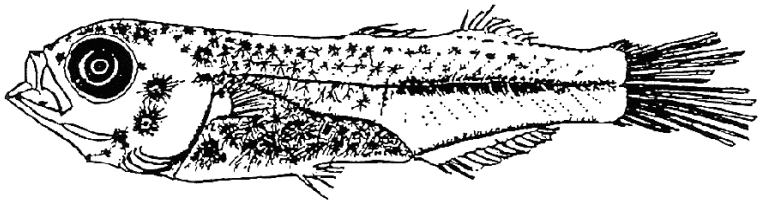
[c] Two species are known from Madagascal, Mauritius, Coromos and Seychelles.



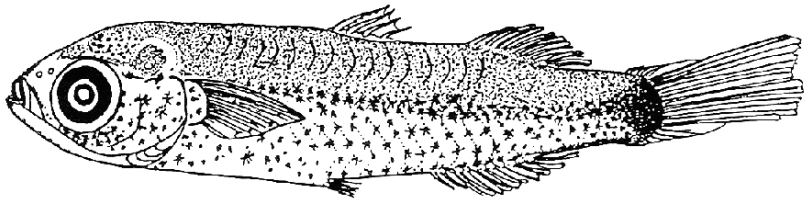
a 3.7 mm TL



b 5.6 mm TL



c 8.2 mm TL



d 15.4 mm TL

Fig. 15 Larvae of Mugilidae sp./spp. from the Gulf of Thailand (Chayakul 1996)

Order: Beloniformes

Family: Exocoetidae (Flyingfishes), Hemiramphidae (Halfbeaks), Belonidae (Needlefishes)

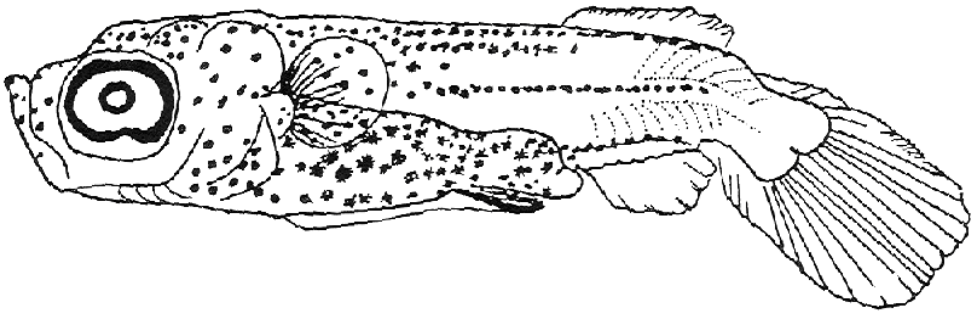
Main characters	Postflexion stage		
	Exocoetidae	**Hemiramphidae**	**Belonidae**
Body shape	Elongate (Oxyporhamphinae, cypselurine *Cheilopogon* and *Hirundichthys*) or elongate to moderate (others), and compressed or squarish in cross section	Elongate to very elongate, and squarish in cross section to moderately compressed	Elongate to very elongate, and cylindrical in cross section to slightly compressed laterally
Gut	Long, reaches to 60-75% BL	Straight and long, reaches to about three-quarters of BL	Straight and extends to more than two-third of BL
Gas bladder	No information available	Initially conspicuous over the anterior half of the gut, later becomes thin and more long to be inconspicuous	Conspicuous over the anterior portion of the gut (*Tylosurus*), or inconspicuous due to heavy pigment (other genera)
Head	Moderate and ovate, becomes slightly smaller with growth	Initially ovate, thereafter becomes increasingly elongate	Small to moderate, becomes elongate as the jaws develop
Snout	Short to very short and somewhat pointed. A prolonged lower jaw forms only in Oxyporhamphinae, but disappears by about 70 mm	Initially short and pointed, later the lower jaw becomes elongate	Initially pointed, and later sharp and very elongate with growth of the jaws. In *Tylosurus*, both jaws are always approximately the same length. In the other genera, the jaws are short and subequal at hatching, thereafter the lower jaw becomes much longer than the upper, and at last the both are nearly in same length
Mouth	Small and oblique, reaches to the anterior edge of the eye. A pair of barbels (*Cheilopogon*, some *Parexocoetus*) or a single barbel (some *Cypselurus*, some *Exocoetus*) forms at the chin after about 10 mm	Small and oblique, reaches anterior to the eye. Very small teeth are present on both jaws	Small (*Platybelone*) to large (*Tylosurus*), reaches to the anterior edge of the pupil. Small canine teeth are present on both jaws
Eyes	Large, and somewhat elongate to round	Somewhat elongate to round. An inconspicuous dorsal lappet appears over the pupil	Small to moderate and slightly elongate. A prominent dorsal lappet extends over the pupil
Head	Absent	Absent	Mostly absent. Serrate ridges

spination			and tiny serration are present on the dentary, preopercle, supraorbital and pterotic in some *Strongylura*
Fin formation	Dorsal and anal fins are located oppositely in the posterior body. Pectoral (and the pelvic in some species) fin becomes remarkably enlarged with growth. Lower lobe of the caudal fin becomes elongate. Pelvic-fin origin is situated anterior to the mid body (*Exocoetus*), at the mid body (*Parexocoetus*), or posterior to the mid body (others). Anal-fin origin is located under the dorsal ray 1-2 (*Exocoetus*), 1-3 (*Paraexocoetus*), 2-3 (*Oxyporhamphus*), 3-4 (*Prognichthys*), 4-8 (*Cheilopogon*), 2-9 (*Cypselurus*), anterior to the dorsal-fin end to under the 1st dorsal ray (*Hirundichthys*)	Dorsal and anal fins are located oppositely in the posterior body. Pelvic fin buds appear just after the mid body and the rays form. A long preanal finfold is present until after all fins are formed	Dorsal and anal fins are located oppositely in the posterior body. Initially pelvic fin is present as a bud posterior to the mid body, later has a full complement of rays. A long preanal finfold is present until after all fins are formed
Pigment	Moderately to heavily pigmented in the whole body including fins and barbel. Pigment bands or spots form on fins and the lateral body in some species	Moderately to heavily pigmented. Longitudinal rows of melanophores appear dorsally on the trunk and tail, and sometimes form laterally, ventrally on the portions. In some species, dorsal surfaces of the head and gut, both jaws and opercle are pigmented, and in large larvae the dorsal, anal and caudal fins are pigmented	Heavily to very heavily pigmented over the entire body and in the caudal-fin base. Dorsal fin is heavily pigmented in *Ablennes* and *Tylosurus*
Similar families	Hemiramphidae, Mugilidae	Atherinidae, Belonidae, Coryphaenidae, Echeneidae, Exocoetidae, Hemiramphidae, Isonidae, Paralepididae, Rachycentridae, Scomberesocidae, Sphyraenidae	

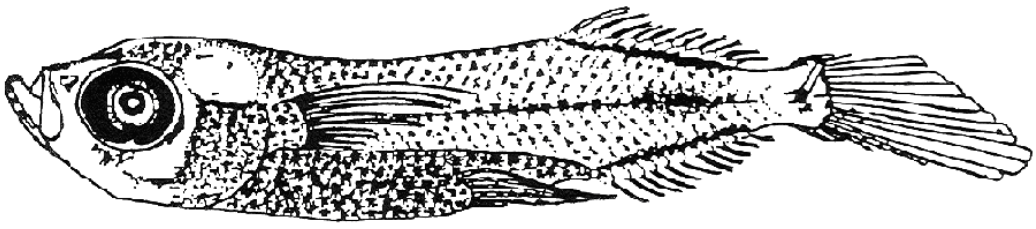
Note: just hatched larvae in above three families have a fully flexed notochord tip and all but the pelvic fin with the incipient rays (exocoetids except the oxyporhamphine *Oxyporhamphus* have pelvic-fin buds).

Meristic characters of the Southeast Asian exocoetid genera

	D	A	P_1	P_2	C	VERTEBRAE
Cypselurinae						
Cheilopogon	11-15	8-11	12-19	6	7+8=15	26-31+14-17=41-47
Cypselurus	10-14	7-11	13-16	6	7+8=15	26-30+13-17=40-45
Hirundichthys	9-12	10-13	15-20	6	7+8=15	28-30+16-18=45-47
Prognichthys	10-11	8-9	13-18	6	7+8=15	28-30+13-15=41-45
Exocoetinae						
Exocoetus	12-15	12-15	13-16	6	7+8=15	24-27+16-19=40-46
Oxyporhamphinae						
Oxyporhamphus	12-15	14-16	11-13	6	7+8=15	30-33+17-19=47-51
Parexocoetinae						
Parexocoetus	9-14	10-14	11-14	6	7+8=15	21-25+14-16=35-41



a 5.3 mm TL



b 7.5 mm TL

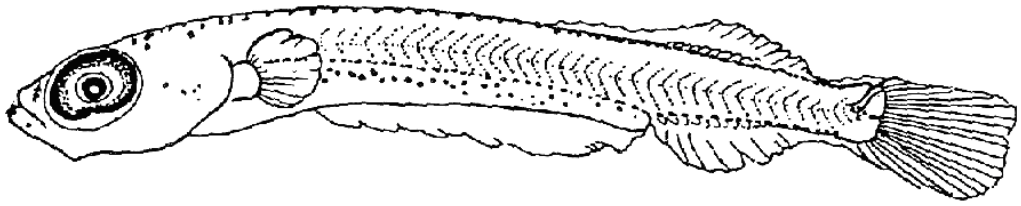
Fig. 16 Larvae of Exocoetidae sp./spp. from the Gulf of Thailand (Chayakul 1996)

Meristic characters of the Indo-Pacific hemiramphid genera (modified from Leis and Carson-Ewart(2000))

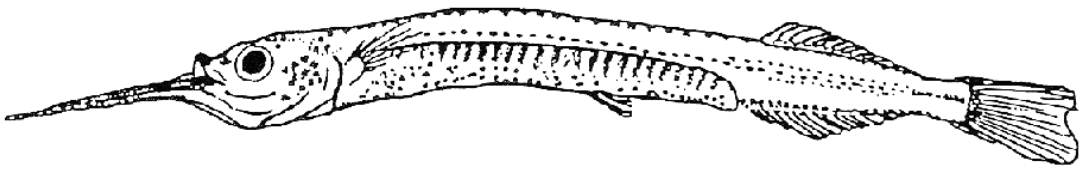
	D	A	P_1	P_2	C	VERTEBRAE
Hemiramphinae						
Arrhamphus	13-16	14-17	12-14	6	7+8 =15	(28-32) + (15-19) = 45-50
Euleptorhamphus [a]	20-25	20-25	7-9	6	7+8 =15	(44-46) + (26-29) = 70-75
Hemiramphus	11-15	9-14	10-13	6	7+8 =15	(30-41) + (16-19) = 50-59
Hyporhamphus	12-18	13-19	10-13	6	7+8 =15	(28-42) + (15-20) = 45-61
Melapedalion	15-17	14-16	12-13	6	7+8 =15	(33-35) + (17-18) = 51-52
Rhynchorhamphus	13-17	12-16	10-12	6	7+8 =15	(37-40) + (16-19) = 54-59
Zenarchopterinae						
Zenarchopterus [b]	10-16	8-14	7-11	6	7+8 =15	(24-36) + (11-18) = 37-51

[a] Oceanic genus.

[b] Freshwater and estuarine fishes.



a 5.6 mm TL

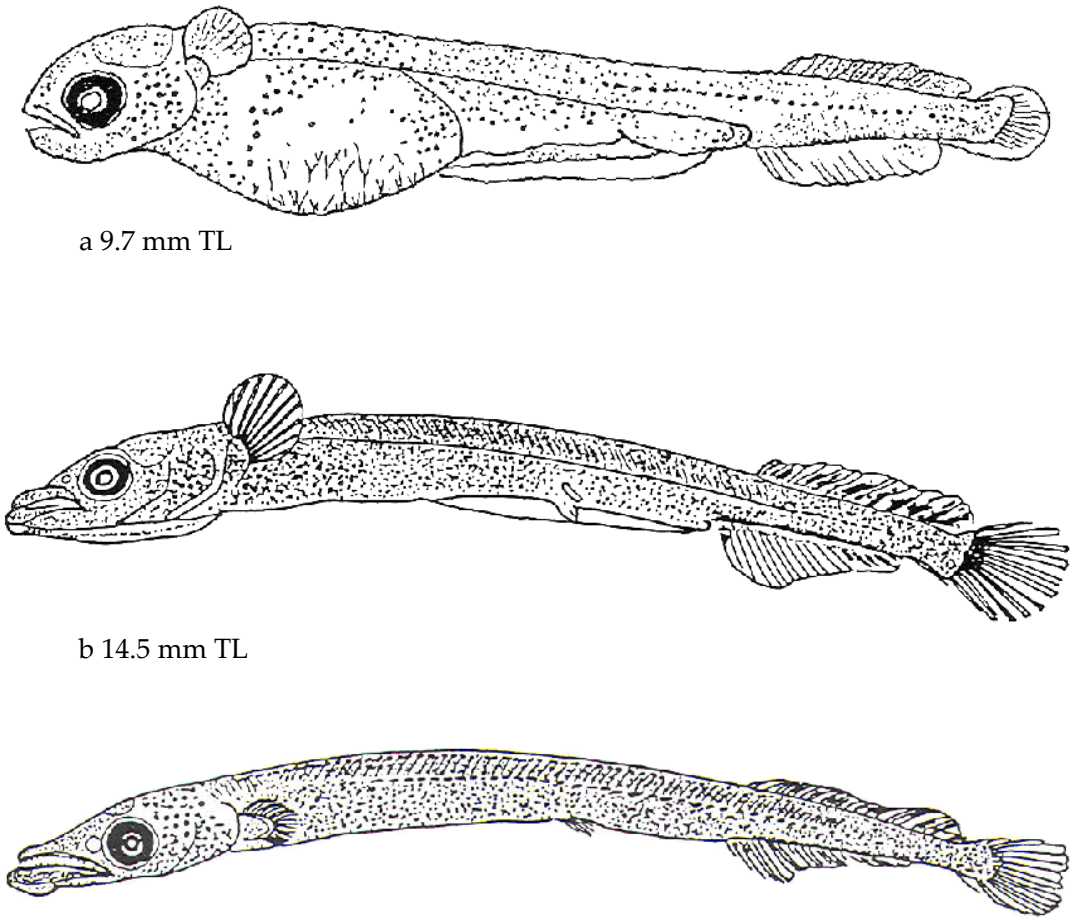


b 19.6 mm TL

Fig.17 Larvae of Hemiramphidae sp./spp. from the Gulf of Thailand (Chayakul 1996)

Meristic characters of the Indo-Pacific belonid genera (Leis and Carson-Ewart, 2000)

	D	A	P_1	P_2	C	VERTEBRAE
Ablennes	22-26	24-29	11-15	6	7+8 = 15	(51+63) + (30-37) = 81-97
Platybelone	11-17	15-21	10-13	6	7+8 = 15	(39-48) + (23-29) = 62-76
Strongylura	12-23	12-27	9-13	6	7+8 = 15	(34-57) + (19-34) = 53-90
Tylosurus	18-27	17-25	11-15	6	7+8 = 15	(41-65) + (23-33) = 67-96



a 9.7 mm TL

b 14.5 mm TL

c 32.2 mm TL

Fig. 18 Larvae of *Tylosurus* sp. from the Gulf of Thailand (Chayakul 1996)

Order: Beryciformes

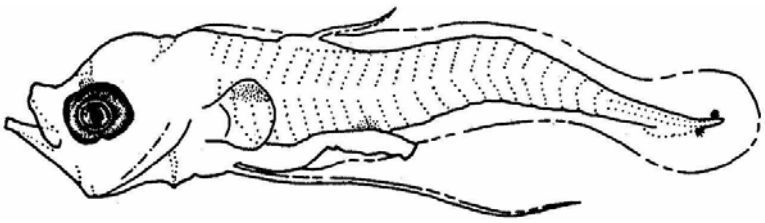
Family: Berycidae (Alfonsinos)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Initially elongate, but soon moderate and laterally compressed, becomes deeper with growth	Moderate and laterally compressed	Moderate (*Beryx*) to deep (*Centroberyx*) and strongly laterally compressed
Gut	Initially straight, and later coiled (at flexion or early postflexion stage in some species), reaches to about the mid body	Coiled, reaches to the mid body	Coiled and deep, reaches just before the mid body (*Beryx*) or just beyond the mid body (*Centroberyx*)
Gas bladder	Conspicuous and large	Conspicuous and large	Conspicuous and large
Head	Initially small, but soon moderate with a concave dorsal profile	Moderate with a concave dorsal profile	Moderate (*Beryx*) to large (*Centroberyx*), becomes rounded
Snout	Short and slightly pointed	Short and somewhat round	Short and somewhat round
Mouth	Moderate and oblique, reaches to the pupil. Small teeth are present on the both jaws at latest by early flexion	Moderate and oblique, reaches to the mid-pupil	Large and oblique, reaches near the posterior margin of the eye
Eyes	Round and large	Round and moderate to large	Round and moderate
Head spination	Not appears yet	The spination is well developed and forms earlier in *Beryx* than *Centroberyx*. Small preopercle spines and a smooth supraocular ridge form. A spine is present anterodorsally on the frontal and at the anterior end of the maxilla and a rugose texture develops over the frontal only in *Beryx* (frontal spines increase in 2 to 3 and project outward at postflexion). Lacrymal, infraorbitals, lower jaw at angle, interopercle and posttemporal wear a spine or spines in *Beryx* (at postflexion in *Centroberyx*). Opercle and	Spines on the preopercle and interopercle increase in number (2 preopercle spines at the angle accompany a serrate ridge on the lateral surface of the bone in *Beryx* more than about 10 mm). Subopercle and pterotic develop spines. A large lachrymal spine of *Beryx* directs backward. Frontal and supramaxilla in both genera and dentary in *Beryx* laterally develop serrate ridge(s) in the large larvae more than about 10 mm

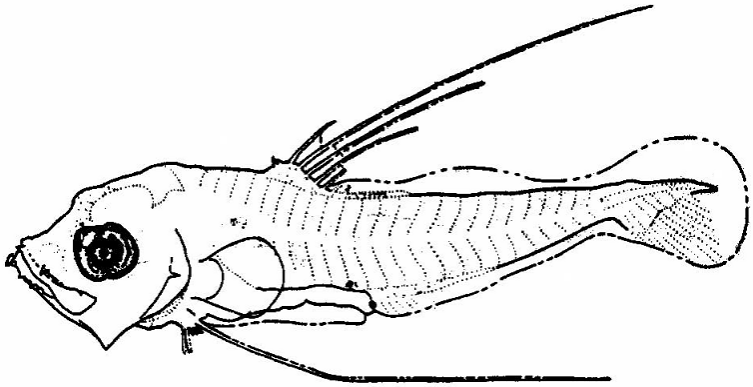
		supracleithral develop a spine in *Centroberyx* (at postflexion in *Beryx*)	
Fin formation	An elongate pelvic-fin ray (*Beryx*) or the buds (*Centroberyx*) form. Anlagen of the dorsal and anal fins appear (the dorsal anlage of *Beryx* is located anteriorly, and the both bases are shorter than those of *Centroberyx*)	Pelvic-fin rays (both genera) and the first several spines of the dorsal fin (*Beryx*) become more elongate. Pectoral-fin rays begin to form	A remnant dorsal finfold is present by about 9 mm in *Beryx*, but absent in *Centroberyx*. The most elongate elements of the dorsal (5th spine) and pelvic (1st soft ray) fins of *Beryx* are nearly as long as body length at postflexion, and over twice body length at juvenile. All fins form completely at latest by 9.4 mm in *Centroberyx* or 15 mm in *Beryx*. Sequence of fin completion: C-D, A-P_1-P_2 (*Beryx*) or C, D, A-P_2-P_1 (*Centroberyx*)
Pigment	Lightly pigmented through larval stage. Melanophores appear internally on the dorsal surfaces of the brain, gut and gas bladder. Noto-chord tip and elongate pelvic fin are pigmented in *Beryx*. Pigment is present on the ventral midline of the tail and over the midbrain in *Centroberyx* (the former pigment is reduced in number, but the latter expanded with growth)	Pigment on the notochord tip in *Beryx* disappears. Pigment is present laterally and dorsally along the caudal peduncle in *Centroberyx*	Dorsal surface of the head and the elongate dorsal and pelvic rays are pigmented in *Beryx*
Similar families	Anomalopidae, Apogonidae, Callanthiidae, Glaucosomatidae, Lampridiform families, Melamphaidae, Pempherididdae, Serranidae (Anthiinae, Serraninae), Stromateidae		

Meristic characters of the Indo-Pacific berycid genera (Leis and Carson-Ewart, 2000)

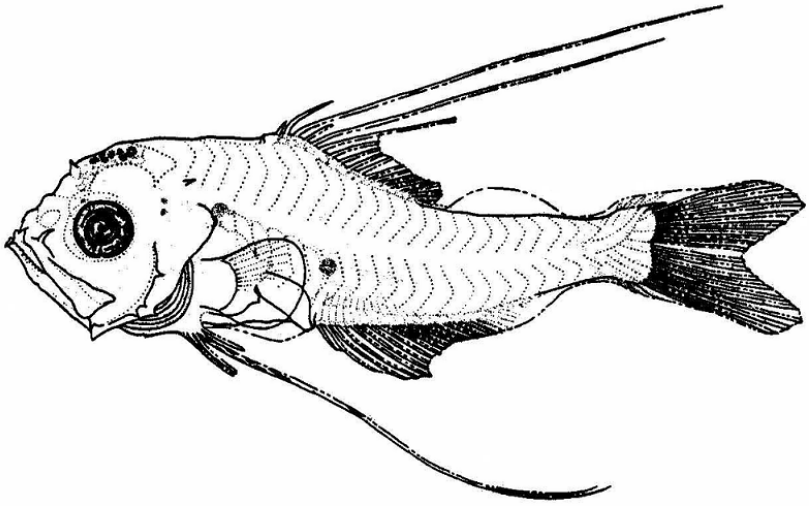
	D	A	P_1	P_2	C	VERTEBRAE
Beryx	IV, 13-20	III-IV, 25-30	15-18	I, 10-13	10+9	10+14 = 24
Centroberyx	VI-VII, 11-14	IV, 12-14	12-14	I, 7	10+9	10+14 = 24



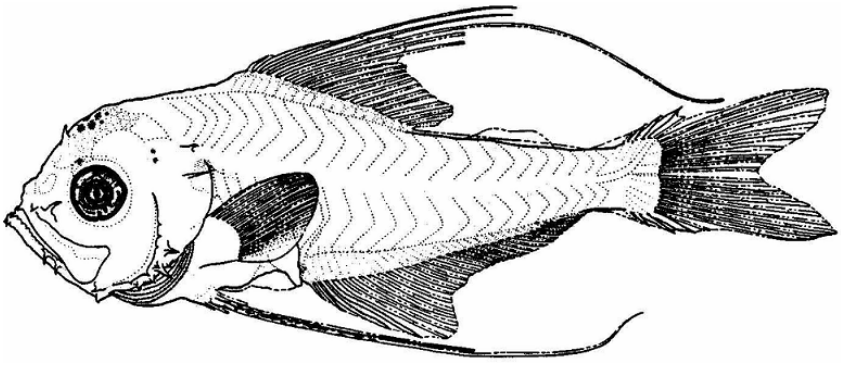
a 3.3 mm SL (*Beryx* sp.)



b 4.6 mm SL (*Beryx* sp.)

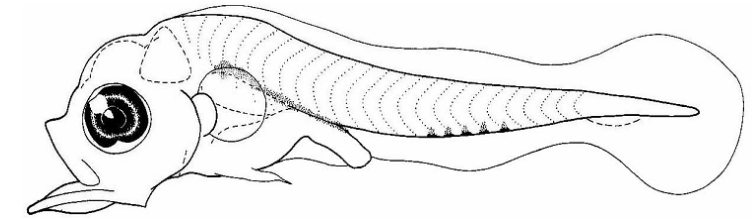


c 6.0 mm SL

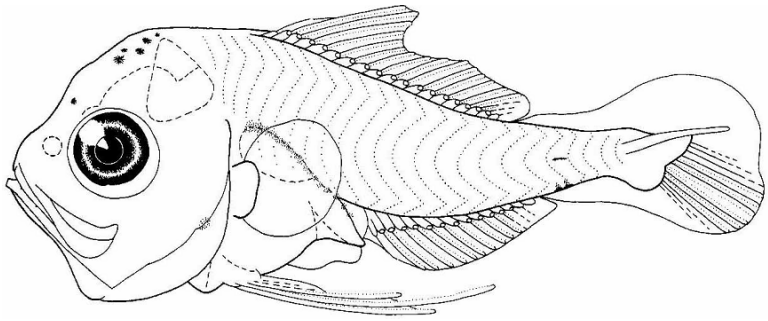


d 7.5 mm SL

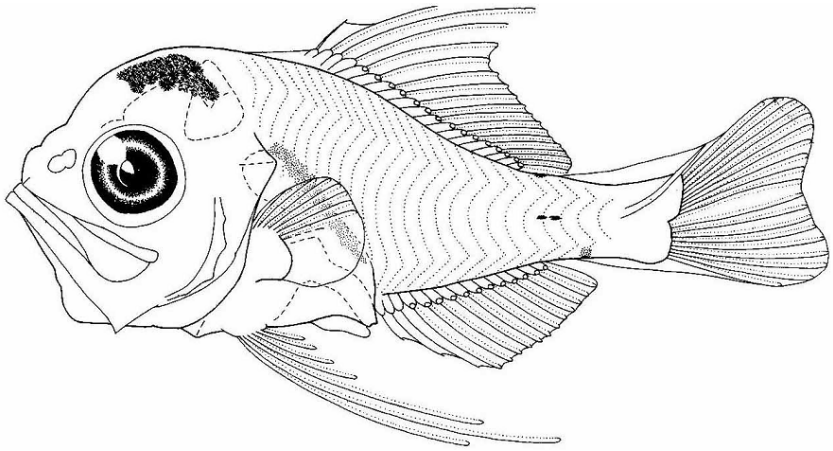
Fig. 19 Larvae of *Beryx splendens* from the central North Pacific (Mundy 1990)



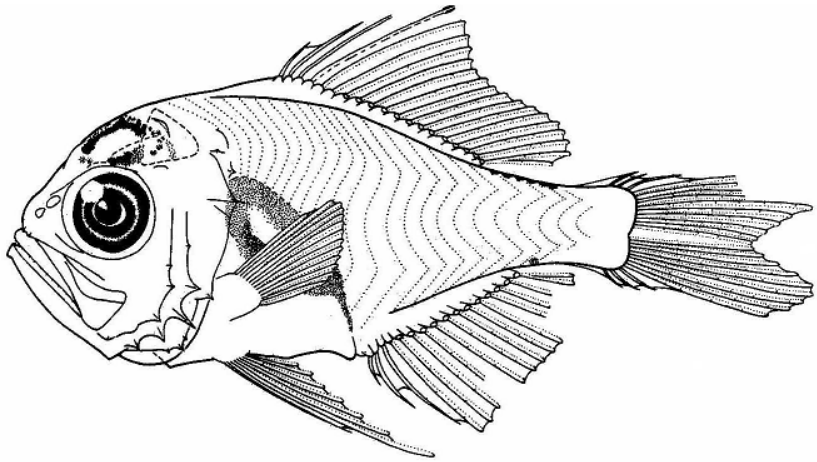
a 3.3 mm SL



b 5.3 mm SL



c 5.7 mm SL



d 9.4 mm SL

Fig. 20 Larvae of *Centroberyx affinis* from South Australia (Miskiewicz et al. 1998)

Order: Beryciformes

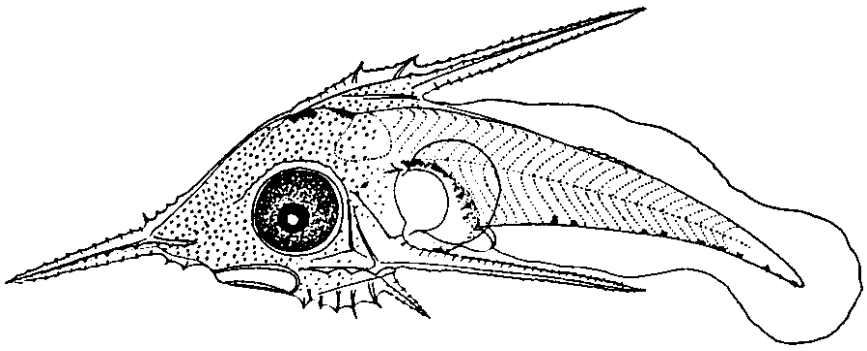
Family: Holocentridae (Squirrelfishes, soldierfishes)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Moderate with the slender tail, becomes deeper with growth	Moderate and laterally compressed with the tapering tail	Moderate and laterally compressed
Gut	Coiled and triangular, reaches to 40-55% BL	Coiled and triangular, reaches beyond the mid body	Coiled and deep, reaches well beyond the mid body
Gas bladder	Small over the anterior portion of the gut	Small over the anterior portion of the gut	Inconspicuous
Head	Moderate to large	Large and deep	Large and deep
Snout	Initially short and truncate, becomes elongate and bulbous as the rostral spine develops	Triangular and bulbous	Elongate and bulbous with the pyramid-shaped (Myripristinae) or needle-like (Holocentrinae) rostral spine
Mouth	Small and initially terminal, later inferior with development of the rostral spine	Small and inferior, reaches to less than the mid eye	Small and inferior, reaches to less than the mid eye
Eyes	Large and round	Large and round	Large and round
Head spination	Well developed through larval stage. A large, complex, serrate rostral spine (bifurcate in Myripristinae) forms. A serrate supraoccipital crest with a large, retrorse spine and small dorsal spines, and serrate or smooth preopercular spines appear. A prominent spine on the opercle and serrate ridges over the eye and on the frontal, pterotic and parietal develop	Supraoccipital crest, preopercle spine at angle and rostral spine become notably elongate and attain maximum relative length by completion of flexion or shortly after flexion	Additional spination appears on the ventral margin of the lachrymal. Elongate supraoccipital crest, and preopercle and rostral spines decrease in size
Fin formation	Pelvic-fin buds first form in Myripristinae (the rays begin to form at flexion). Anlagen of the soft dorsal and anal fins in Myripristinae, and the dorsal-fin anlage in Holocentrinae develop at the tail	Pelvic-fin buds form in Holocentrinae (the rays begin to form at postflexion). Incipient rays of the soft dorsal, anal and pectoral fins appear concurrently with several dorsal-fin spines	All fins form completely by 8.3 mm. Sequence of fin completion: C-D, A-P_1-P_2
Pigment	Lightly pigmented. Melanophores appear dorsally on	Melanophores increase in number on the gut and head.	Entire body except the soft dorsal, caudal and pectoral

	the gut and gas bladder. Head on the brain and the rostral spine are pigmented in some species. Myripristines develop melanophores on the dorsal, lateral and ventral tail, and on the pelvic buds. Holocentrines have a series of pigment on the ventral midline of the tail (pigment on the tail in the both taxa disappears by flexion)	Pigment appears on the dorsal trunk, operculum and dorsal-fin spines	fins, caudal peduncle and snout is pigmented lightly to moderately
Similar families	Malacanthidae (*Hoplolatilus*), Caproidae, Cepolidae, Leiognathidae, Lethrinidae, Priacanthidae		

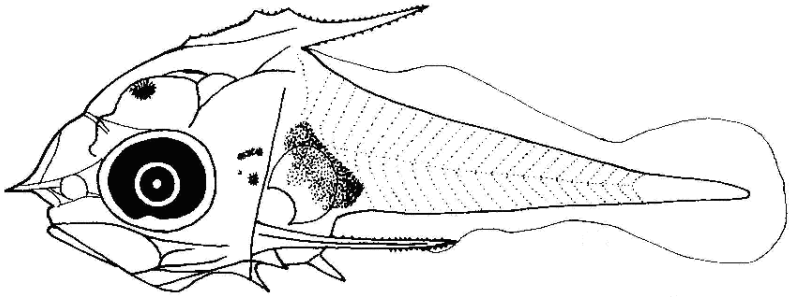
Meristic characters of the Indo-Pacific holocentrid genera (Leis and Carson-Ewart, 2000)

	D	A	P_1	P_2	C	VERTEBRAE
Holocentrinae						
Sargocentron	XI, 12-16	IV, 8-11	13-16	I, 7	10+9	11+16 = 27
Neoniphon	XI, 11-14	IV, 7-9	12-15	I, 7	10+9	11+16 = 27
Myripristinae						
Myripristis	X+I, 13-17	IV, 10-16	14-17	I, 7	10+9	11+15 = 26
Ostichthys	XI-XIII, 12-14	IV, 10-12	14-17	I, 7	10+9	11+15 = 26
Plectrypops	XI+I, 15-16	IV, 11-12	17-18	I, 7	10+9	11+16 = 27
Pristilepis	XII, 14-15	IV, 11-12	15-16	I, 7	10+9	11+18 = 29

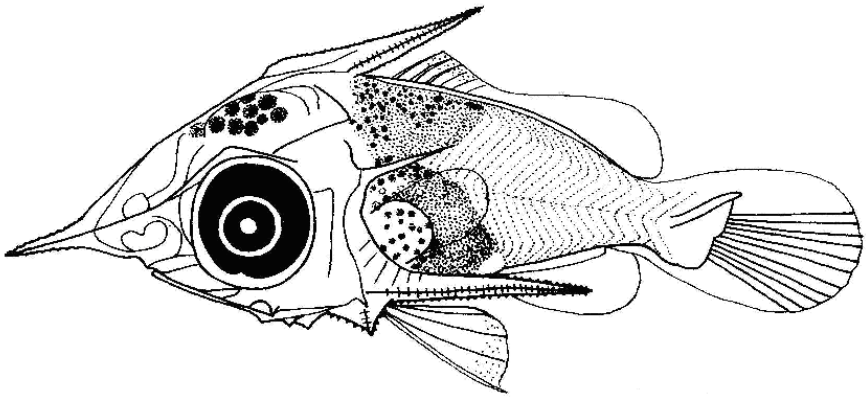


a 4.65 mm TL

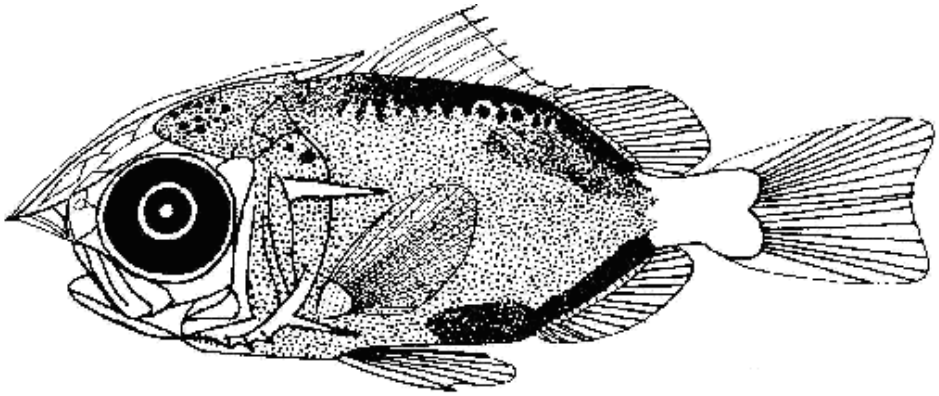
Fig. 21 Larvae of Holocentrinae sp. from southern Japan (Mito 1966)



a ca 2.5 mm TL



b ca 5.2 mm TL



c ca 10.5 mm TL

Fig. 22 Larvae of Myripristinae sp./spp. from Thailand (by Termvidchakorn, A.)

Order: Zeiformes

Family: Zeidae (Dories)

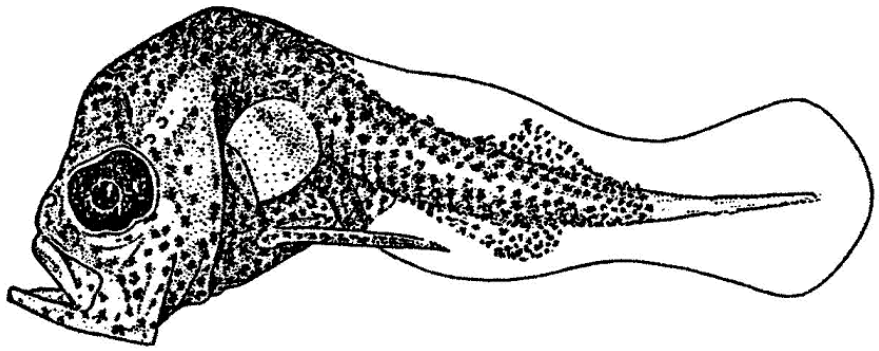
Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Initially moderate, thereafter deep and laterally compressed, and becomes deeper with growth	Deep and strongly laterally compressed	Very deep and strongly laterally compressed
Gut	Coiled and initially somewhat slender, thereafter becomes triangular as the body deepens. Anus is located at the mid-body or slightly beyond it, and moves posteriorly with growth	Coiled and very deep, extends beyond the mid-body	Coiled and very deep, extends beyond the mid-body
Gas bladder	Conspicuous anteriorly over the dorsal surface of the gut	Conspicuous over the dorsal surface of the gut	Conspicuous entirely over the gut
Head	Moderate with a hump-backed profile, becomes larger, deeper with growth	Large, deep and round in the dorsal profile	Large, deep and round in the dorsal profile
Snout	Short and initially round, thereafter steep	Short and steep to very steep	Short and very steep
Mouth	Terminal, large and oblique, reaches to the mid pupil	Terminal, large and oblique, reaches to the mid pupil	Terminal, large and oblique, reaches to the mid pupil
Eyes	Large and round	Large and round	Large and round
Head spination	Absent or poorly developed through larval stage. A small spine forms at the otic region (*Zenopsis*, *Zeus*?)	Additional spines develop on the supraocular ridge and outer margin of the preopecle in *Zenopsis*. A supraocular ridge with tinny spines ephemerally appears in *Zeus*	Absent in *Zeus*. No information available for *Zenopsis*
Fin formation	Pelvic-fin buds first appear at the abdomen, thereafter the fins become large with soft rays. Anlagen of the dorsal and anal fins form (in *Zeus*, the anlagen are initially separated from the body margin in the median finfolds and connected to the body by a series of hyaline strands, later	Pelvic fins just posterior to the level of the pectoral-fin base are greatly large and extend to the middle of the anal fin (a full complement of the fin is attained in *Zeus*). First several spines of the dorsal fin develop more rapidly than the rays and become elongate. Caudal- and anal-fin rays develop	Pelvic fin originates in the level of the pectoral-fin base and its posterior margin extends to the caudal-fin base. All fins form completely by 7.2 mm in *Zeus*

	attached to the body)		
Pigment	Heavily pigmented through larval stage. Whole body except the posterior regions of the tail and median finfolds are heavily pigmented. Later melanophores appear on the dorsal- and anal-fin anlagen and the anterior region of the dorsal finfold	Elongate, spinous dorsal fin is heavily pigmented (in *Zeus*, additional pigment is present on the middle region of the dorsal- and anal-fin bases)	Whole body except the soft dorsal and anal fins and the caudal fin is heavily pigmented
Similar families	Anomalopidae, Carangidae (*Alectis*), Lampridae (*Lampris*), Monocentridae, Trachichthyidae (*Aulotrachichthys*)		

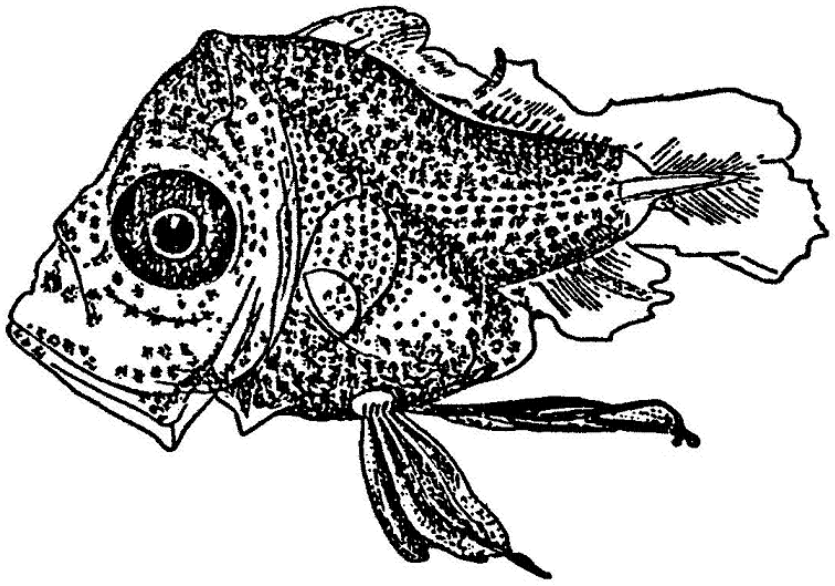
Meristic characters of the Indo-Pacific zeid genera[a] (modified from Leis and Carson-Ewart (2000))

	D	A	P_1	P_2	C	VERTEBRAE
Zenopsis	VII-XI, 24-29	III, 22-27	11-13	I, 5	6+7	(12-13) + (21-22) = 32-36
Zeus	IX-XI, 21-24	IV-V, 19-25	12-15	I, 6-7	6+7	30-32

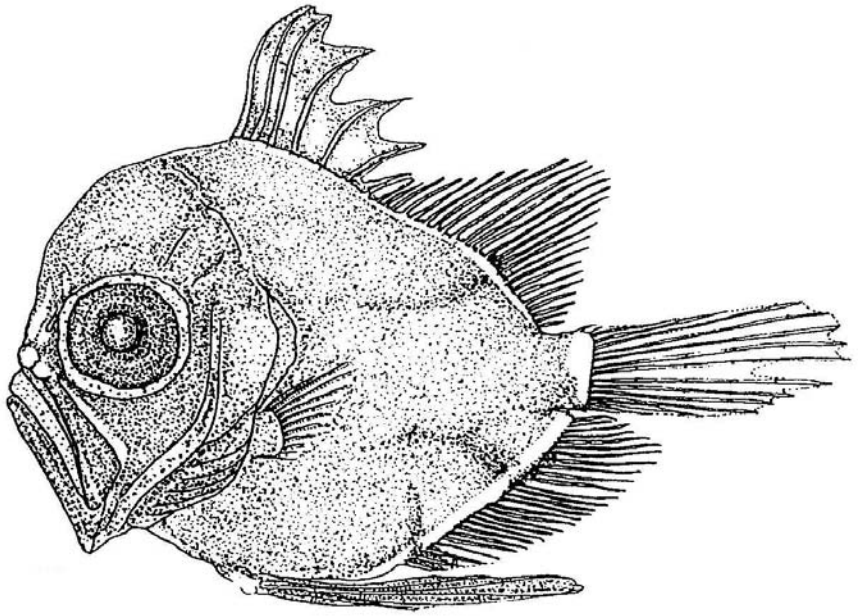
[a] *Capromimus*, *Cyttopsis* and *Stethopristes*, and *Cyttus* are replaced in Zeniontidae, Parazenidae and Cittidae, respectively (Nelson 2006).



a 4.8 mm SL



b 4.5 mm SL



c 7.2 mm SL

Fig. 23 Larvae of *Zeus faber* (a, b: Sanzo 1956; c: Okiyama 1988b)

Order: Scorpaeniformes

Family: Scorpaenidae (Scorpionfishes, rockfishes)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Moderate and slightly compressed, becomes deeper with growth. Body is commonly enclosed in a dermal sac at the early preflexion	Moderate and laterally compressed	Moderate to deep, wide in the head and trunk and laterally compressed and ovoid in cross-section in the tail
Gut	Coiled and triangular, reaches anterior to the mid body. Preanal length becomes relatively larger with growth	Coiled and triangular, reaches to about the mid body	Coiled and triangular, reaches posterior to the mid body
Gas bladder	Small, located over the anterior portion of the gut	Small, located over the anterior portion of the gut	Small, located over the anterior portion of the gut
Head	Moderate and round, becomes larger with growth (Morph A and B)	Moderate and round (Morph A), large and triangular (Morph B)	Moderate to large and round (Morph A), large and triangular (Morph B)
Snout	Short and slightly round (Morph A and B)	Relatively short and steep (Morph A), relatively long and triangular (Morph B)	Relatively short and steep (Morph A), relatively long and triangular (Morph B)
Mouth	Oblique, reaches beyond the anterior edge of the eye	Oblique, reaches to or beyond the mid pupil	Oblique, reaches to or beyond the mid pupil. Mostly, both jaws develop small teeth
Eyes	Large and round, become relatively smaller with growth	Moderate to large and round	Mostly moderate and round
Head spination	Well developed through larval stage. Parietal, supraocular, pterotic and preopercle spines form (some species develop some of them in the early flexion stage)	Spines form on the lachrymal, posttemporal and supracleithrum. Head spines are relatively short and smooth in Morph A, and relatively long and serrated partly on the parietal, supraocular and preopercle bones in Morph B	Additional spines appear on the cleithrum, opercle and interopercle in some species
Fin formation	Large (Morph B) to very large (Morph A) pectoral fin forms with incipient rays. Pelvic-fin buds form at latest by flexion stage	Anlagen of the dorsal and anal fins are present, and the spines and rays begin to form	Pectoral fin reaches to the caudal peduncle commonly (Morph A) or occasionally (Morph B). Pelvic-fin spine is short and weak (Morph A), or relatively moderate to long and robust (Morph B). Full completion of all fins is

			achieved at latest by 7.5 mm. Sequence of fin completion: P_1-C- P_2-D, A
Pigment	Generally lightly pigmented through larval stage (in particular at pre-flexion and flexion stages). Dorsal surface of the gut is pigmented. Melanophores are present on the dorsal and ventral midlines of the body and pectoral fin in some species	Pectoral fin is fully or partly pigmented in some species	Pigment appears on other fins in some species. Pigment stripes develop on the head and body portions in *Apistus* and *Dendrochirus*
Similar families	Aploactinidae, Calacanthidae, Dactylopteridae, Hoplichthyidae, Istiophoridae, Malacanthidae, Platycephalidae, Serranidae (Anthiinae), Symphysanodontidae, Triglidae		

Morph A: Apistinae, Synanceiinae, Tetraroginae (at least *Apistus*, *Inimicus*, *Minous*, *Neocentropogon*, *Paracentropogon*, *Synanceia* and *Vespicula*)

Morph B: Scorpaeninae, Sebastinae, Setarchinae (at least *Dendrochirus*, *Ectreposebastes*, *Iracundus*, *Pterois*, *Rhinopias*, *Scorpaena*, *Scorpaenodes*, *Sebastiscus* and *Taenianotus*)

Meristic characters of the Indo-Pacific scorpaenid genera (modified from Leis and Carson-Ewart (2000))

	D	A	P_1	P_2	C (Branched)	VERTEBRAE
Apistinae						
Apistops	XIV, 7-9	III, 5-7	11	I, 5	-	25-27
Apistus	XIV-XVI, 8-10	III, 6-8	11-13	I, 5	-	25-26
Cheroscorpaena [a]	XIII, 7-9	III, 6-7	12	I, 5	11-12(5+4-5)	26
Neosebastinae						
Neosebastes	XIII, 7-9	III, 4-8	18-23	I, 5	-	26?
Plectrogeninae						
Plectrogenium	XII, 6-7	III, 5	21-23	I, 5	-	26
Scorpaeninae						
Pteroni						
Brachypterois	XIII, 11	III, 5-7	15-16	I, 5	-	24
Dendrochirus	XIII, 8-11	III, 5-7	16-21	I, 5	(5-6+5)	24
Ebosia	XIII, 9-10	III, 7-9	15-18	I, 5	-	24
Parapterois	XIII, 8-9	II-III, 6-8	18-20	I, 5	6+5 = 11	24
Pterois	XII-XIII, 9-12	III, 5-8	12-18	I, 5	-	24
Scorpaenini						
Idiastion [b]	XII, 9	III, 5	18	I, 5	(7+7)	25
Iracundus [c]	XII, 9	III, 5	17-19	I, 5	-	24
Neomerinthe	XII, 9	III, 5	18-19	I, 5	-	24
Parascorpaena	XII, 8-10	III, 5	14-17	I, 5	-	24
Phenacoscorpius	XII, 9	III, 5	17	I, 5	-	25
Pontinus	XII, 9-10	III, 5	15-20	I, 5	8+7(6+5)	24
Pteroidichthys	XII, 9-10	II, 6	15-16	I, 5	6+6	24

Rhinopias	XII, 9	III, 5	14-18	I, 5	14(12)	24
Scorpaena	XII, 8-10	III, 4-6	15-20	I, 5	8+7-8=15-16	24-25
Scorpaenodes	XII-XIV, 7-10	III, 4-6	15-20	I, 5	8+7(6+5)	24-25
Scorpaenopsis	XII, 8-10	III, 5-6	16-19	I, 5	(6+5)	24
Sebastapistes	XII, 8-12	III, 5	14-20	I, 5	-	24
Taenianotus	XII, 10-11	III, 5-7	14-15	I, 5	-	24
Ursinoscorpaenopsis [d]	XII, 10	III, 5	17	I, 5	16	8+16=24
Sebastinae						
Sebastiscus	XI-XIII, 10-13	III, 5-6	16-20	I, 5	-	-
Setarchinae						
Ectreposebastes	XI-XII, 9-11	III, 5-7	18-21	I, 5	-	-
Lioscorpius	XII, 9-10	II, 6	23-25	I, 5	-	-
Setarches	XI-XIII, 9-11	III, 4-6	20-25	I, 5	-	-
Synanceiinae						
Choridactylini						
Choridactylus [e]	XII-XV, 8-10	II, 8-10	11-12	I, 5	(5+6)	26-28
Inimicus	XV-XVIII, 5-9	II, 8-13	12	I, 5	14(9)	27-30
Minoini						
Minous	VIII-XII, 8-14	II, 7-11	11-13	I, 5	7+7 = 14	24-27
Synanceiini						
Erosa	XII-XIV, 5-9	II-III, 5-6	12-16	I, 4	8+8 = 16?	24-26?
Leptosynanceia	XVI, 5	III-IV, 5-6	13-15	I, 4	-	28
Pseudosynanceia [f]	XV-XVII, 4-6	III, 7-8	14-15	I, 3	-	26-27
Synanceia	XII-XVII, 4-7	III,4-7	11-19	I, 4-5	(4+5)	24
Trachicephalus	XI-XIII, 12-14	II, 12-14	14-15	I, 5	-	28-30
Tetraroginae						
Ablabys	XV-XVII, 7-11	III, 5-9	11-13	I, 5	11-13(4+5-6)?	26-28?
Centropogon	XV-XVI, 7-9	II-III, 5-6	13-15	I, 5	12(5+5)	26-27
Coccotropsis [g]	XIV-XVI, 5-6	III, 3-6	11-12	I, 3	-	25-27
Cottapistus	XIII-XV, 5-7	III, 5-6	13-15	I, 4	12(5+5)	24-25
Liocranium	XIII-XIV, 6-9	III, 5-6	13-15	I, 4	12-14(5-6+5-6)	24-25
Neocentropogon	XIII-XV, 7-8	III, 5-7	13-16	I, 5	11-12(4-5+5)	24-25
Ocosia	XIV-XVII, 7-10	III, 4-7	11-13	I, 5	8+8 = 15(9-11)	26-30
Paracentropogon	XIII-XV, 6-8	III, 3-5	9-12	I, 4	12(5+5)	25-27
Richardsonichthys	XII-XIII, 5-8	III, 5-7	14-16	I, 5	12(10)	24-25
Snyderina	XII-XIV, 9-11	III, 5-6	13-15	I, 5	12-14(5-6+5-6)	24-28
Tetraroge	XIII-XIV, 6-9	III, 4-6	11-13	I, 5	10(4+4)	24-26
Vespicula	III+VII-XII, 3-8	III, 3-6	10-14	I, 5	10-12(4-5+4-5)	24-26

[a] Known from the western Central Pacific.

[b] Known from southern Japan.

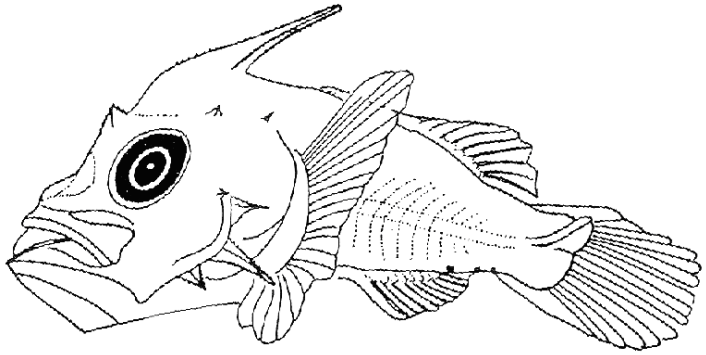
[c] Known from southern Japan, Taiwan, New Caledonia, Hawaii and South Africa.

[d] Known only from Japan.

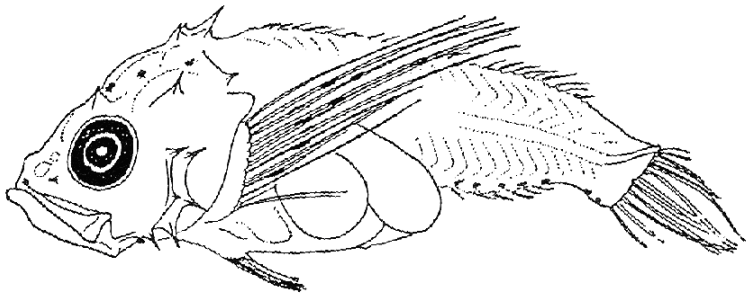
[e] Known from southern Japan, Taiwan and Australia.

[f] Known only from western Indian Ocean.

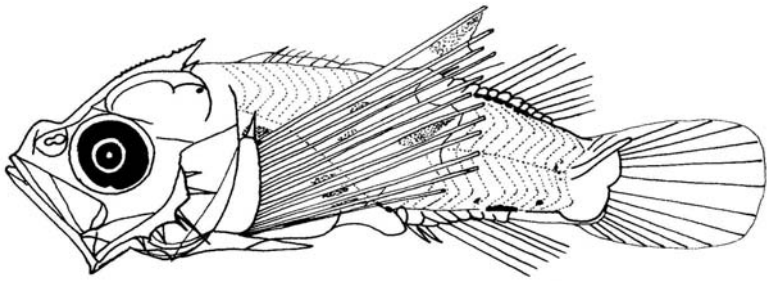
[g] Known only from South Africa.



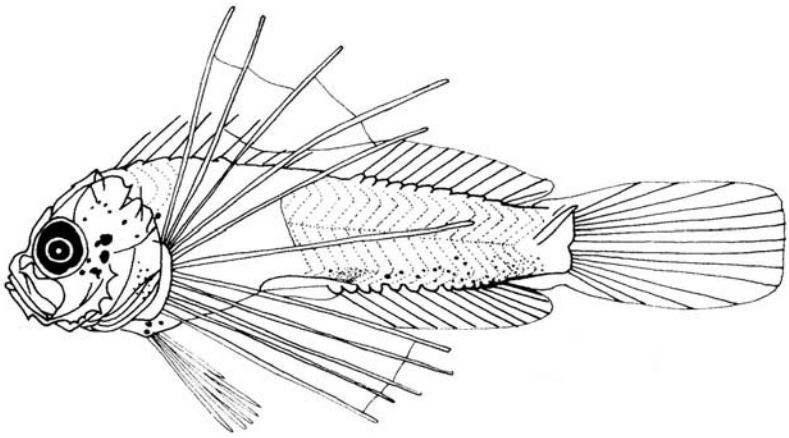
a 4.3 mm TL



b 6.0 mm TL



c 6.71 mm TL (*Minous* sp.)



d 11.03 mm TL (*Minous* sp.)

Fig. 24 Larvae of Scorpaenidae spp. from the Gulf of Thailand (a, b: Chayakul 1996) and the South China Sea (c, d: Termvidchakon 1997)

Order: Scorpaeniformes

Family: Platycephalidae (Flatheads)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Elongate to moderate with a hump-backed appearance, and slightly compressed	Elongate to moderate with a hump-backed appearance, and round to ovoid in cross-section	Elongate to moderate with a hump-backed appearance, and round to ovoid in cross-section
Gut	Initially straight and later coiled, reaches to the mid body. Preanal length becomes longer with growth. Anus protrudes beyond the ventral body margin until flexion stage	Coiled, reaches beyond the mid body	Coiled, reaches distinctly beyond the mid body
Gas bladder	Small over the anterior portion of the gut	Small over the anterior portion of the gut	Small and inconspicuous over the anterior portion of the gut
Head	Moderate and somewhat round, becomes larger with growth	Moderate to large with a wedge-shaped profile	Large and vertically de-pressed with a wedge-shaped profile
Snout	Mostly prominently concave in dorsal profile, becomes larger and depressed with growth	Slightly concave and flattened	Laterally pointed and vertically flattened
Mouth	Terminal and large, mostly reaches to or past the mid eye. Small villiform teeth are present on the upper jaw	Terminal and large, mostly reaches to or past the mid eye. Small villiform teeth are present on the lower jaw	Terminal and large, mostly reaches to or past the mid eye. Lower jaw protrudes beyond the upper jaw in some species
Eyes	Large to moderate and round, becomes smaller with growth	Moderate to small and round	Small and round, and migrate dorsally after settlement
Head spination	Small preopercle and parietal spines form	Preopercle spines increase in number and size. Supra-ocular, supracleithral, post-temporal, pterotic and cleithrum spines are present	Infraorbital series and two opercular spines develop. A small nasal spine forms in some species
Fin formation	Anlagen of the dorsal and anal fins and pelvic-fin buds form	Fan-shaped pectoral fin with the incipient rays develops. Dorsal-, anal- and pelvic-fin elements begin to form	Pelvic fin becomes enlarged in some species. Full com-pletion of all fins is achieved by 7 mm. Sequence of fin completion: P_1-C-D, A-P_2
Pigment	Small melanophores appear mostly on the ventral mid-line of the tail, on the gut,	Melanophores on the snout, operculum, pectoral fin and lateral body increase in	Entire body except the 2nd dorsal fin, anal and caudal fins and caudal peduncle is

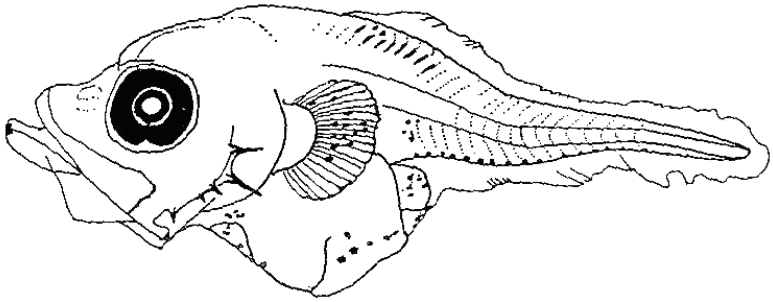
	jaws, operculum, pectoral fin and its base. Dorsal mid-line of the body and the lateral body are pigmented in some species	number. Brain, pelvic fin and spinous dorsal fin are pig-mented in some species	heavily pigmented at juvenile stage
Similar families	Callionymidae, Hoplichthyidae, Opistognathidae, Percophidae, Serranidae (Anthiinae), Sphyraenidae, Triglidae,		

Meristic characters of the Indo-Pacific platycephalid genera (modified from Leis and Carson-Ewart (2000))

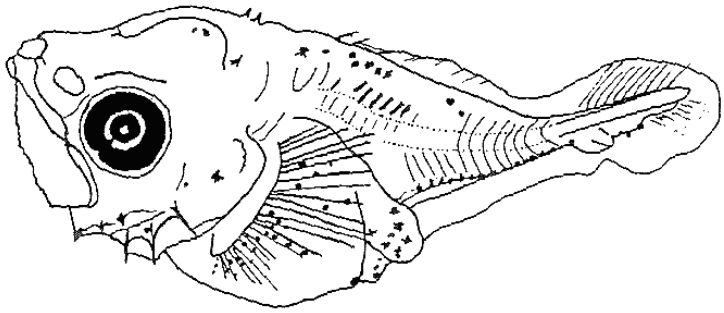
	D [a]	A	P_1	P_2	C (Branched)	VERTEBRAE
Cociella	VIII-IX+10-12	10-13	19-22	I, 5	[10-12]	27-28
Cymbacephalus	VIII-X+11-12	11-12	19-21	I, 5	-	(11-12) + (15-16) = 27
Elates	VI+13-14	12-14	19-22	I, 5	8+7	27
Eurycephalus	VIII-IX+11-12	12-13	18-22	I, 5	-	27
Grammoplites	VIII-X+12+13	12-13	18-23	I, 5	[6+5-6]	27
Inegocia	VIII-IX+11-12	11-13	19-25	I, 5	-	27
Kumococius	IX-X+11	12-13	18-20	I, 5	-	27
Onigocia	VIII-IX+11-12	11-13	20-23	I, 5	7+6[5+5]	27
Papilloculiceps [b]	IX+11	11	19-22	I, 5	-	-
Platycephalus	VII-X+13-14	13-14	17-20	I, 5	-	27
Ratabulus	IX-X+11	11-12	18-20	I, 5	7+8	(11-12) + (15-16) = 27
Rogadius	VIII-IX+10-13	10-13	19-23	I, 5	15[10-13]	27
Sorsogona	IX+10-12	10-12	19-22	I, 5	-	-
Suggrundus	VIII-IX+10-12	11-12	19-22	I, 5	(6-7)+(6-7) = 13	-
Thysanophrys	VIII-IX+11-14	11-14	18-22	I, 5	7+7	27

[a] The first dorsal spine is often not connected by a membrane to the second and therefore is sometimes reported as I+VII+I.

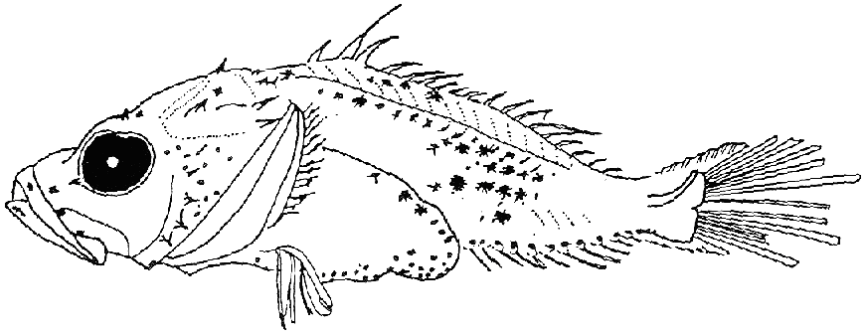
[b] Only *P. longiceps* is known from the western Indian Ocean and the Red Sea.



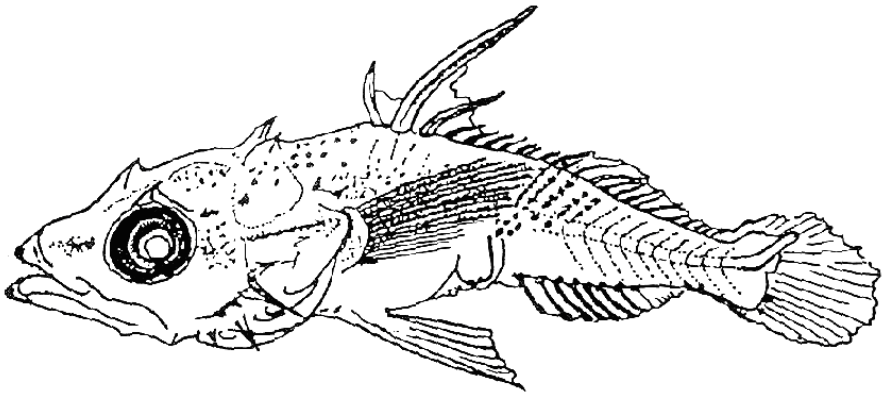
a 3.5 mm TL



b 3.8 mm TL



c 6.5 mm TL



d 5.5 mm TL

Fig. 25 Larvae of Platycephalidae sp./spp. from the Gulf of Thailand (Chayakul 1996)

Order: Perciformes

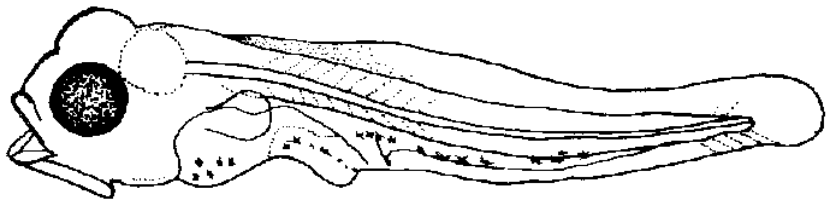
Family: Latidae (Barramundi, sea basses)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Initially elongate, later moderate	Moderate and compressed	Moderate and compressed
Gut	Coiled, reaches beyond the mid body. Preanal length becomes larger with growth	Coiled and broadly triangular, reaches beyond the mid body	Coiled and broadly triangular, reaches beyond the mid body
Gas bladder	Conspicuous, over the anterior gut	Conspicuous, over the anterior gut	Inconspicuous due to dense pigment on the body
Head	Moderate to large, with a convex dorsal profile	Large, with a convex dorsal profile	Large and robust
Snout	Short, round and steep	Short and slightly pointed	Short and triangular
Mouth	Oblique	Large and oblique. The upper jaw reaches to the mid pupil	Large and oblique. The upper jaw reaches to the mid pupil
Eyes	Large and round	Moderate and round	Moderate and round
Head spination	Small preopercle spines appear	Preopercle spines increase in number and become larger	Small spine appears on the opercle and interopercle (disappear by about 8 mm). Supracleithral ridge forms
Fin formation	Dorsal and anal fin anlagen form late. Pectoral fin buds form	Incipient rays of the dorsal and anal fins form. Pelvic fin buds appear	Full completion of all fins is achieved by at latest 10 mm. Sequence of fin completion: C-D, A-P_2-P_1
Pigment	Pigment series appears on the dorsal, lateral and ventral midlines, and ventral margin of the gut. Internal pigment band lies laterally in the snout and from posterior to the eye to the dorsal margin of the gut. Some melanophores appear on the head	Melanophores increase in number and become larger in the head, trunk and tail	Pigment extends in the spinous dorsal and pelvic fins, and on the bases of the soft dorsal fin and anal fin, covering most of the body
Similar families	Gobiidae (heavily pigmented and deep-bodied larvae), Leptobramidae, Mugilidae, Toxotidae		

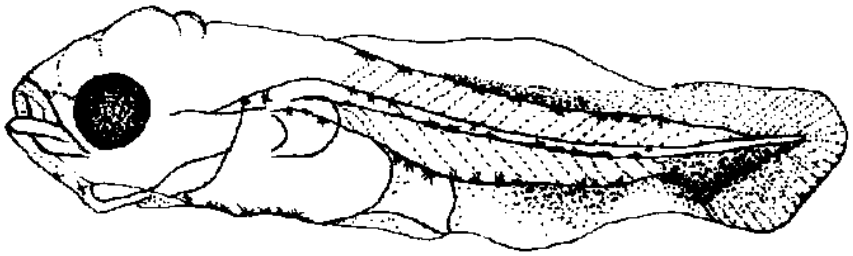
Meristic characters of the Indo-Pacific latid genera (Leis and Carson-Ewart, 2000)

	D[a]	A[a]	P_1	P_2	C	VERTEBRAE
Lates	VII-VIII + I, 10-12	III, 7-9	16-18	I, 5	9+8	11+14 = 25
Psammoperca	VII + I, 12	III, 8	16-17	I, 5	9+8	11+14 = 25

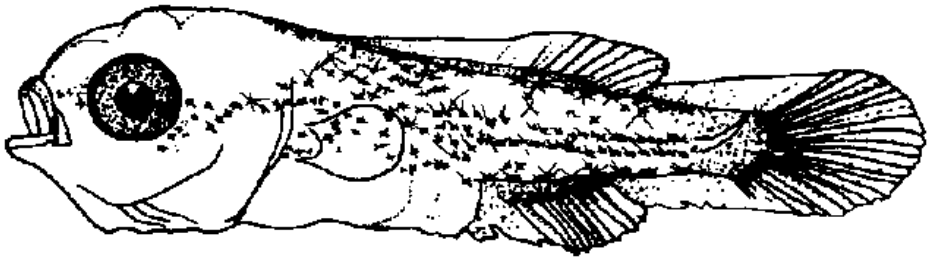
[a] Reared larvae may have counts somewhat outside these ranges.



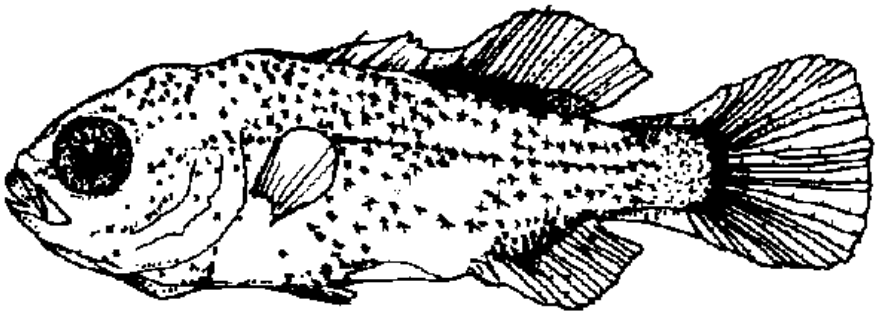
a 2.10 mm SL (rearing, 4 days after hatching)



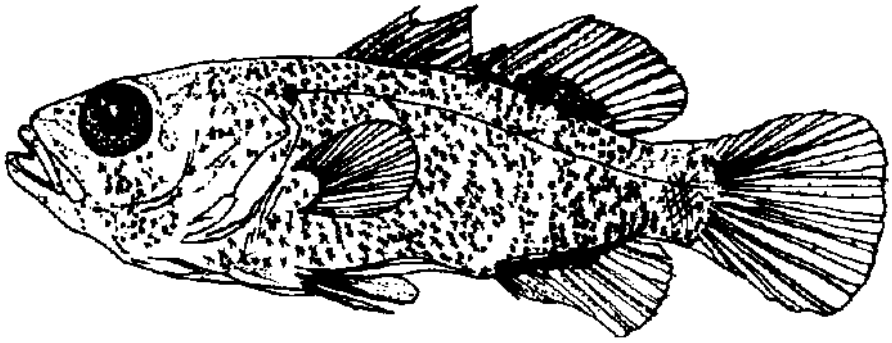
b 2.90 mm SL (rearing, 8 days after hatching)



c 3.15 mm SL (rearing, 11 days after hatching)



d 5.10 mm SL (rearing, 16 days after hatching)



e 9.50 mm SL (rearing, 25 days after hatching)

Fig. 26 Larvae of *Lates calcarifer* from Thailand (Tunvilai et al. 1986)

Order: Perciformes

Family: Acropomatidae (Lanternbellies)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Moderate and compressed	Moderate (*Malakichthys*, *Synagrops*) to deep (*Acropoma*, *Doederleinia*) and compressed	Moderate (*Malakichthys*, *Synagrops*) to deep (*Acropoma*, *Doederleinia*) and compressed
Gut	Coiled, reaches beyond the mid body	Coiled, reaches beyond the mid body. Anus of *Acropoma* begins to shift forward	Coiled, reaches beyond the mid body. Anus of *Acropoma* is more close to the pelvic-fin base than the anal-fin origin
Gas bladder	Conspicuous, extends along most of the dorsal surface of the gut	Conspicuous, extends along most of the dorsal surface of the gut	Conspicuous, extends along most of the dorsal surface of the gut
Head	Moderate to large, becomes larger with growth	Large (*Malakichthys*, *Synagrops*) to very large (*Acropoma*, *Doederleinia*)	Large (*Malakichthys*, *Synagrops*) to very large (*Acropoma*, *Doederleinia*)
Snout	Short and somewhat concave	Short and somewhat round	Short and somewhat round or truncate
Mouth	Large and oblique, reaches to the mid-pupil	Large and oblique, reaches to the mid-pupil	Large and oblique, reaches to the mid-pupil
Eyes	Round and large, become relatively smaller with growth	Round and large	Round and large to moderate
Head spination	Supraoccipital crest (single tiny spine in *Acropoma* and *Doederleinia*, serrate ridge in *Synagrops*, and no crest in *Malakichthys*) and pre-opercular spines (spine at angle serrated at flexion in *Synagrops*) appear	Serrate ridge appears on the frontal (only in *Synagrops*) and supraocular portion. Posttemporal, supracleithral, opercle, subopercle and infraorbital spines form	Dentary and pterotic spines form in some species
Fin formation	Pectoral fin buds form. Anlagen of the dorsal and anal fins, and the pelvic buds appear at late pre-flexion to early flexion stage	Anterior spines and rays of the dorsal fin and rays of the anal fin appear. Pectoral-fin rays begin to form	Pelvic spine and/or spines of the dorsal (2^{nd} spine of the first fin, 1^{st} spine of the second fin) and anal (2^{nd} spine) fins are serrated in some *Synagrops*. All fins form completely at the latest by 9 mm. Sequence of fin completion: D_2-A-D_1-P_2- P_1
Pigment	Melanophores are present on the isthmus and jugular, over the gut and gas bladder, and on the hind-	Nape, opercular portion and trunk (dorsolateral portion) are pigmented. Inner pigment spreads widely on the gut	Dorsal margin of the trunk, the dorsal and ventral margins or the lateral portion of the tail are pigmented in

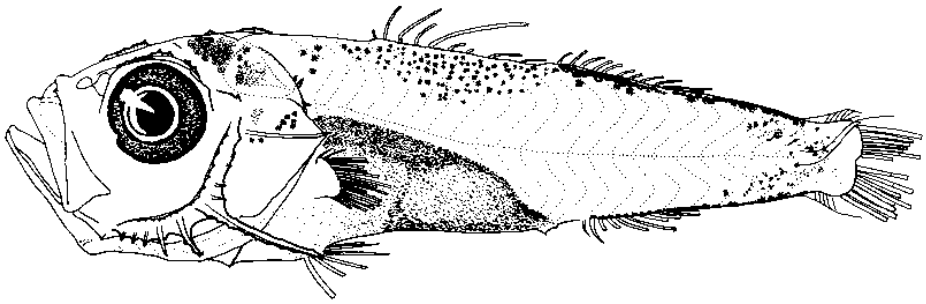
	brain or forebrain		*Doederleinia* and *Synagrops*. *Acropoma* and *Malakichthys* larvae are poorly pigmented
Similar families	Apogonidae, Carangidae, Serranidae (Serraninae, Anthiinae), Symphysanodontidae		

Meristic characters of the Indo-Pacific acropomatid genera (modified from Leis and Carson-Ewart (2000))

	D	A	P_1	P_2	C	VERTEBRAE
Acropoma	VIII-IX + I, 10	III, 7	15-16	I, 5	9+8	10+15 = 25
Apogonops [a]	IX+I, 10	III, 6-7	14	I, 5	17	25
Doederleinia	IX, 10	III, 6-8	15-18	I, 5	9+8	10+15 = 25
Malakichthys	IX-X, 9-10	III, 7-9	13-15	I, 5	9+8	10+15 = 25
Neoscombrops	IX-X + I, 9-10	III, 7	15-17	I, 5	9+8	10+15 = 25
Pseudohowella [b]	-	-	-	-	-	-
Synagrops	VIII-IX + I, 8-10	II-III, 6-8	15-18	I, 5	9+8	10+15 = 25

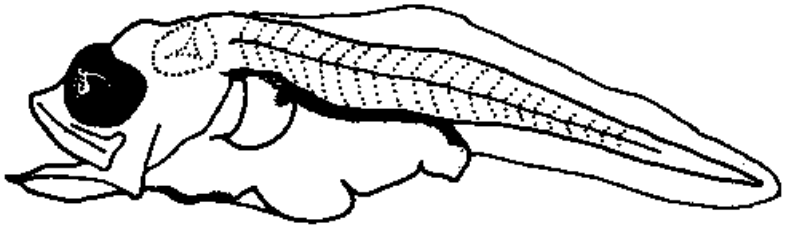
[a] Only *A. anomalus* is reported from Australia.

[b] Only *P. intermedia* is reported from Papua New Guinea and Hawaii.

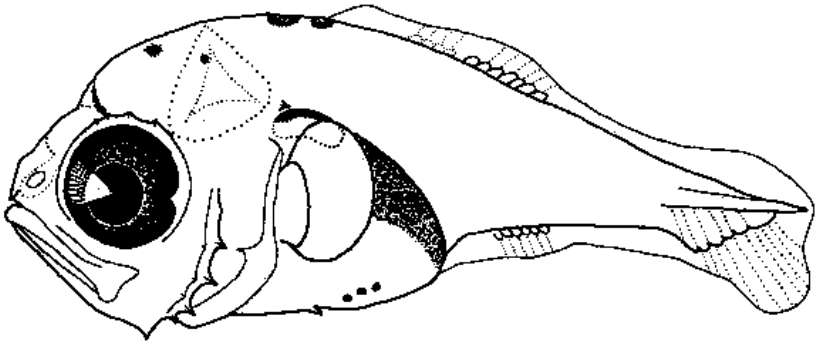


a 10.7 mm SL

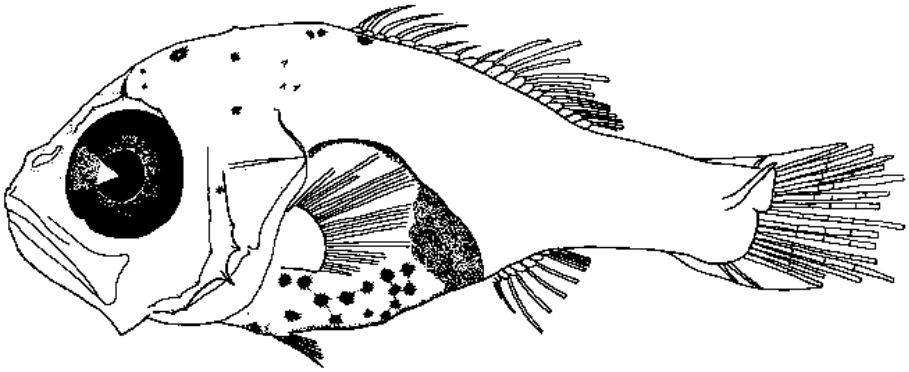
Fig. 27 Larva of *Synagrops japonicus* from southern Japan (Konishi 1988a)



a 2.3 mm SL

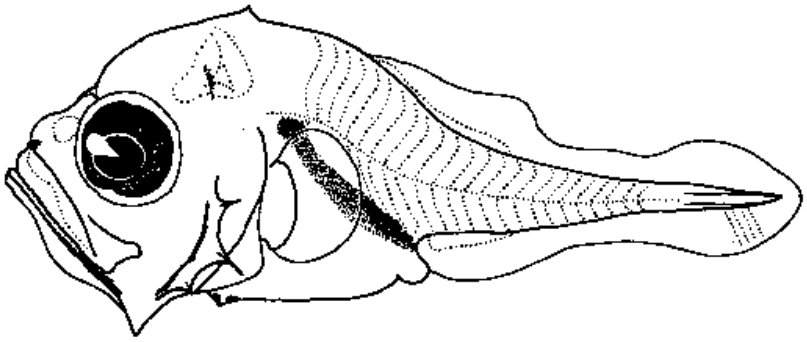


b 4.2 mm SL

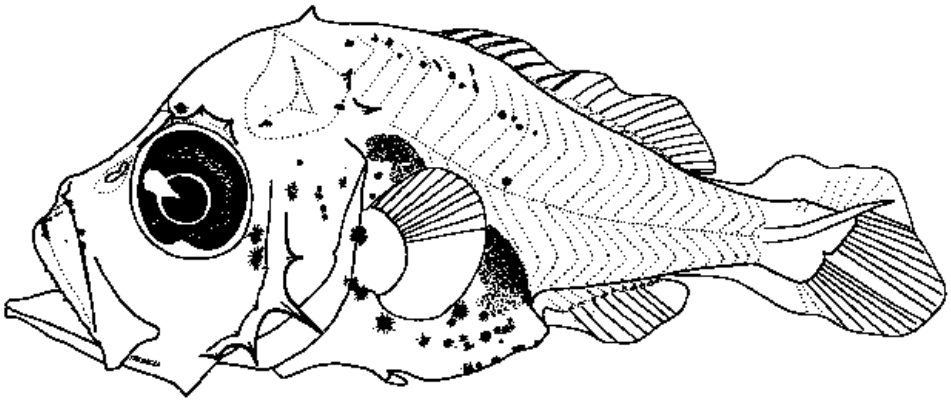


c 6.1 mm SL

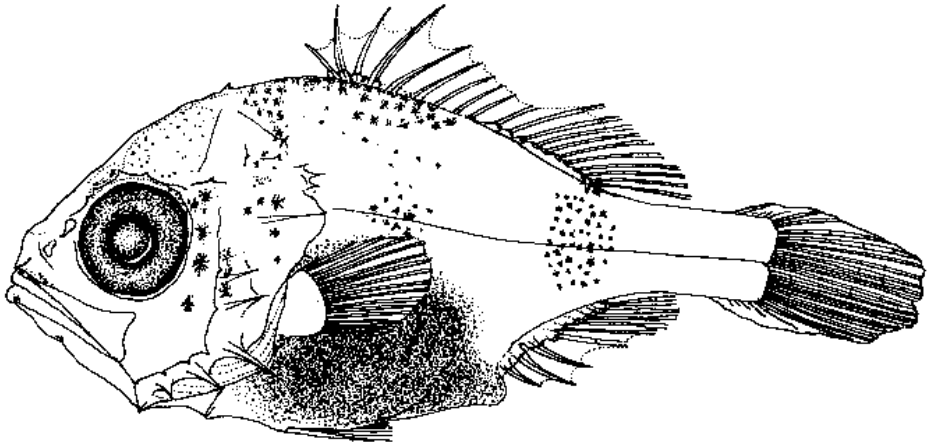
Fig. 28 Larvae of *Acropoma japonicum* from southern Japan (Konishi 1988b)



a 3.4 mm SL



b 4.7 mm SL



c 8.0 mm SL

Fig. 29 Larvae of *Doederleinia berycoides* from southern Japan (a, b: Konishi 1988c; c: Okiyama 1982)

Order: Perciformes

Family: Serranidae (Sea basses)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Moderate and compressed, and sometimes hunch-backed in Anthiinae	Moderate (Serraninae, Epinephelinae except Diploprionini) to deep (Anthiinae, epinephelin Diploprionini), compressed, and sometimes hunchbacked in Anthiinae and kite-shaped in epinephelin Niphonini and Epinephelini	Moderate (Serraninae, Epinephelinae except Diploprionini) to deep (Anthiinae, epinephelin Diploprionini), compressed, and robust (Anthiinae) and kite-shaped (epinephelin Niphonini and Epinephelini)
Gut	Coiled and compact (Anthiinae, Epinephelinae), reaches to about 60% BL (Serraninae), about 50% BL (Anthiinae, Epinephelinae except Grammistini) or anterior to the mid body (epinephelin Grammistini). The anus moves posteriorly with growth in some taxa (Anthiinae, epinephelin Gramimistini, Diploprionini and Liopropomini)	Coiled and compact, reaches to about 60% BL (Serraninae), about 50% BL (Anthiinae, Epinephelinae except Grammistini) or anterior to the mid body (epinephelin Grammistini)	Coiled and compact, reaches to about 60% BL (Serraninae), about 50% BL (Anthiinae, Epinephelinae). A small gap is present between the anus and anal-fin origin in early postflexion stage (Epinephelinae)
Gas bladder	Small and inconspicuous, located anteriorly above the gut	Small and inconspicuous, located anteriorly above the gut	Small and inconspicuous, located anteriorly above the gut
Head	Moderate (epinephelin Diploprionini, Grammistini and Liopropomini), mod-erate to large (Serraninae, Anthiinae, epinephelin Niphonini and Epinephelini), and round. Angle of the lower jaw is prominent through larval stage (Serraninae)	Moderate (epinephelin Diploprionini, Grammistini and Liopropomini), moderate to large (epinephelin Niphonini and Epinephelini), large (Serraninae), large to very large (Anthiinae), and sloped in dorsal profile	Moderate to large (Epinephelinae), large (Serraninae), large to very large (Anthiinae), round and sloped in dorsal profile
Snout	Short to moderate and blunt	Short to moderate and blunt, and prominently convex in the dorsal profile in some taxa due to a swell at the anterior tip of the premaxilla	Short to moderate, round to truncate or slightly pointed

Mouth	Oblique, reaches to the anterior edge of the eye or beyond it. The mouth increases in size with growth. Small teeth form	Oblique, reaches to the mid eye or beyond it	Oblique, reaches to the mid eye
Eyes	Small to moderate (Serraninae), moderate to large (Epinephelinae), large (Anthiinae), and round, mostly become smaller with growth	Small to moderate (Serraninae), moderate (Anthiinae, epinephelin Diploprionini, Grammistini and Liopropomini), moderate to large (epinephelin Epinephelini and Niphonini), and round	Moderate and round. The eye moves anteriorly and upward toward the adult position shortly before settlement in Serraninae
Head spination	Well-developed extensively through larval stage particularly in Anthiinae. Small, smooth spines form on the preopercle (Serraninae, Anthiinae, epinephelin Epinephelini and Niphonini). An opercle spine forms in Anthiinae (at flexion in Serraninae and Epinephelinae), and the other 2 spines are present at postflexion stage (the spines become serrate in some species). Spination in epinephelin Diploprionini, Grammistini and Liopropomini begins to form from flexion stage	Preopercle spines form (epinephelin Diploprionini, Grammistini and Liopropomini), increase in number (Serraninae, Anthiinae), and a smooth preopercle spine at angle becomes greatly enlarged (epinephelin Niphonini and Epinephelini). A supraoccular ridge is low and smooth (Serraninae), or bears spines (Anthiinae, Niphonini, Epinephelini). Small, post-temporal spines form in Serraninae, Niphonini and Epinephelini (at postflexion stage in Anthiinae and some species in Diploprionini). Supracleithrum and inter-opercle bear a small spine in Serraninae (at postflexion stage in Anthiinae and Epinephelinae)	A preopercle spine at angle becomes slightly larger (Serraninae) or greatly larger (Anthiinae, epinephelin Niphonini and Epinephelini), and is serrate mostly in Anthiinae and Epinephelini. A supraoccular ridge in Anthiinae and Epinephelini becomes serrate and some species of Diploprionini form the ridge. A moderate to large spine on the supracleithrum becomes serrate mostly in Anthiinae. Small, smooth spines are present on the subopercle (Serraninae, Anthiinae, Epinephelini except Diploprionini). A cranium is rugose in most species of Anthiinae, and bears serrate ridges in some species. A few species of Anthiinae develop a large, serrate spine on the inter-opercle and supraoccipital, and a serrate ridge(s) on the lacrymal and tabular
Fin formation	Anlagen of the first dorsal and anal fins are present (Serraninae, Anthiinae), and thereafter the dorsal spines begin to form in Anthiinae, but in Serraninae the fin	The second dorsal and anal fin anlagen are present and the fin elements begin to form (Epinephelinae). The second or third dorsal spine becomes elongate (some species of	Second to fourth dorsal spines become long and serrate in some species in Anthiinae. A full complement of all fin rays is attained mostly in 5 to 7 mm.

	element formation is at flexion stage. In Epinephelinae dorsal-fin spines early form prior to appearance of the second dorsal and anal anlagen, and the second spine (Epinephelini, Grammistini), the third spine (Niphonini), or the second or third spine (Diploprionini, Liopropomini) becomes elongate with hook-like serration (Epinephelini) or without it (Niphonini, Diploprionini, Grammistini and Liopropomini). Pelvic-fin buds are present (Anthiinae, Epinephelinae), and thereafter the spine and rays and only the spine begin to form in Anthiinae, and in Niphonini and Epinephelini, respectively. Pelvic spine becomes elongate with serration (Epinephelini) or without it (Niphonini)	Anthiinae), or quite to remarkably elongate (Epinephelinae). The pelvic fin buds are present in Serraninae, thereafter the fin elements form. The serrate or smooth pelvic spine becomes quite elongate in epinephelin Niphonini and Epinephelini. The anterior pelvic rays are longer than the spine (Anthiinae, epinephelin Diploprionini, Grammsitini and Liopropomini), shorter (Epinephelini), or subequal (Niphonini). Pectoral fin becomes larger (some species in Anthiinae) or fan-shape (Diploprionini, Grammistini)	Sequence of fin completion: D_2-A-D_1-P_2-P_1 in Serraninae; P_2, D_1-A, D_2-P_1 in Anthiinae, epinephelin Niphonini and Epinephelini; D_1 spine(s)-P_1-D_1-D_2-A-P_2 in epinephelin Diploprionini, Grammistini and Liopropomini
Pigment	Sparsely to moderately pigmented through larval stages. Dorsal surface of the gut is pigmented in three subfamilies, and heavily pigmented especially in epinephelin Epinephelini. Small to large melanophores are present on the ventral midlines of the gut and tail, on the dorsal midlines on the trunk and tail (Serraninae), on the dorsal and ventral midlines of the tail (some species in Anthiinae, Epinephelinae) and on the lateral midline of the tail (some species in Anthiinae). The tail pigment eventually grows toward one another to form	A prominent dorsal melanophore at the mid-body becomes a vertical bar in Serraninae. The first dorsal fin (Anthiinae), pelvic fin (Serraninae, Anthiinae, epinephelin Diploprionini and Grammistini) and caudal fin (Serraninae, some species in Anthiinae) are pigmented. A pigment spot on the ventral midline of the tail usually becomes reduced in size, and sometimes increase in number (epinephelin Epinephelini). Melanophores develop over the brain (some species in Anthiinae)	A single or some spots, blotches or bars of pigment forms under the spiny dorsal fin and extends onto the fin just before settlement (Serraninae, some species in Anthiinae). The ventral tail spot migrates to the centered caudal peduncle (epinephelin Epinephelini), and the brain (epinephelin Epinephelini, Diploprionini and Liopropomini), snout and lips (Epinephelini) are pigmented. The fan-shaped pectoral fin of diploprionin *Diploprion bifasciatum* is densely pigmented

	a band in diploprionin *Diploprion bifasciatum*. Elongate fin spines (Epinephelinae) and the pectoral fin (Serraninae, epinephelin Diploprionini and Grammistini) are pigmented. A prominent pigment is present on the lower jaw angle and at the anus in Serraninae		
Similar families	Serraninae: Acropomatidae, Apogonidae, Berycidae, Haemulidae, Opistognathidae, Plesiopidae; Anthiinae: Berycidae, Callanthiidae, Carangidae, Cirrhitidae, Lethrinidae, Lutjanidae, Scorpaenidae; Epinephelin Niphonini and Epinephelini: Gempylidae, Lutjanidae, Pomacentridae, Scorpaenidae, Siganidae, Trichiuridae; Epinephelin Diploprionini, Grammistini and Liopropomini: Bothidae, Carapidae, Cynoglossidae, Labridae, Lophiiformes, Pseudochromidae, Scaridae, Scorpaeniformes		

Meristic characters of the Indo-Pacific serranid genera (modified from Leis and Carson-Ewart (2000))

	D	A	P_1	P_2	C(Branched)[a]	VERTEBRAE
Anthiinae						
Acanthistius [b]	-	-	-	-	-	-
Caprodon	X, 19-21	III, 7-8	16-18	I, 5	9+8(15)	26-27
Giganthias [c]	IX, 13	III, 8	16	I, 5	-	10+15 = 25
Holanthias [d]	X, 13-19	III, 7-8	16-19	I, 5	(13)	9+17 = 26
Luzonichthys	X+15-17	III, 7 or II, 9	17-23	I, 5	(13)	11+15 = 26
Nemanthias [e]	XI-XII, 16-17	III, 7	20-21	I, 5	-	-
Odontanthias [f]	X, 13-14	III, 7	17-19	I, 5	(13-14)	10+16 = 26
Plectranthias	X, 13-18	III, 6-8	12-18	I, 5	9+(13-15)	10+(16-17) = 26-27
Pseudanthias	X-XI, 15-17 [k]	III, 6-9	15-20	I, 5	9+(13-15)	(10-11)+(15-16) = 26
Rabaulichthys [g]	X, 15-16	III, 6-7	19-21	I, 5	(15)	10+16 = 26
Sacura	X, 14-18	III, 7	16-18	I, 5	9+7(13)	10+16 = 26
Selenanthias	X, 15-17	III, 7	15-16	I, 5	(13)	10+16 = 26
Serranocirrhitus	X, 18-20	III, 7	13-14	I, 5	(13)	10+16 = 26
Tosana	X, 13-14	III, 6-7	15-16	I, 5	(13)	11+15 = 26
Tosanoides [h]	X, 17	III, 8	13	I, 5	(13)	10+16 = 26
Epinephelinae						
Niphonini						
Niphon	XIII, 10-11	III, 6-8	15-17	I, 5	9+8	12+18 = 30
Epinephelini						
Aethaloperca	IX, 16-18	III, 8-9	17-18	I, 5	9+8	10+14 = 24
Anyperodon	XI, 14-16	III, 8-9	15-17	I, 5	9+8	10+14 = 24
Cephalopholis	IX, 13-17	III, 7-10	15-20	I, 5	9+8	10+14 = 24
Cromileptes	X, 17-19	III, 9-10	17-18	I, 5	9+8	10+14 = 24

Dermatolepis [i]	XI, 17-19	III, 9-10	17-19	I, 5	9+8	10+14 = 24
Epinephelus	XI, 12-19	III, 7-10	15-20	I, 5	9+8	10+14 = 24
Gracila	VIII-IX, 14-16	III, 9-10	18-19	I, 5	9+8	10+14 = 24
Plectropomus	VIII, 10-12	III, 8	14-18	I, 5	9+8	10+14 = 24
Saloptia	VIII, 11	III, 8	14-15	I, 5	9+8	10+14 = 24
Triso	XI, 18-21	III, 9-10	18-20	I, 5	9+8	10+14 = 24
Variola	IX, 13-15	III, 8	16-19	I, 5	9+8	10+14 = 24
Diploprionini						
Aulacocephalus	IX, 12	III, 9	14-16	I, 5	9+8	10+14 = 24
Belonoperca	VIII-IX+0-I, 10	II-III, 7-8	13-15	I, 5	9+8	10+14 = 24
Diploprion	VIII, 13-16	II, 12-13	15-18	I, 5	9+8	10+14 = 24
Liopropomini						
Liopropoma	VIII, 11-14	III, 8-11	13-17	I, 5	9+8	10+14 = 24
Rainfordia [j]	IV+I, 9	II, 8	17	I, 5	9+8	10+14 = 24
Grammistini						
Aporops	VII, 23-25	III, 19-21	15-17	I, 5	9+8	10+18 = 28
Grammistes	VII, 12-14	II-III, 8-9	16-18	I, 5	9+8	10+14 = 24
Grammistops	VI-VII, 11-13	III, 8-9	14-15	I, 5	9+8	10+14 = 24
Pogonoperca	VIII, 12-13	III, 8	17-18	I, 5	9+8	10+14 = 24
Pseudogramma	VI-VIII, 18-23	III, 14-19	13-18	I, 5	9+8	10+(15-17) = 25-27
Suttonia	VII, 22-25	III, 18-22	14-17	I, 5	9+8	10+(16-17) = 26-27
Serraninae						
Chelidoperca	X, 9-10	III, 6	15-17	I, 5	9+8	24

[a] Serranids have (8-9) + (7-8) principal caudal-fin rays, and most species probably have 9+8. Most published caudal-ray counts of anthiines are of branched rays, or branched rays plus two, not principal rays in the sense of those supported by the hypurals and parahypural.

[b] Five species are known from Australia and the western Indian Ocean.

[c] Only *G. immaculatus* is reported from southern Japan and Taiwan.

[d] The Southeast Asian 5 species, *H. borbonius*, *H. chrysostictus*, *H. rhodopeplus*, *H. tapui* and *H. unimaculatas* are placed in the genus *Odontanthias* (Randall and Heemstra, 2006).

[e] Only *N. carberryi* is reported from the western Indian Ocean.

[f] Known from the western Indian Ocean, Australia, southern Japan and Hawaii.

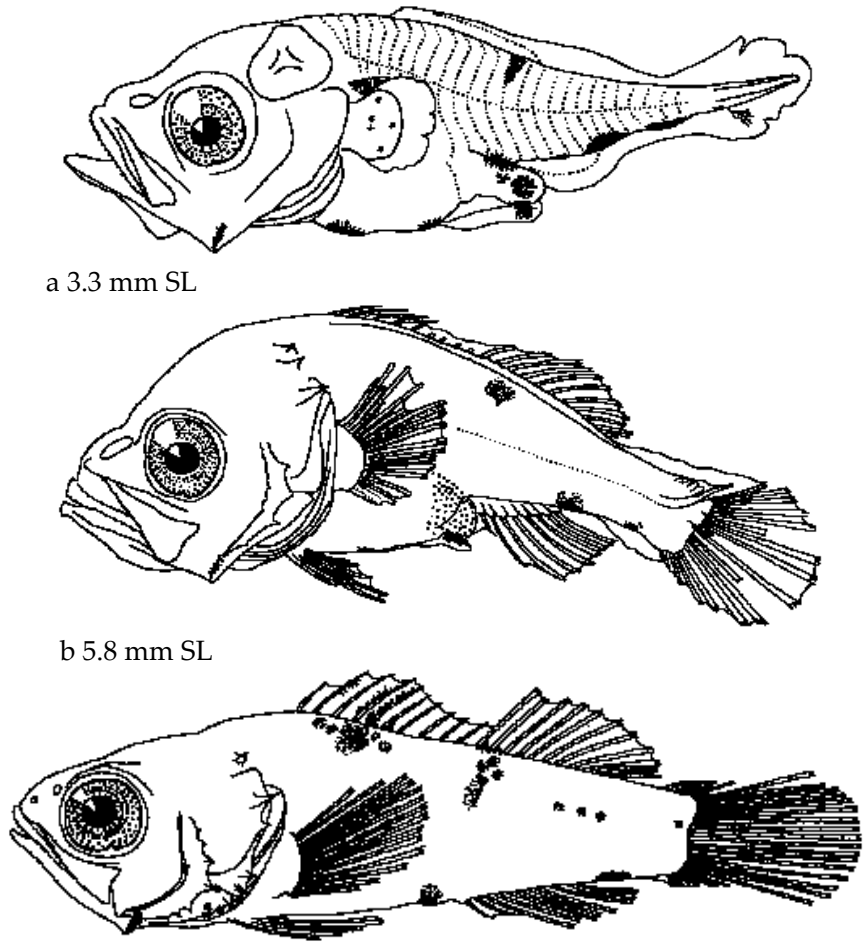
[g] Known from the western Indian Ocean, Papua New Guinea and southern Japan.

[h] Known from Japan, Tonga and Melanesia.

[i] *D. striolata* is known from the western Indian Ocean.

[j] Only *R. opercularis* is reported from Australia.

[k] The little known Japanese species *Pseudanthias taira* Schmidt apparently has DX, 11-13, but as this species is not recorded south of 28°N, it is excluded from the table.

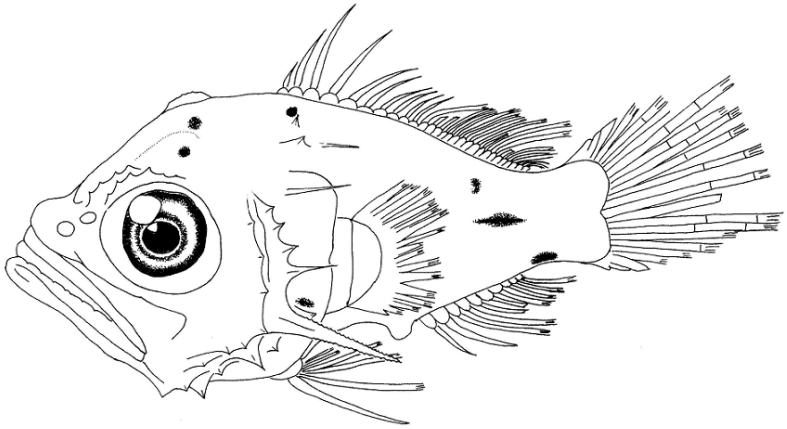


a 3.3 mm SL

b 5.8 mm SL

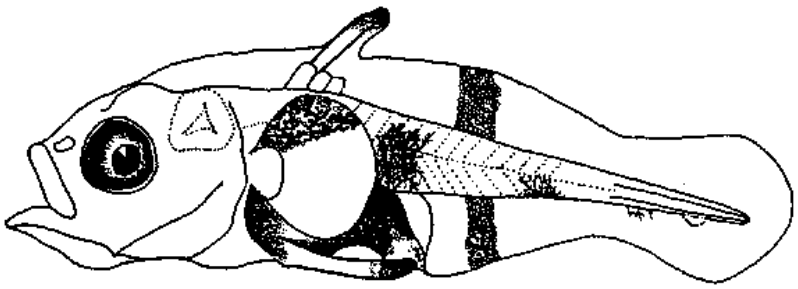
c 8.7 mm SL

Fig. 30 Larvae of *Chelidoperca hirundinacea* from southern Japan (Mori 1988)

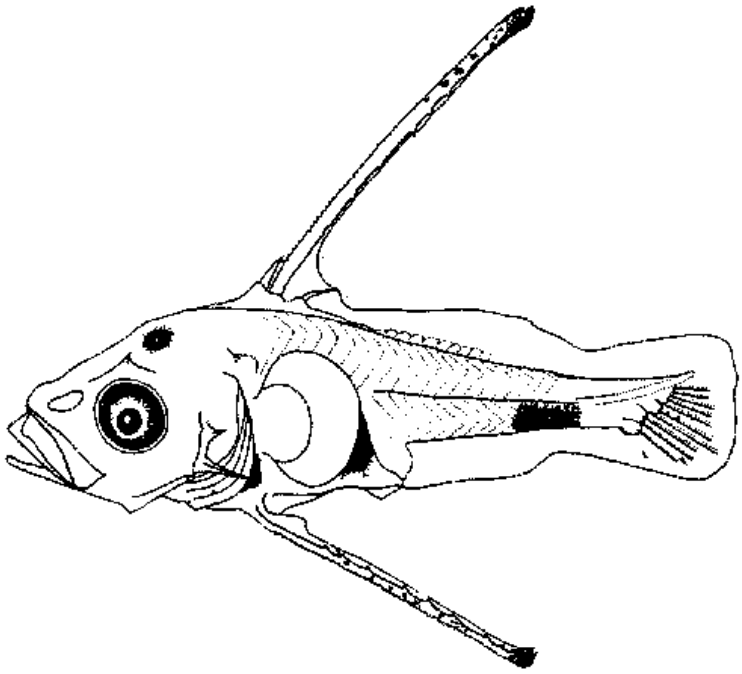


a 4.8 mm SL

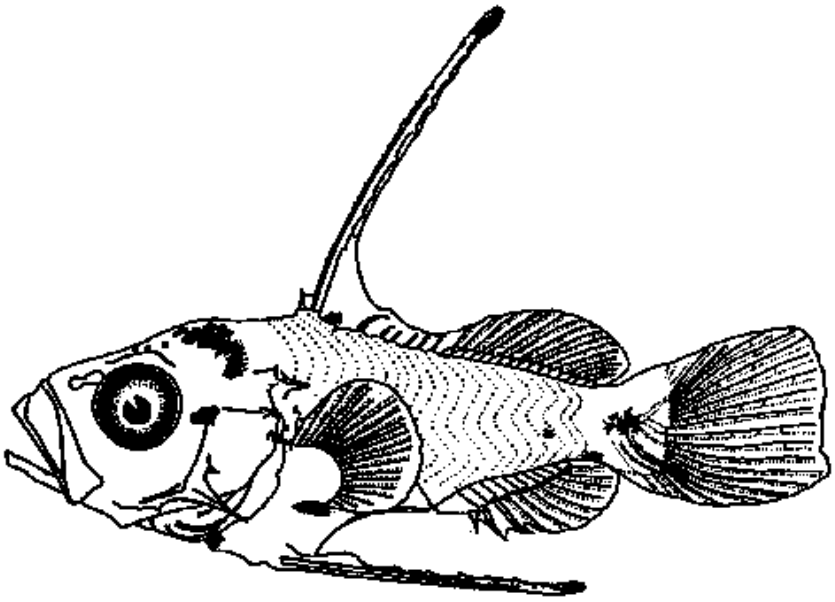
Fig. 31 Larva of Anthiinae sp. from the Andaman Sea (by Puewkhao, P.)



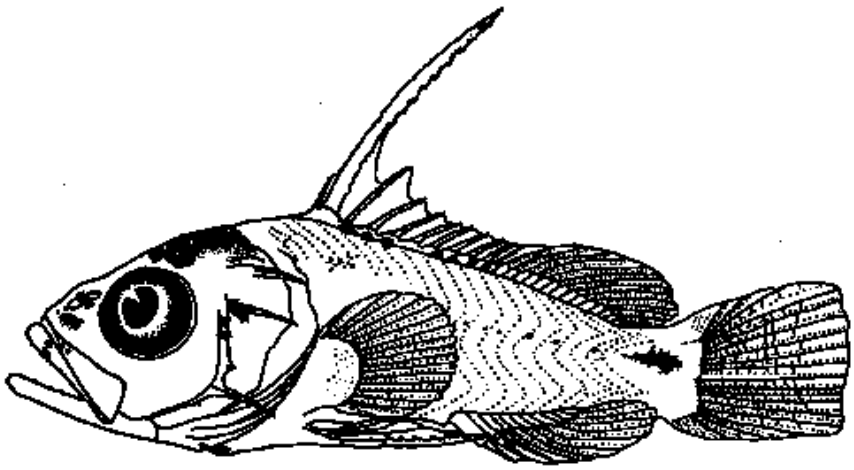
a 3.57 mm SL (rearing, 12 days after hatching)



b 5.80 mm SL (rearing, 18 days after hatching)



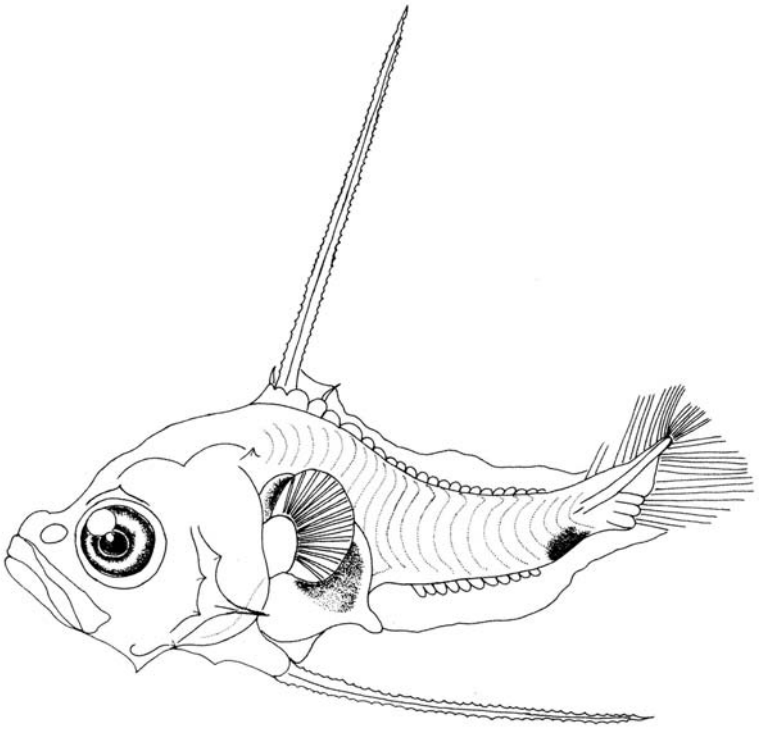
c 8.10 mm SL (rearing, 32 days after hatching)



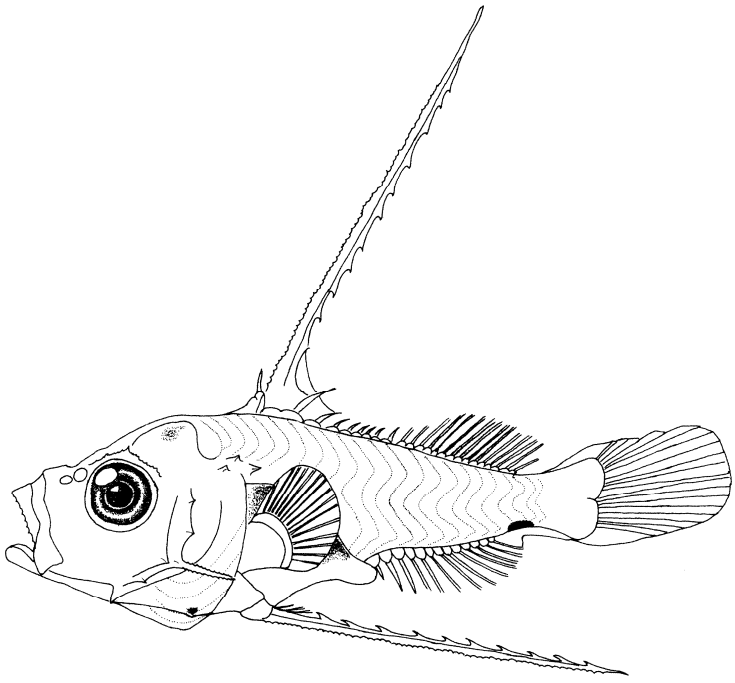
d 12.1 mm SL (rearing, 39 days after hatching)

e 15.5 mm SL (rearing, 55 days after hatching)

Fig. 32 Larvae of *Epinephelus malabaricus* from Thailand (Predalumpaburt and Tanvilai 1988)



a 4.5 mm SL (from the Celebes Sea)



b 6.5 mm SL (from the Gulf of Thailand)

Fig. 33 Larvae of *Epinephelus* sp./spp. (by Puewkhao, P.)

Order: Perciformes

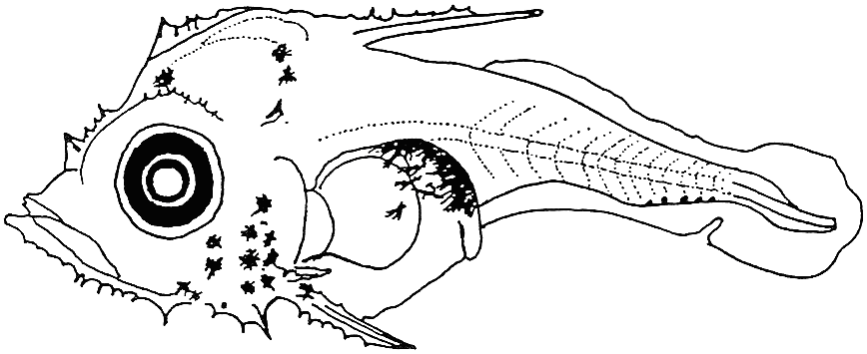
Family: Priacanthidae (Bigeyes)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Moderate depth and laterally compressed, becomes deeper with growth	Moderate to deep and laterally compressed	Deep and laterally compressed
Gut	Coiled, extends to near the mid body	Coiled, deep and broad, reaches beyond the mid body	Coiled, deep and broad, reaches largely beyond the mid body
Gas bladder	Small and obscured by pigment	Small and obscured by pigment	Small and obscured by pigment
Head	Moderate to large and round, becomes larger with growth	Large and fairly broad and deep	Large and fairly broad and round
Snout	Short and steeply sloped	Short and steeply sloped	Short and steeply sloped
Mouth	Moderate and oblique, reaches to about the mid eye. Small teeth develop on the upper jaw	Moderate and oblique, reaches to the mid eye	Moderate and oblique, reaches to the mid eye. Small teeth develop on the lower jaw
Eyes	Round and large	Round and large	Round and large
Head spination	Well-developed and formed mostly by flexion and retained by settlement. Large supraoccipital crest with a serrated, retrorse spine and the elongate, serrate preopecle spine at angle are developed (initially both spines are small and smooth). The spination appears on the supraocular region, pterotic, suparcleithral and lower jaw	A large, retrorse spine at the posterior end of the supra-occipital crest reaches its maximum relative length. Additional spinataion appears on the frontal, post-temporal, infraorbitals, opercle, interopercle and subopercle	Most of head spination is reduced in size in larger larvae, but small spines appear additionally on the branchiostegal rays. Spinous scales begin to form
Fin formation	Pectoral fin buds form	Pelvic fin buds form and the pectoral fin rays begin to form. Dorsal and anal fin anlagen appear, later the soft rays and spines form	Coarse serration occurs on the dorsal, anal and pelvic fin spines. Small serrations on the dorsal and anal soft rays are present in large larvae. Full completion of all fins is achieved by 7 mm. Sequence of fin completion: D_2-A-D_1-P_2-P_1

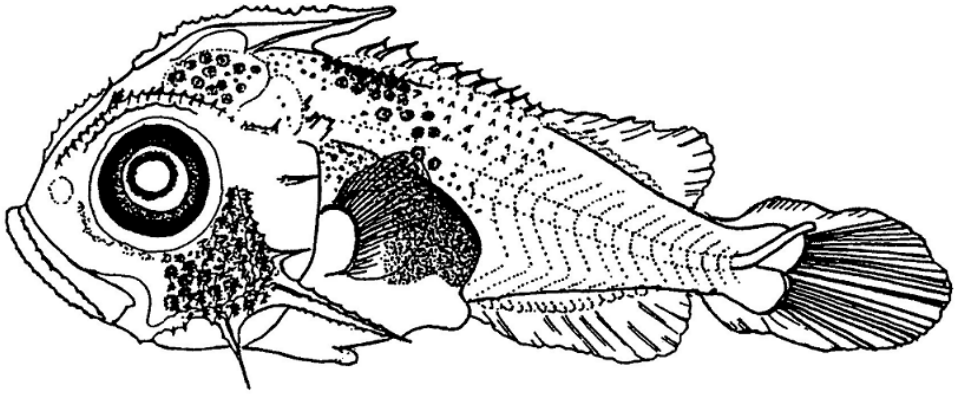
Pigment	Heavy pigment appears on the gut, head and in some species along the ventral midline of the tail	Melanophores spread on the trunk and tail	Melanophores cover the entire body except the pectorals
Similar families	Caproidae, Cepolidae, Holocentridae, Leiognathidae, Lethrinidae, Lobotidae (and *Hapalogenys*)		

Meristic characters of the Indo-Pacific priacanthid genera (Leis and Carson-Ewart, 2000)

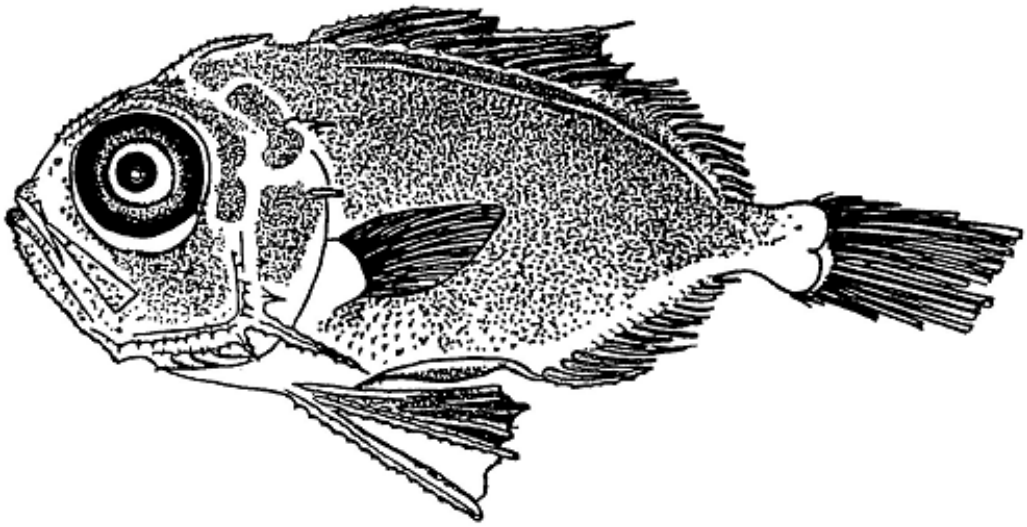
	D	A	P_1	P_2	C	VERTEBRAE
Cookeolus	X, 12-14	III, 12-13	17-19	I, 5	8+8	10+13 = 23
Heteropriacanthus	X, 12-13	III, 13-14	18-19	I, 5	8+8	10+13 = 23
Priacanthus	X, 11-15	III, 12-16	17-21	I, 5	8+8	10+13 = 23
Pristigenys	X, 10-12	III, 10-11	17-19	I, 5	8+8	10+13 = 23



a 2.8 mm TL



b 5.0 mm TL



c 14.4 mm TL

Fig. 34 Larvae of *Priacanthus* sp. from the Gulf of Thailand (Chayakul 1996)

Order: Perciformes

Family: Apogonidae (Cardinalfishes)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Elongate to moderate	Moderate to deep and compressed mostly with the long caudal peduncle	Moderate to deep and compressed mostly with the long caudal peduncle
Gut	Coiled, reaches to around the mid-body. *Siphamia versicolor* larvae have the inner light organs with pigment before the anus	Coiled and sometimes deep, reaches near or beyond the mid-body	Coiled and sometimes deep, reaches near or beyond the mid-body
Gas bladder	Conspicuous, located above the anterior portion of the gut	Conspicuous, located above the anterior portion of the gut	Conspicuous, located above the anterior portion of the gut
Head	Moderate to large	Moderate to large	Moderate to large
Snout	Short to moderate, and somewhat pointed to round	Short to elongate and round to truncate, sometimes slightly pointed	Short to elongate and round to truncate, sometimes slightly pointed
Mouth	Oblique, reaches anterior to the mid eye	Oblique, reaches to about the mid eye	Nearly horizontal to oblique, reaches to the mid eye or beyond it
Eyes	Round and large (moderate in some Pseudaminae)	Round and moderate to large	Round and small to moderate (large in some Apogoninae)
Head spination	None or small to conspicuous spines on the supraoccipital and preopercle	Varies among species. Spine(s) is present on the preopercle, interopercle, subopercle, opercle, supracleithrum, posttemporal. A supraocular ridge appears. Some apogonids are completely lacking head spination	Most of head spination disappears or becomes reduced
Fin formation	Pectoral fin buds appear. Some pseudamin larvae have the early-forming, long pelvic fins	Anlagen of the 2nd dorsal fin and anal fin oppositely appear, thereafter the incipient rays form. Pelvic-fin buds appear	First dorsal fin forms (at flexion in some species, becoming elongate at postflexion). All fins are formed completely. Sequence of fin completion: D_2-A-D_1-P_2-P_1 (Apogoninae) or P_2-D_2-A-D_1-P_1 (Pseudaminae)
Pigment	Variable among species: mostly, the dorsal surfaces of the head, gas bladder and gut, and the ventral	Variable among species: mostly, the head, gas bladder, gut and the ventral midline of the tail, sometimes lateral	Variable from light to heavy pigment among species: light pigment appears on the head, gas bladder and gut, some-

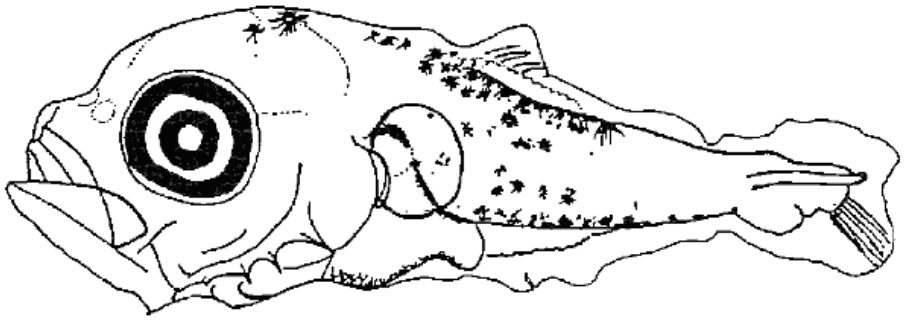
	midline of the tail are lightly pigmented. Early-forming pelvic fin is heavily pigmented in some Pseudaminae	portion of the tail are lightly pigmented	times dorsal and/or ventral midlines of the tail, and the caudal fin base; heavy pigment is present on the whole of the head, trunk, tail, 1st dorsal fin, pelvic fin and caudal fin base. Some apogonin juveniles have longitudinal pigment stripes on the lateral surface of the body
Similar families	Acropomatidae, Ambassidae, Berycidae, Carangidae, Gerreidae, Gobiidae, Kyphosidae, Lactariidae, Lethrinidae, Leptobramidae, Opistognathidae, Pempheridídae, Plesiopidae, Serranidae (Serraninae)		

Meristic characters of the Indo-Pacific apogonid genera (modified from Leis and Carson-Ewart (2000))

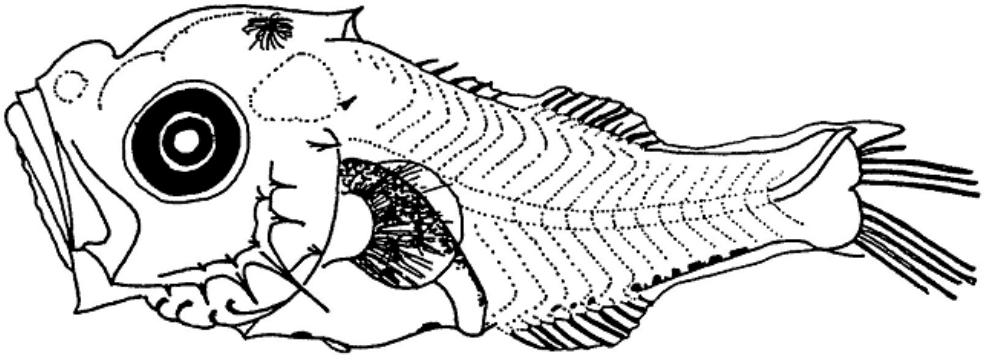
	D	A	P_1	P_2	C	VERTEBRAE
Apogoninae						
Apogon	VI-VIII+I, 8-9	II, 8-9	12-17	I, 5	9+8	10+14
Apogonichthys	VII-VIII+I, 9	II, 8	14-16	I, 5	9+8	10+14
Archamia	VI+I, 7-9	II, 12-18	13-15	I, 5	9+8	10+14
Cercamia	VI+I, 9-10	II, 11-13	10	I, 5	9+8	9-10+14-15
Cheilodipterus	VI+I, 9-10	II, 8-9	10-15	I, 5	9+8	10+14
Coranthus	VII+I, 10	II, 8	14	I, 5	9+8	10+14
Foa	VII+I, 9	II, 8	12	I, 5	9+8	10+14
Fowleria	VII+I, 9	II, 8	13-14	I, 5	9+8	10+14
Holapogon [a]	VIII+I, 9	II, 7	13-14	I, 5	9+8	10+14
Lachneratus	VI+I, 12-13	II, 13-16	10	I, 5	9+8	10+14
Neamia	VIII+I, 9	II, 8	18	I, 5	9+8	10+14
Pterapogon	VII+I, 14	II, 13-16	16	I, 5	9+8	10+14
Rhabdamia	VI-VII+I, 9-11	II, 9-13	12-17	I, 5	9+8	10+14
Siphamia	VI-VII+I, 7-10	II, 7-9	11-16	I, 5	9+8	10+14
Sphaeramia	VI-VII+I, 9	II, 8-9	12	I, 5	9+8	10+14
Pseudaminae						
Gymnapogon	VI+I, 9-10	II, 8-10	13-15	I, 5	9+8	10+14
Paxton [b]	-	-	-	-	-	-
Pseudamiops	VI+I, 7-9	II, 8-9	14-17	I, 5	9+8	10+14
Pseudamia	VI+I, 8-10	II, 7-10	15-20	I, 5	9+8	10+14

[a] Only *H. maximus* is known from the Gulf of Oman and the southern Arabian coast.

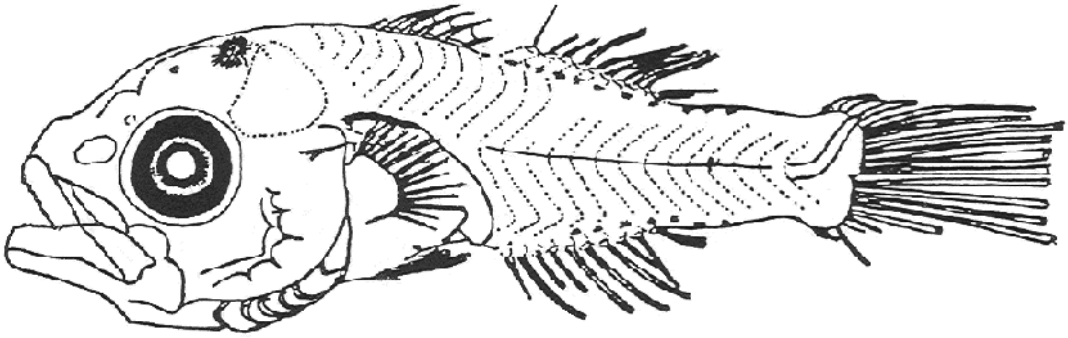
[b] Only *P. concilians* is reported from western Australia.



a 3.1 mm TL (Type 1)



b 3.7 mm TL (Type 2)



c 6.2 mm TL (Type 3)

Fig. 35 Larvae of Apogonidae spp. from the Gulf of Thailand (Chayakul 1996)

Order: Perciformes

Family: Malacanthidae (Tilefishes)

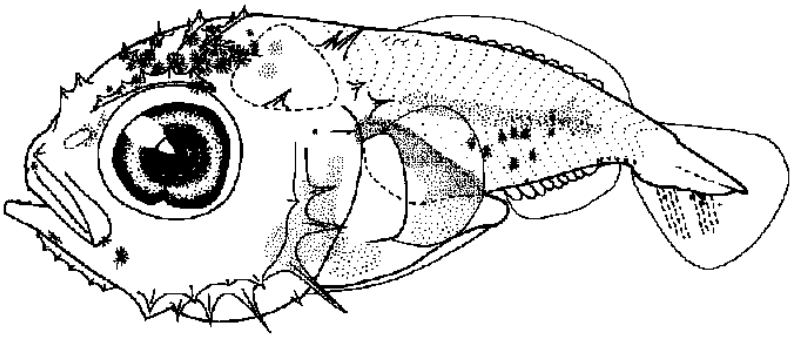
Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Moderate (*Branchiostegus*, *Hoplolatilus*) to elongate (*Malacanthus*)	Moderate to deep (*Branchiostegus*, *Hoplolatilus*), or elongate (*Malacanthus*)	Deep (*Branchiostegus*, *Hoplolatilus*) to elongate (*Malacanthus*)
Gut	Coiled, reaches beyond the mid body	Coiled and triangular, reaches much beyond the mid body (*Branchiostegus*, *Hoplolatilus*) or just the mid body (*Malacanthus*)	Coiled and triangular, reaches much beyond the mid body (*Branchiostegus*, *Hoplolatilus*) or much before the mid body (*Malacanthus*)
Gas bladder	Conspicuous, extends dorsally along the entire gut	Conspicuous, extends dorsally along the entire gut	Conspicuous, extends dorsally along the entire gut
Head	Moderate (*Branchiostegus*), moderate to large (*Hoplolatilus*), or large (*Malacanthus*)	Large (*Branchiostegus*), very large (*Hoplolatilus*), or moderate (*Malacanthus*)	Large (*Branchiostegus*), very large (*Hoplolatilus*), or moderate (*Malacanthus*)
Snout	Short and round (somewhat concave in *Branchiostegus*)	Short and round (*Branchiostegus*), more elongate by development of the rostral spine (*Hoplolatilus*), or slightly pointed (*Malacanthus*)	Short and round (*Branchiostegus*), more elongate by development of the rostral spine (*Hoplolatilus*), or slightly pointed (*Malacanthus*)
Mouth	Terminal, slightly oblique. Upper jaw extends to the anterior edge of the eye (*Branchiostegus*, *Hoplolatilus*), or before it (*Malacanthus*)	Inferior due to development of the rostral spine (*Branchiostegus*, *Hoplolatilus*), or terminal (*Malacanthus*). Upper jaw extends beyond the mid eye (*Branchiostegus*, *Hoplolatilus*), or before the eye (*Malacanthus*)	Inferior due to development of the rostral spine (*Branchiostegus*, *Hoplolatilus*), or terminal (*Malacanthus*). Upper jaw extends beyond the mid eye (*Branchiostegus*, *Hoplolatilus*), or before the eye (*Malacanthus*)
Eyes	Round. Large (*Branchiostegus*), moderate to large (*Hoplolatilus*), moderate (*Malacanthus*)	Round. Large (*Branchiostegus*), moderate to large (*Hoplolatilus*), moderate (*Malacanthus*)	Round. Large (*Branchiostegus*), moderate to large (*Hoplolatilus*), moderate (*Malacanthus*)
Head spination	Well developed. Spines and ridges appear on the frontal, preopercle, posttemporal and dentary. Additional spination develops on the supracleithrum, opercle, supraocular portion, pterotic	Well developed. Serrate ridges form on the lachrymal in *Branchiostegus* and *Hoplolatilus* (at postflexion in *Malacanthus*). Serrate frontal ridges increase in number, and are arranged in fan-shape	Well developed by about 20 mm in *Branchiostegus* and *Hoplolatilus*, or about 40 mm in *Malacanthus*. Rostral spine is in trough-shape (*Branchiostegus*), needle-shape (*Hoplolatilus*) or hammer-

	and subopercle in *Branchiostegus* and *Hoplolatilus* (at flexion or postflexion in *Malacanthus*) and on the interopercle in *Hoplolatilus* (at flexion in *Branchiostegus* and at post-flexion in *Malacanthus*)	(*Branchiostegus*, *Hoplolatilus*) or parallel (*Malacanthus*). Serrate rostral, posttemporal and preoprcle spines in some *Hoplolatilus* become very long. Spinous scales begin to appear in *Branchiostegus* and *Hoplolatilus* (at postflexion in *Malacanthus*)	shape (*Malacanthus*). Spinous scales spread widely on the body
Fin formation	Dorsal and anal fin anlagen appear, thereafter the incipient rays form	Pelvic fin buds form, thereafter the incipient rays are present	Full completion of all fins is achieved by about 7 mm in *Branchiostegus* and *Hoplolatilus*. Sequence of fin completion: D_2-A-D_1-P_2-P_1
Pigment	Head, gut, and ventral midline and lateral body of the tail are pigmented sparsely (*Malacanthus*) to moderately (*Branchiostegus*, *Hoplolatilus*)	Melanophores spread moreover on the head, trunk and tail (*Branchiostegus*, *Hoplolatilus*)	Whole body except fins and the caudal peduncle is pig-mented lightly or heavily (*Branchiostegus*, *Hoplolatilus*). Pigmentation in *Malacanthus* is still sparsely
Similar families	Serranidae (Anthiinae), Chiasmodontidae, Coryphaenidae (prejuvenile stage), Holocentridae, Istiophoridae, Scorpaenidae, Symphysanodontidae, Trachichthyidae		

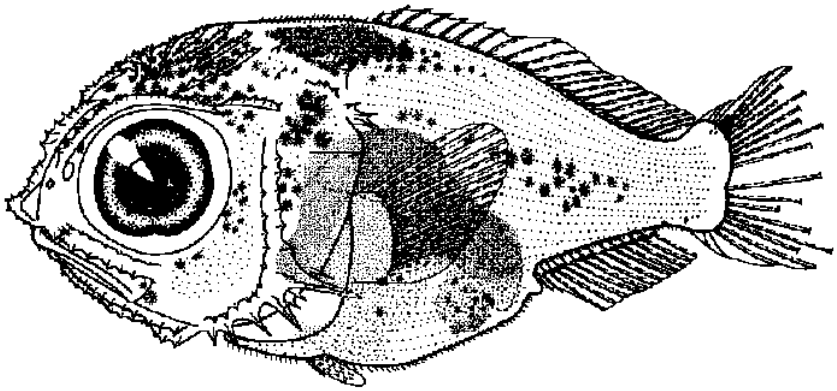
Some malacanthid *Hoplolatilus* larvae have the nearly same head spination as in the malacanthid *Branchiostegus*

Meristic characters of the Indo-Pacific malacanthid genera (Leis and Carson-Ewart, 2000)

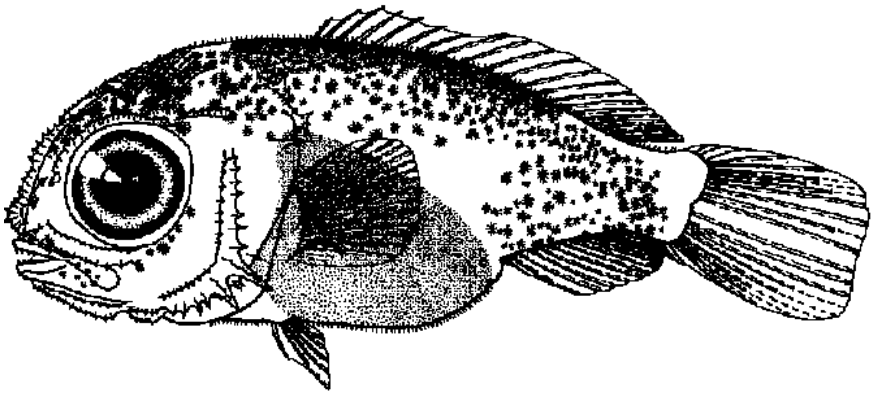
	D	A	P_1	P_2	C	VERTEBRAE
Latilinae						
Branchiostegus	VI-VIII, 14-16	II, 11-13	17-19	I,5	9+8	10+14 = 24
Malacanthinae						
Hoplolatilus	III-X, 13-34	I-II, 12-20	16-19	I,5	9+8	10-11+14 = 24-25
Malacanthus	I-IV, 42-60	I, 37-55	15-17	I,5	9+8	10+14 = 24



a 3.5 mm SL

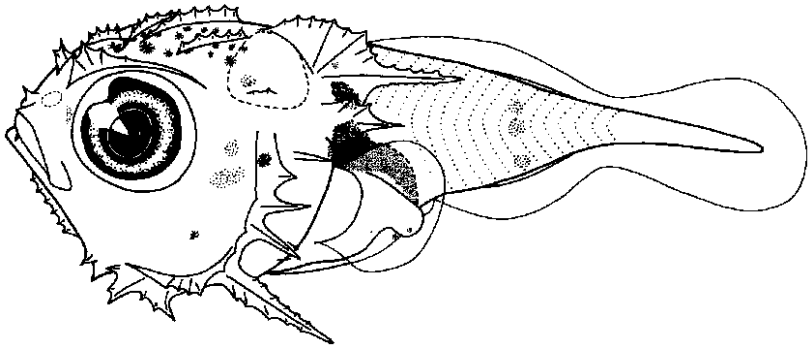


b 6.2 mm SL

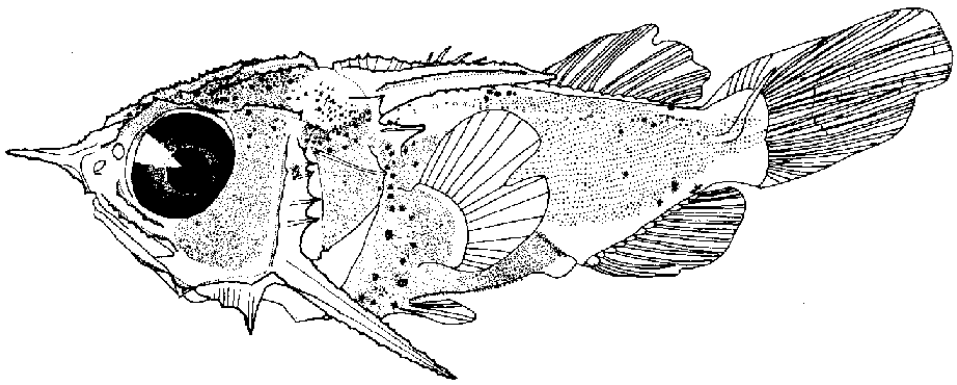


c 7.9 mm SL

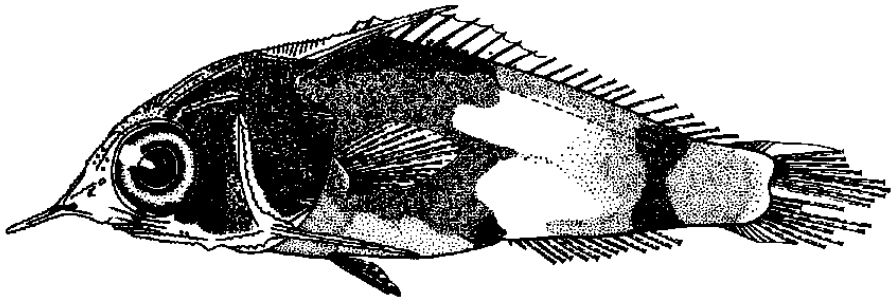
Fig. 36 Larvae of *Branchiostegus sawakinensis* from Australia (Leis and Trnski 1989)



a 2.8 mm SL

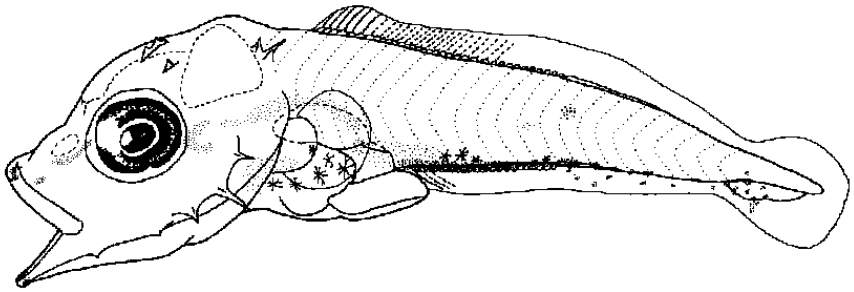


b 5.7 mm SL

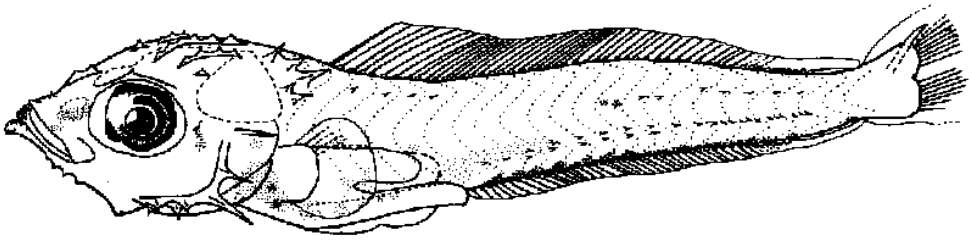


c 18.1 mm SL (*H. fronticinctus* or *H. chlupatyi*)

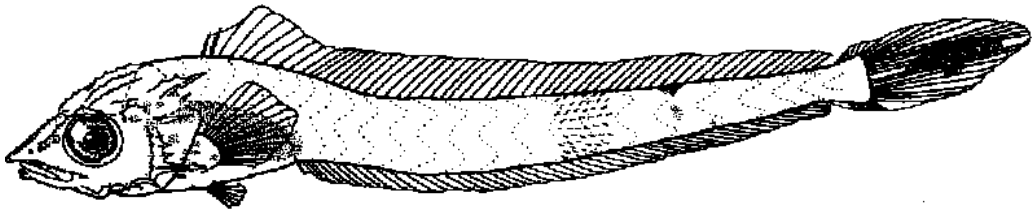
Fig. 37 Larvae of *Hoplolatilus* sp./spp. from southern Japan (a, c: Leis and Trnski 1989; b: Konishi 1988d)



a 3.7 mm SL



b 5.4 mm SL



c 14.5 mm SL

Fig. 38 Larvae of *Malacanthus brevirostris* from Australia (a, b) and Hawaii (c) (Leis and Trnski 1989)

Order: Perciformes

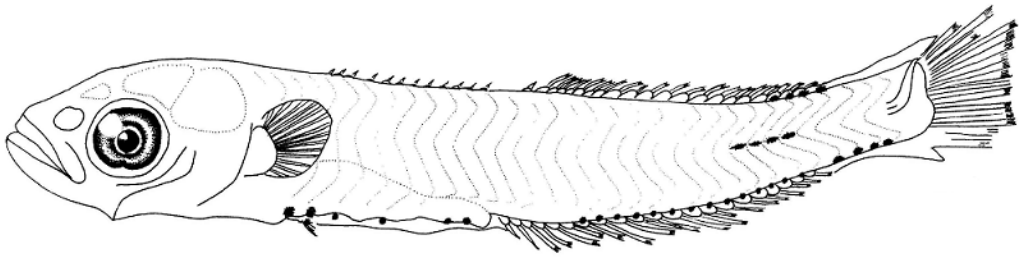
Family: Sillaginidae (Sand smelts, whitings)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Elongate and somewhat compressed	Elongate and somewhat compressed	Elongate and somewhat compressed
Gut	Straight with a relative large diameter and reaches beyond the mid body. Anus moves anteriorly with growth	Coiled, reaches to the mid body	Fully coiled, reaches to the mid body or anterior to it
Gas bladder	Not visible in larvae caught during daylight	Not visible in larvae caught during daylight	Not visible in larvae caught during daylight
Head	Initially small, thereafter moderate	Moderate	Moderate
Snout	Initially short, sometimes concave in profile	Somewhat pointed and concave in profile	Slightly straight in profile and somewhat pointed
Mouth	Oblique, reaches to about the anterior margin of the eye	Oblique, reaches to about the anterior margin of the eye. Minute teeth are present on both jaws	Oblique, reaches to about the anterior margin of the eye
Eyes	Large to moderate and round, becomes relatively smaller with growth	Moderate and round	Moderate and round
Head spination	Poorly developed through larval stage. Very small preopercular spines begin to form (some species in flexion stage)	Depending on species, there are one to many small, inconspicuous spines on the preopercle	A weak posttemporal and/or supracleithral ridge appears. Preopercular spines begin to reduce in size from about 8 mm, but are retained in most species until settlement. The opercular spine develops just before settlement
Fin formation	Pectoral fin buds appear	Anlagen of the long dorsal and anal fins develop, thereafter the soft rays begin to ossify	Small pelvic buds appear, thereafter the rays form. Spines of the dorsal and anal fins and soft rays of the pectoral fin form. A full complement of all fin rays is attained at latest by 9.5 mm. Sequence of fin completion: D_2-A-D_1-P_2-P_1
Pigment	Lightly pigmented through larval stage. A row of pigment appears along the throat, the ventral midlines	Some species have a series of melanophores midlaterally on the tail and caudal-fin base	The trunk pigment becomes much reduced. Pigment on the first dorsal fin membrane develops

	of the abdominal finfold (which moves to the mid-line of the gut at postflexion stage) and tail. Lower jaw at angle and the dorsal surface of the gut usually are pigmented. Melano-phores appear along the dorsal midlines of the trunk and tail in some species (which reduce in number at flexion stage)		
Similar families	Bythitidae, Cheilodactylidae, Clinidae, Creediidae, Gobiidae, Pseudochromidae, Sphyraenidae, Terapontidae, Tripterygiidae		

Meristic characters of the Indo-Pacific sillaginid genera (Leis and Carson-Ewart, 2000)

	D	A	P_1	P_2	C	VERTEBRAE
Sillaginopsis	X+I, 25-27	II, 24-27	20-22	I, 5	9+8	15+27 = 42
Sillago	X-XIII+I, 16-24	II, 14-24	14-17	I, 5	9+8	(12-17)+(18-25) = 32-40



a 6.60 mm SL

Fig. 39 Larva of *Sillago* sp. from the Andaman Sea (by Puewkhao, P.)

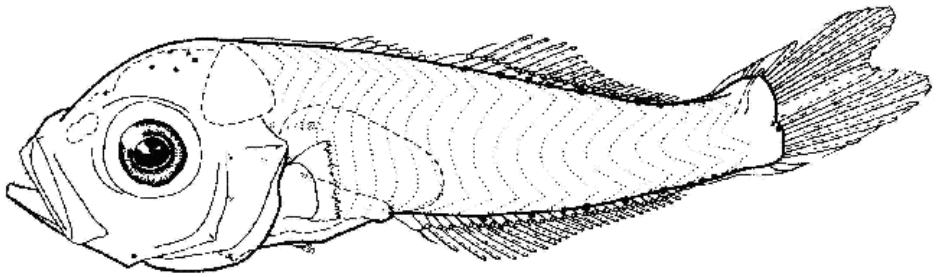
Order: Perciformes

Family: Lactariidae (False trevallies)

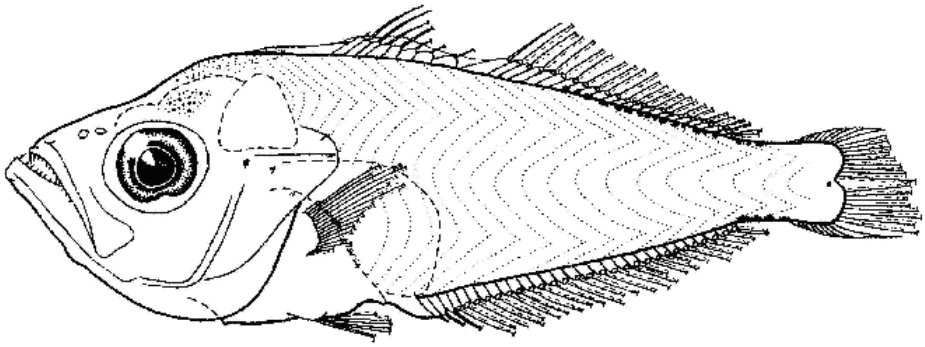
Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	No information available	No information available	Moderate and compressed
Gut	No information available	No information available	Coiled, reaches to anterior to the mid body
Gas bladder	No information available	No information available	Large and conspicuous, extends a considerable distance posterior to the anus
Head	No information available	No information available	Large, becomes pointed with growth due to increased protrusion of the lower jaw
Snout	No information available	No information available	Initially slightly concave in the dorsal profile and its length is larger than eye diameter, becoming less steep and smaller with growth
Mouth	No information available	No information available	Somewhat large and oblique, reaches to the mid eye in the large postflexion
Eyes	No information available	No information available	Large and round
Head spination	No information available	No information available	A small spine forms ephemerally on the preopercle at angle in 6.0-mm larva. Two weak spines appear on the opercle
Fin formation	No information available	No information available	By 10.3 mm all fins have a full complement, except that the ventral rays of the pectoral fin are still incipient
Pigment	No information available	No information available	Dorsal and ventral margins of the tail, base of the caudal fin, dorsum of the head sparsely pigmented
Similar families	Apogonidae, Carangidae, Nomeidae		

Meristic characters of the Indo-Pacific lactariid genus (Leis and Carson-Ewart, 2000)

	D	A	P_1	P_2	C	VERTEBRAE
Lactarius	VII-VIII+I, 19-23	III, 25-28	16-17	I, 5	9+8	10+14 = 24



a 6.0 mm SL



b 23 mm SL

Fig. 40 Larvae of *Lactarius lactarius* from the Gulf of Thailand (a) and Australia (b) (Leis 1994)

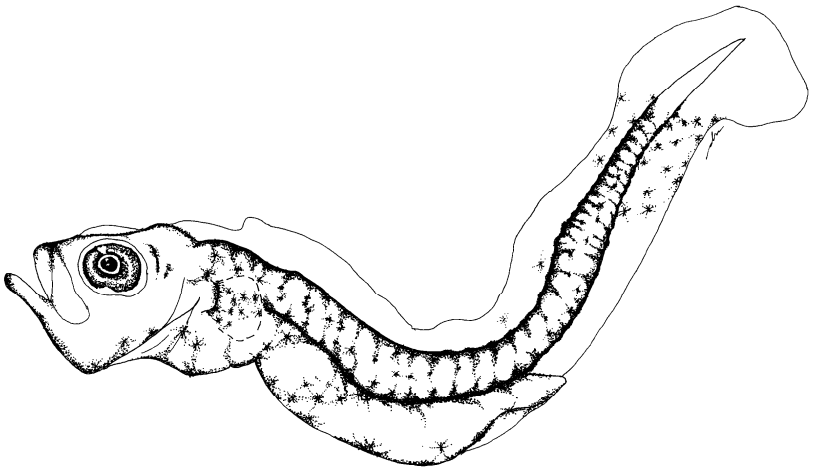
Order: Perciformes

Family: Coryphaenidae (Dolphinfishes)

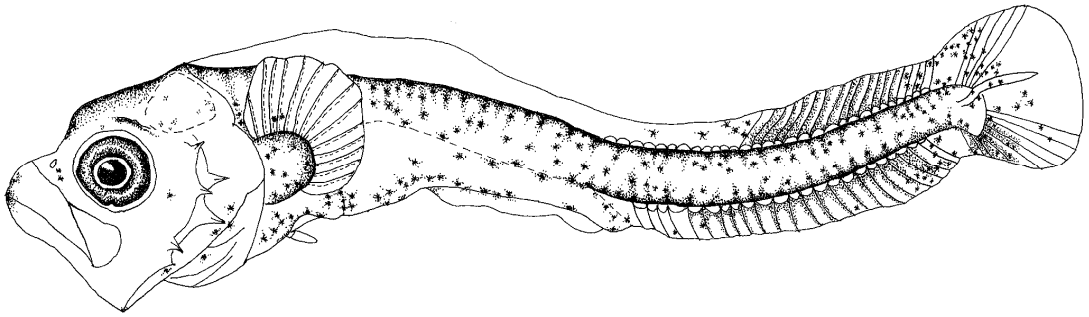
Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Elongate	Elongate	Elongate
Gut	Initially straight and long, later coiled anteriorly, reaches beyond the mid body	Coiled portion extends posteriorly, reaches beyond the mid body	Coiled, reaches beyond the mid body
Gas bladder	Inconspicuous, located anteriorly over the gut	Inconspicuous, located anteriorly over the gut	Inconspicuous due to heavy pigment
Head	Moderate	Moderate, becomes larger relatively	Moderate, becomes larger relatively
Snout	Short and slightly pointed	Short and somewhat concave due to a swell of the pre-maxilla at the ascending process	Short
Mouth	Slightly oblique	Oblique, reaches beyond the mid eye	Oblique, reaches beyond the mid eye
Eyes	Round and large	Round and large	Round and large
Head spination	Tiny spines present in the preopercle	Preopercle spines become long and increase in number. Supraocular spine forms	Small or low spine is present on the posttemporal, pterotic and retroarticular
Fin formation	Pectoral fin buds visible	Dorsal and anal fin rays develop anteriorly, forming the long base. Pelvic fin buds form	Sequence of fin completion: C, A, D-P_2, P_1
Pigment	Nearly whole body pigmented (notochord tip pigmented in *Coryphaena equiselis*, unpigmented in *C. hippurus*)	Basal portions of the dorsal, anal and caudal fins are pigmented	Entire body is heavily pigmented. Distinct pigment bands which extend to the dorsal and anal fins are present on the trunk and tail, and melanophores appear on the pelvic fin in *C. hippurus*.
Similar families	Cheilodactylidae, Echeneidae, Rachycentridae		

Meristic characters of the Southeast Asian coryphaenid genus

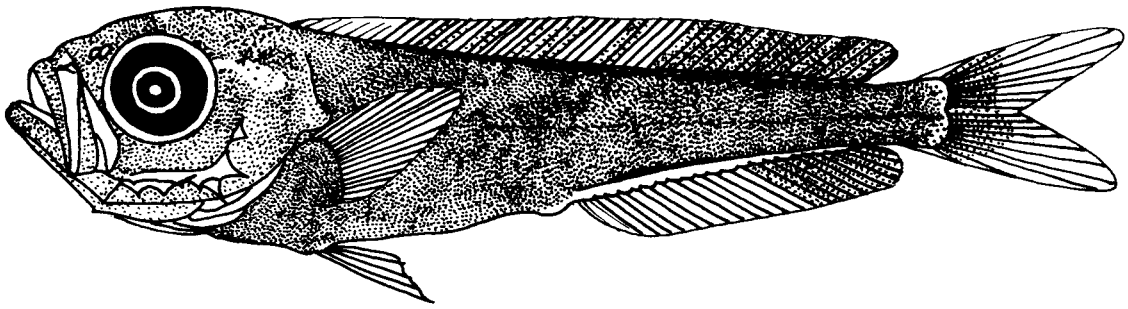
	D	A	P_1	P_2	C	VERTEBRAE
Coryphaena	48-67	25-30	17-20	I,5	9+8	30-34



a 3.8 mm SL (*Coryphaena* sp.)



b 6.2 mm SL (*Coryphaena hippurus*)



c 13.10 mm TL (*Coryphaena equiselis*)

Fig. 41 Larvae of *Coryphaena* spp. (a, b: from the Celebes Sea by Estremadura, DM. G.; c: from the Andaman Sea (Termvidchakorn 1987a))

Order: Perciformes

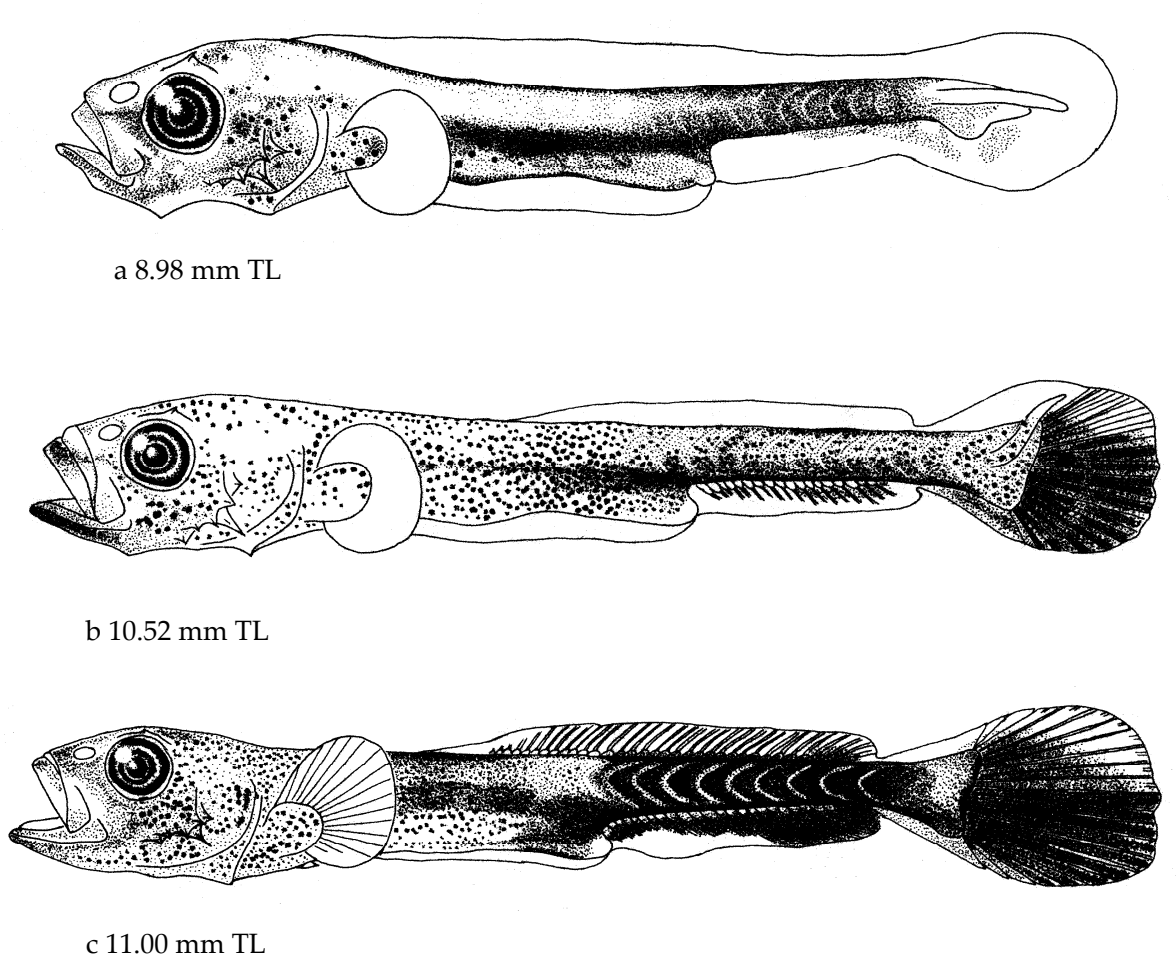
Family: Rachycentridae (Cobia)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Elongate and subcylindrical	Elongate and subcylindrical	Elongate and subcylindrical
Gut	Initially straight but later loosely coiled, extends to about two-thirds body length. A gap between the anus and the ventral margin of the abdominal finfold is present	Loosely coiled, extends to about two-thirds body length. Gut is still covered by the abdominal finfold, but no gap between the anus and the ventral margin of the finfold	Loosely coiled, extends to about two-thirds body length
Gas bladder	Not visible	Not visible	Not visible
Head	Moderate, becomes slightly smaller with growth	Moderate	Moderate
Snout	Short and triangular in profile	Short and triangular in profile	Short and triangular in profile
Mouth	Large and oblique, and reaches to about the mid eye	Large and oblique, and reaches to about the mid eye	Large and oblique, and reaches to about the mid eye
Eyes	Moderate and round, becomes smaller with growth	Small and round	Small and round
Head spination	A single spine on the supra-ocular ridge, a series of small to moderate spines along both the inner and outer border of the pre-opercle are prominent through larval stage	A tiny spine appears on the supracleithral	Two small spines form on the posttemporal
Fin formation	Pectoral fin buds form	Dorsal and anal fin anlagen form. Pelvic buds form	Dorsal and anal fin rays begin to form with anal rays developing before dorsal rays and the spines are the last element to form. Pectoral rays form. A full complement of all fin rays is attained by early transition about 20 mm. Sequence of fin completion: $A\text{-}D_2\text{-}P_2\text{-}P_1\text{-}D_1$
Pigment	Well pigmented through larval stage. Dorsolateral and ventrolateral portions of the trunk and tail except	The caudal peduncle, caudal fin, posterior one-third of the anal finfold and anlagen of the dorsal and anal fins are	Entire body except the dorsal fin is heavily pigmented

	the notochord tip is moderately to heavily pigmented. Inner pigment stripe aligns longitudinally from the tip of the snout to the otic capsule	pigmented	
Similar families	Belonidae, Coryphaenidae, Echeneidae, Hemiramphidae		

Meristic characters of the Indo-Pacific rachycentrid genus (Leis and Carson-Ewart, 2000)

	D	A	P_1	P_2	C	VERTEBRAE
Rachycentron	VII-VIII+I, 28-35	I-III, 22-28	20-22	I, 5	9+8	(11-12)+(13-14) = 25



a 8.98 mm TL

b 10.52 mm TL

c 11.00 mm TL

Fig. 42 Larvae of *Rachycentron canadum* from the Andaman Sea (by Puewkhao, P.)

Order: Perciformes

Family: Carangidae (Jacks, pompanos)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Initially somewhat elongate, later moderate	Moderate to deep (Caranginae), moderate (Naucratinae, Scomberoidinae, Trachinotinae)	Moderate to deep (Caranginae), moderate (Naucratinae, Scomberoidinae, Trachinotinae)
Gut	Round and coiled, reaches beyond the mid body	Round and coiled, reaches beyond the mid body	Round and coiled, reaches beyond the mid body
Gas bladder	Conspicuous, small to moderate, located over the gut	Caranginae: conspicuous over the gut; Naucratinae, Scomberoidinae and Trachinotinae: often obscured by heavy pigment	Caranginae: conspicuous over the gut; Naucratinae, Scomberoidinae and Trachinotinae: often obscured by heavy pigment
Head	Initially moderate, later moderate to large	Large	Large
Snout	Caranginae: short to moderate, initially concave; other 3 subfamilies: short, initially concave	Caranginae: triangular to blunt; other 3 subfamilies: slightly pointed or blunt	Caranginae: triangular to blunt; other 3 subfamilies: slightly pointed or blunt
Mouth	Oblique, reaches beyond the mid eye	Oblique, reaches beyond the mid eye	Oblique, reaches beyond the mid eye
Eyes	Round and moderate to large (mostly large)	Round and moderate to large (mostly large)	Round and moderate to large (mostly large)
Head spination	Suparaoccipital crest (Caranginae, *Scomberoides*, *Elagatis*), preopercle spines (spine at angle with serration only in *Elagatis*), supraocular ridge, and pterotic ridge (Trachinotinae) form	Posttemporal and supracleithral spines (prominent in *Naucrates* and *Trachinotus*) appear. Supraoccipital crest is reduced. Supraocular ridge with spines well develop in *Naucrates*	Supraoccipital crest is reduced well, later disappears. Other spination is reduced
Fin formation	Anlagen of the dorsal and anal fins form. The incipient rays of the dorsal and anal fins anteriorly develop in *Alectis*. Pelvic-fin buds develop in *Alectis* and *Naucrates* and the rays in *Alectis* become elongate	Incipient rays of the dorsal and anal fins develop in most species except *Alectis*. Some rays of the dorsal, anal and pelvic fins become more elongate in *Alectis*	Sequence of fin completion: P_2-D, A-C-P_1 (*Alectis*); C-D, A-P_1 (or P_2)-P_2 (or P_1) (others)
Pigment	Abdominal finfold is mostly pigmented. Dorsal	Dorsolateral and ventrolateral trunk and tail are	Body is densely (Scomberoidinae,

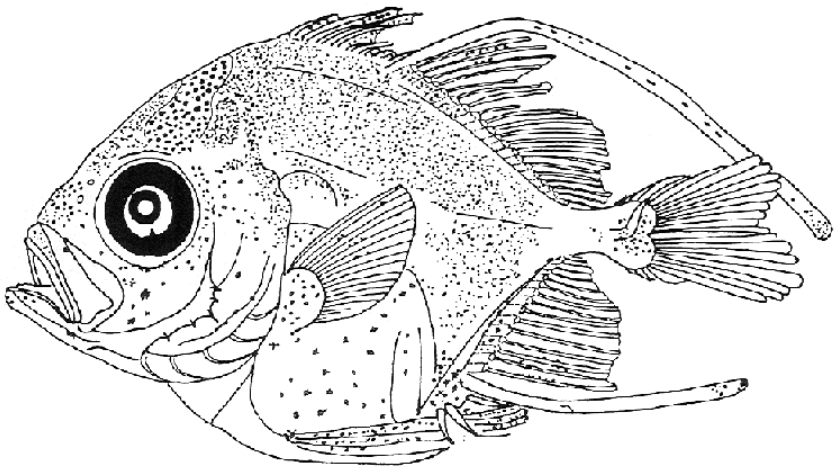
	and ventral margins and sometimes lateral midline of the body are pigmented. Head pigmentation including the branchio-stegal membranes is varied. Precocious pelvic (*Alectis*, *Naucrates*), and the dorsal and anal fins (*Alectis*) are pigmented	pigmented (tail pigment in *Seler*, *Alepes* and *Atule* aligns along myosepta)	Naucratinae, Trachinotinae) or lightly (Caranginae) pigmented
Similar families	Acropomatidae, Apogonidae, Centrogeniidae, Chaetodontidae, Citharidae, Drepaneidae, Emmelichthyidae, Ephippidae, Haemulidae (*Hapalogenys*), Kyphosidae, Lactariidae, Leiognathidae, Lethrinidae, Lobotidae, Menidae, Nomeidae, Pempheridiidae, Pomacathidae, Serranidae (Anthiinae), Sparidae, Terapontidae, Toxotidae		

Meristic characters of the Indo-Pacific carangid genera (modified from Leis and Carson-Ewart (2000))

	D	A	P_1	P_2	C	VERTEBRAE
Caranginae						
Alectis	VI-VII+I, 18-19	II+I, 15-20	18-20	I, 5	9+8	10+14 = 24
Alepes	VIII+I, 23-27	II+I, 18-23	20-22	I, 5	9+8	10+14 = 24
Atropus	VIII+I, 19-22	II+I, 17-18	19-20	I, 5	9+8	10+14 = 24
Atule	VIII+I, 22-25	II+I, 18-21	22-24	I, 5	9+8	10+14 = 24
Carangoides [a]	VIII+I, 18-35	II+I, 16-29	18-24	I, 5	9+8	10+(14-15) = 24-25
Caranx	VIII+I, 13-25	II+I, 14-21	19-23	I, 5	9+8	10+(14-15) = 24-25
Caranx [b]	VIII+I, 23-25	II+I, 20	20-21	I, 5	9+8	10+14 = 24
Decapterus	VII-VIII+I, 27-38+1	II+I, 21-31+1	20-24	I, 5	9+8	10+14 = 24
Gnathanodon	VII+I, 18-21	II+I, 15-18	20-23	I, 5	9+8	10+14 = 24
Megalaspis	VIII+I, 18-20	II+I, 16-17	20-22	I, 5	9+8	10+14 = 24
Pantolabus	VIII+I, 21-23	II+I, 18-20	20-22	I, 5	9+8	10+14 = 24
Parastromateus	IV-V+I, 41-44	II+I, 35-39	20-21	I, 5 [c]	9+8	10+14 = 24
Pseudocaranx [d]	VIII+I, 23-28	II+I, 20-24	19-22	I, 5	9+8	10+(14-15) = 24-25
Selar	VIII+I, 24-28	II+I, 19-23	19-23	I, 5	9+8	10+14 = 24
Selaroides	VIII+I, 24-26	II+I, 21-23	20	I, 5	9+8	10+14 = 24
Trachurus [e]	VIII+I, 26-36	II+I, 24-32	20-23	I, 5	9+8	10+14 = 24
Ulua	VIII+I, 21-22	II+I, 17-18	20-22	I, 5	9+8	10+14 = 24
Uraspis	VIII+I, 24-32	II+I, 17-28	21-25	I, 5	9+8	10+14 = 24
Naucratinae						
Elagatis	V-VI+I, 24-28+2	I+I, 15-20+2	19-22	I, 5	9+8	10+14 = 24
Naucrates	III-V+I, 25-29	II+I, 15-18	18-20	I, 5	9+8	10+15 = 25
Seriola	VI-VIII+I, 22-39	II+I, 15-25	18-22	I, 5	9+8	(10-11)+(13-14) = 24-25
Seriolina	VII+I, 30-37	I+I, 15-18	18-20	I, 5	9+8	11+13 = 24
Scomberoidinae						
Scomberoides	VI-VII+I, 19-21	II+I, 16-20	16-20	I, 5	9+8	10+16 = 26

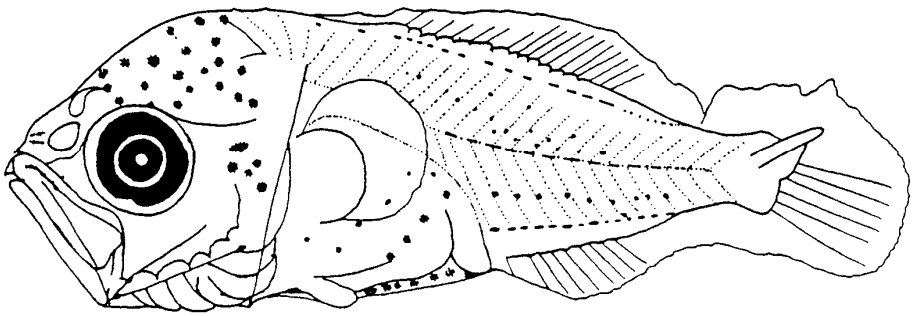
Trachinotinae						
Lichia [f]	VII+I, 19-21	II+I, 17-21	19-21	I, 5	9+8	10+14 = 24
Trachinotus	V-VI+I, 18-25	II+I, 16-24	17-21	I, 5	9+8	10+14 = 24

[a] Some authors further divide this genus and recognize the genera *Carangichthys* and *Kaiwarinus*.
[b] Some species are in uncertain generic status.
[c] Absent in adults.
[d] Only *P. dentex* is known as the anti-tropical species from the Indo-Pacific waters.
[e] Known from Japan, Korea, China, Australia and New Zealand.
[f] Only *L. amia* is known from the western Indian Ocean.

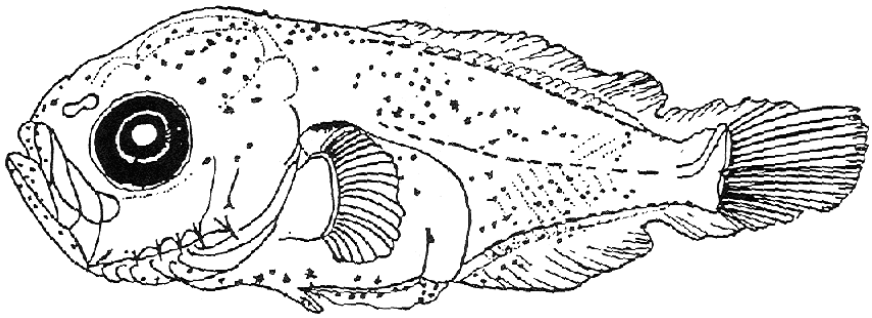


a 11.0 mm TL

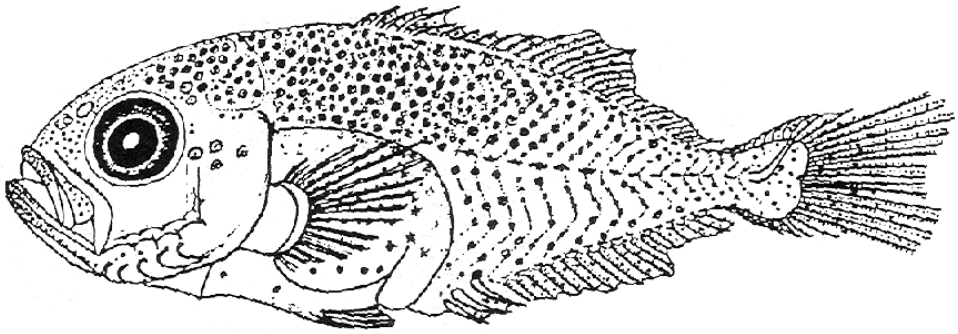
Fig. 43 Larva of *Alectis ciliaris* from the Gulf of Thailand (Chayakul 1996)



a 4.68 mm TL

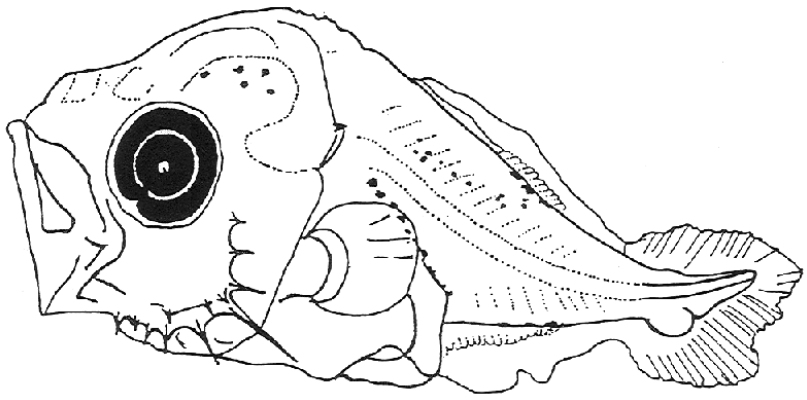


b 4.8 mm TL

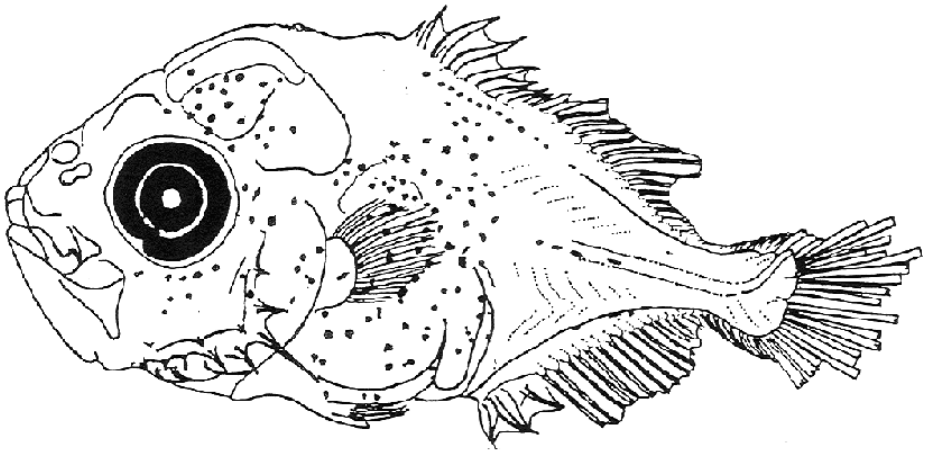


c 8.3 mm TL

Fig. 44 Larvae of *Atule mate* from the Gulf of Thailand (a: Termvidchakorn 1997; b, c: Chayakul 1996)

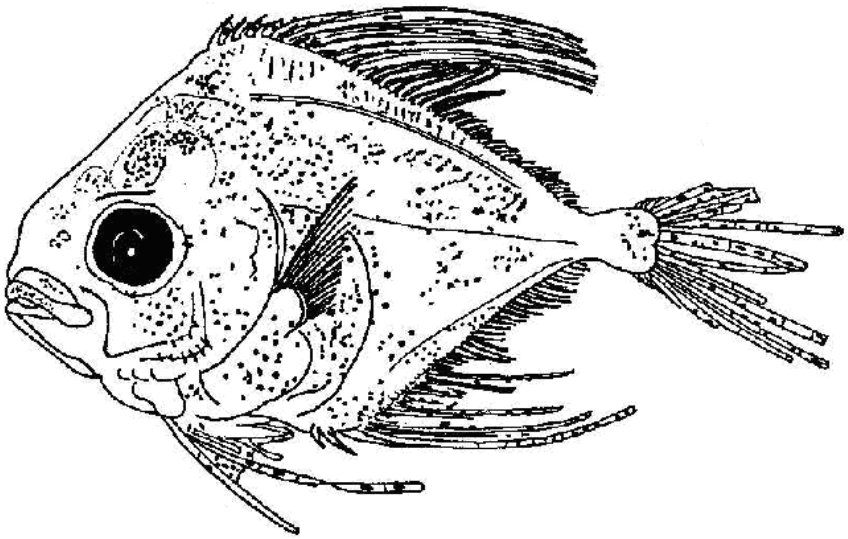


a 3.6 mm TL

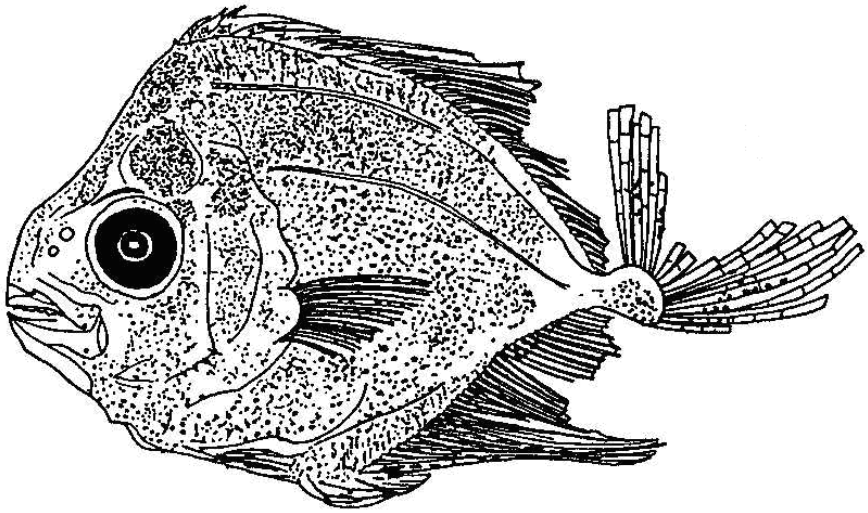


b 5.8 mm TL

Fig. 45 Larvae of *Gnathanodon speciosus* from the Gulf of Thailand (Chayakul 1996)

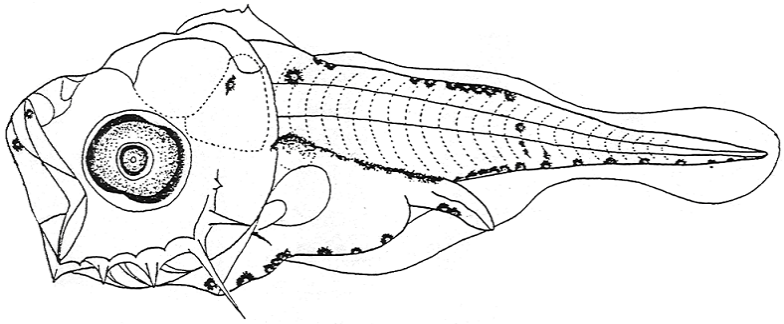


a 14.6 mm TL

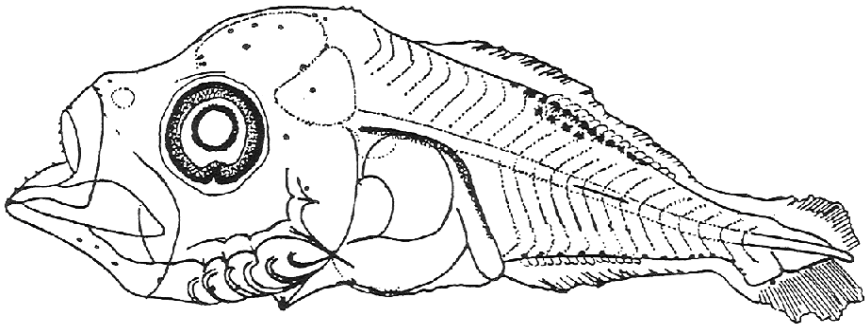


b 15.2 mm TL

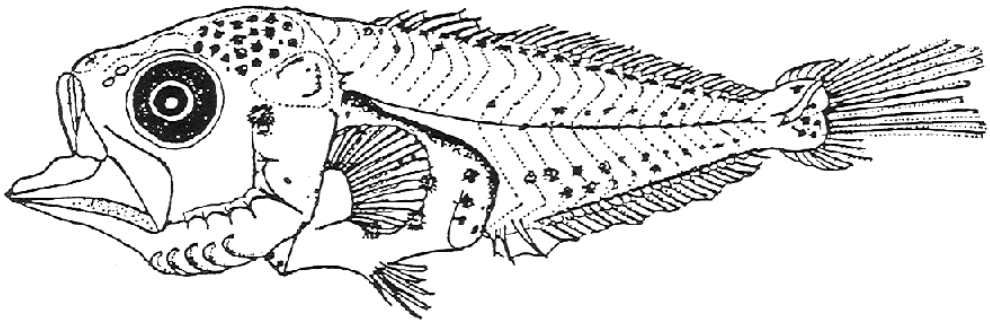
Fig. 46 Larvae of *Parastromateus niger* from the Gulf of Thailand (Chayakul 1996)



a 3.0 mm TL

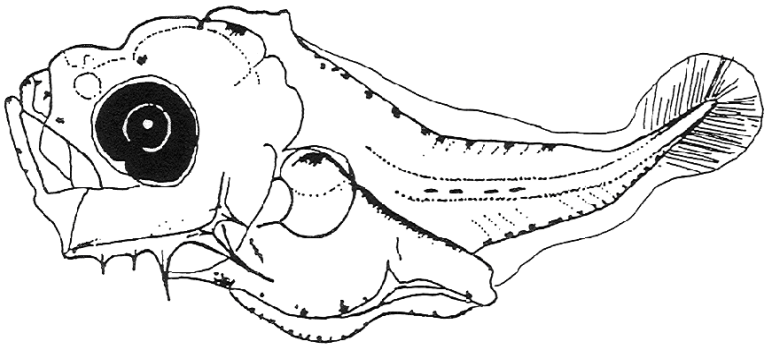


b 3.6 mm TL

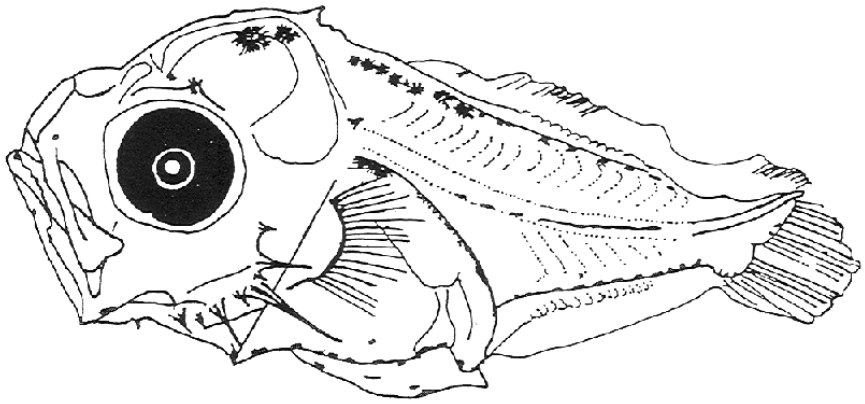


c 9.3 mm TL

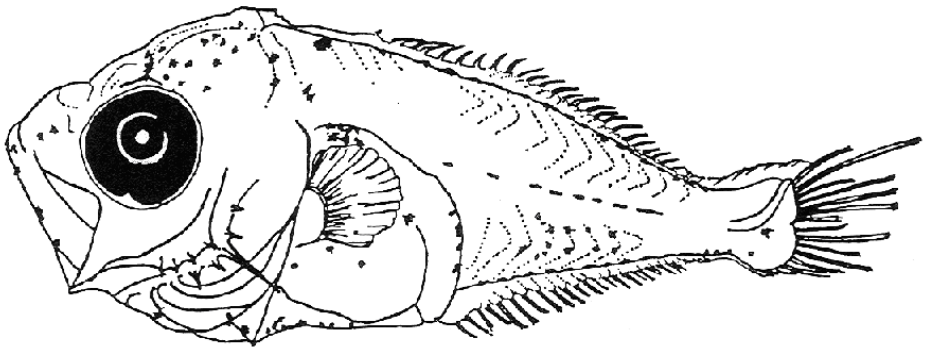
Fig. 47 Larvae of *Selar crumenophthalmus* from the Gulf of Thailand (a: Chamchang 1986; b, c: Chayakul 1996)



a 2.85 mm TL

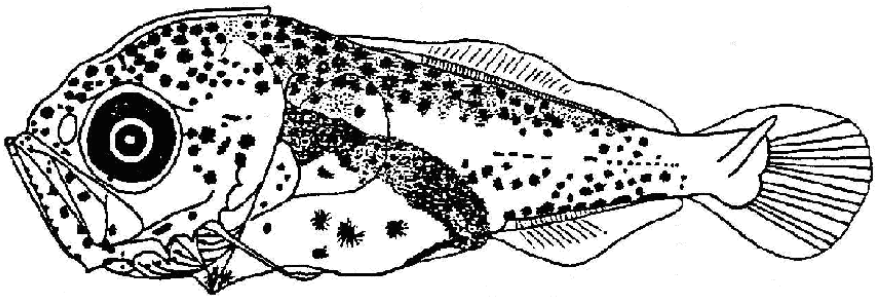


b 3.8 mm TL



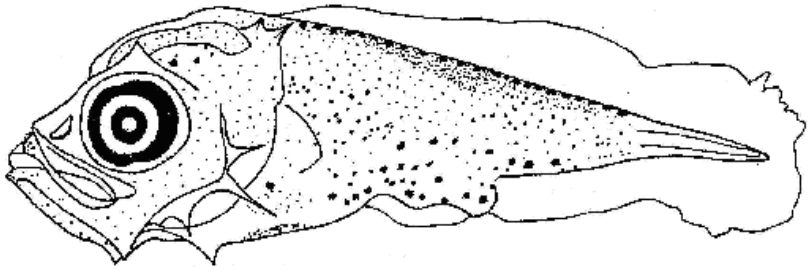
c 5.8 mm TL

Fig. 48 Larvae of *Selaroides leptolepis* from the Gulf of Thailand (Chayakul 1996)

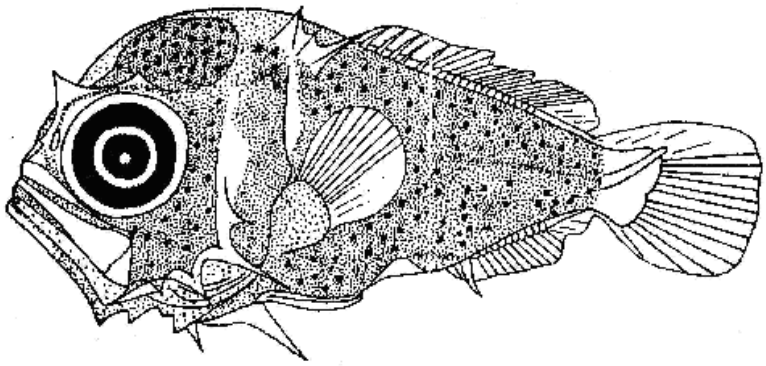


a 5.76 mm TL

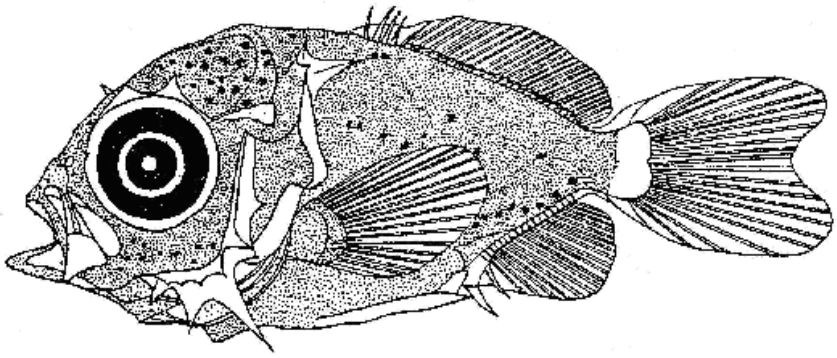
Fig. 49 Larva of *Elagatis bipinnulata* from the Gulf of Thailand (Termvidchakorn 1987a)



a 4.08 mm TL

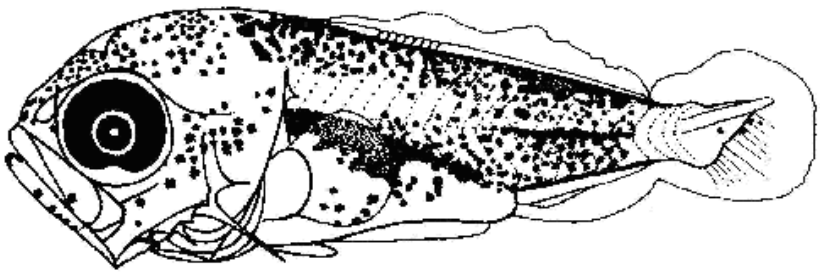


b 5.51 mm TL

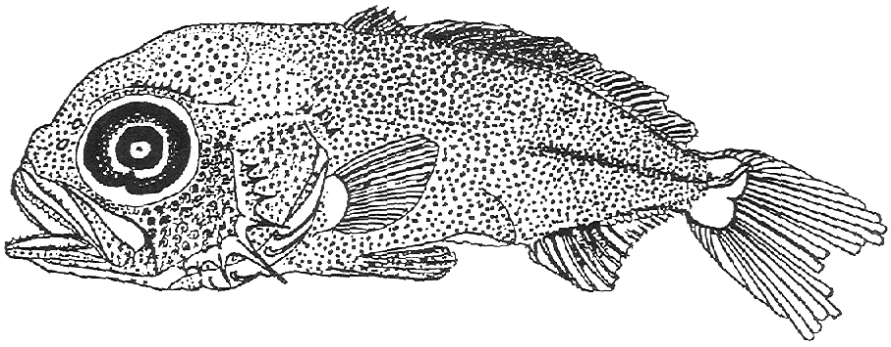


c 10.73 mm TL

Fig. 50 Larvae of *Naucrates ductor* from the South China Sea and southern Japan (Termvidchakorn 1984)

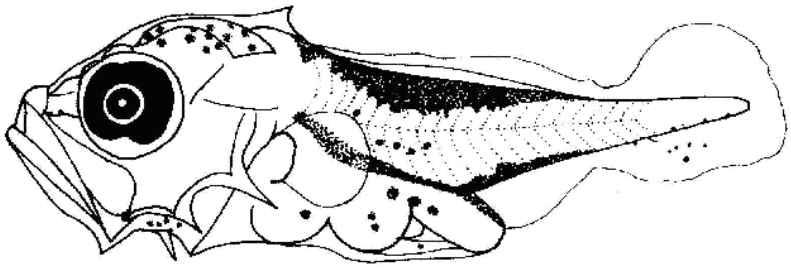


a 4.89 mm TL

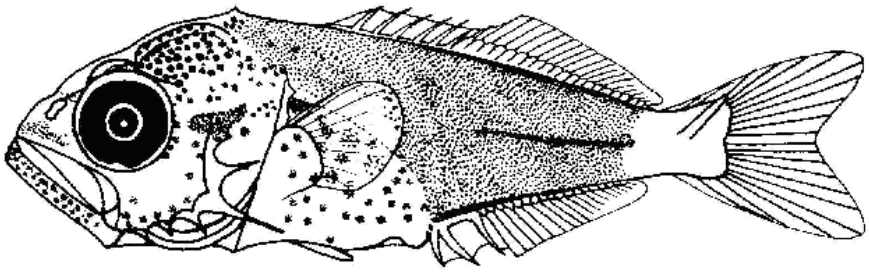


b 7.7 mm TL

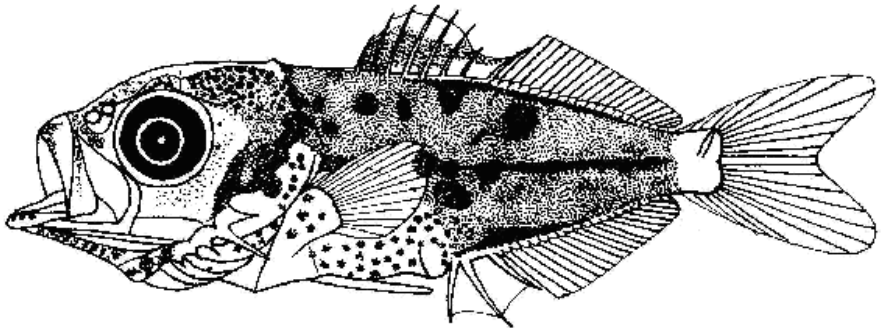
Fig. 51 Larvae of *Seriolina nigrofasciata* from the Gulf of Thailand (a: Termvidchakorn 1987b; b: Chayakul 1996)



a 3.03 mm TL

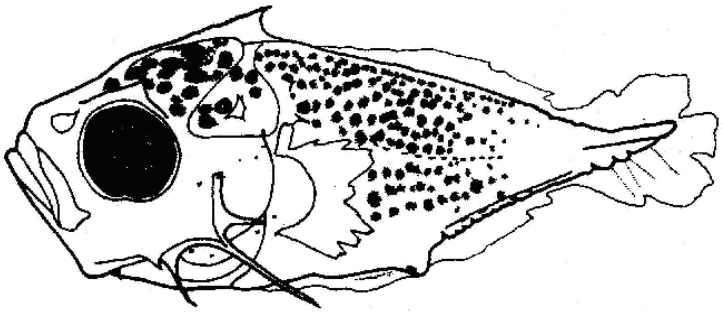


b 6.97 mm TL

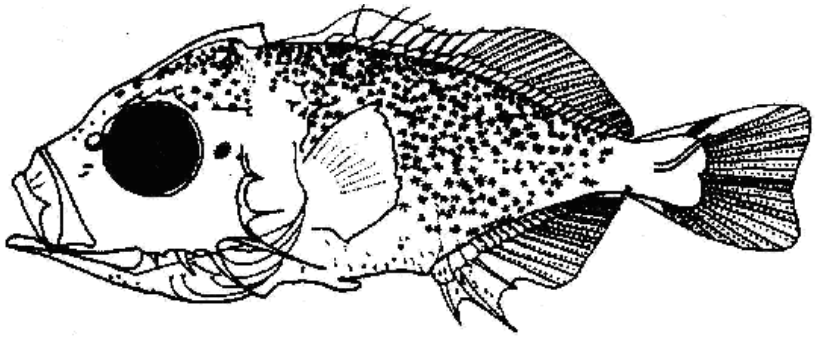


c 10.24 mm TL

Fig. 52 Larvae of *Scomberoides lysan* from the Gulf of Thailand (Termvidchakorn 1988)

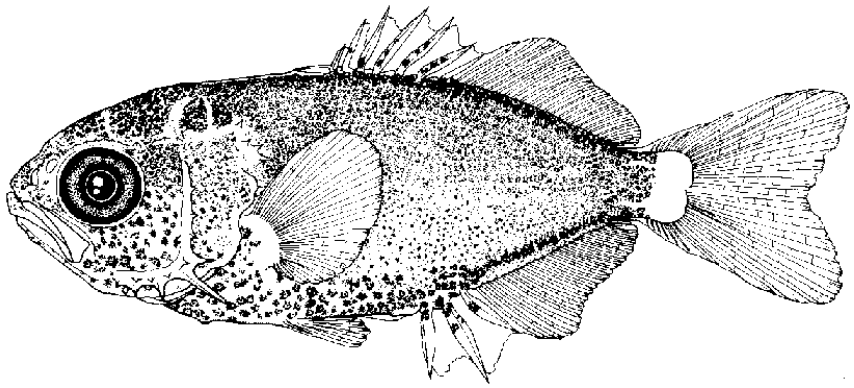


a 3.45 mm NL



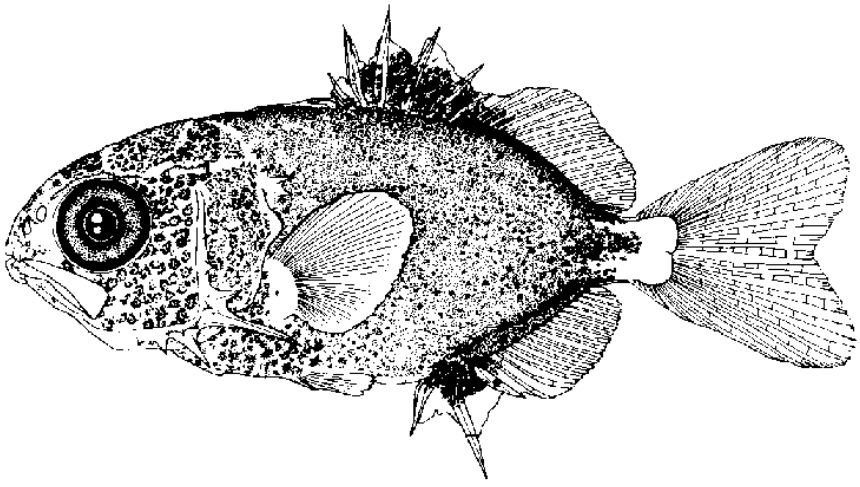
b 6.80 mm SL

Fig. 53 Larvae of *Scomberoides tol* from the Gulf of Thailand (Predalumpaburt 1987)



a 9.9 mm SL

Fig. 54 Juvenile of *Trachinotus baillonii* from southern Japan (Kojima 1985)



a 8.9 mm SL

Fig. 55 Juvenile of *Trachinotus blochii* from southern Japan (Kojima 1985)

Order: Perciformes

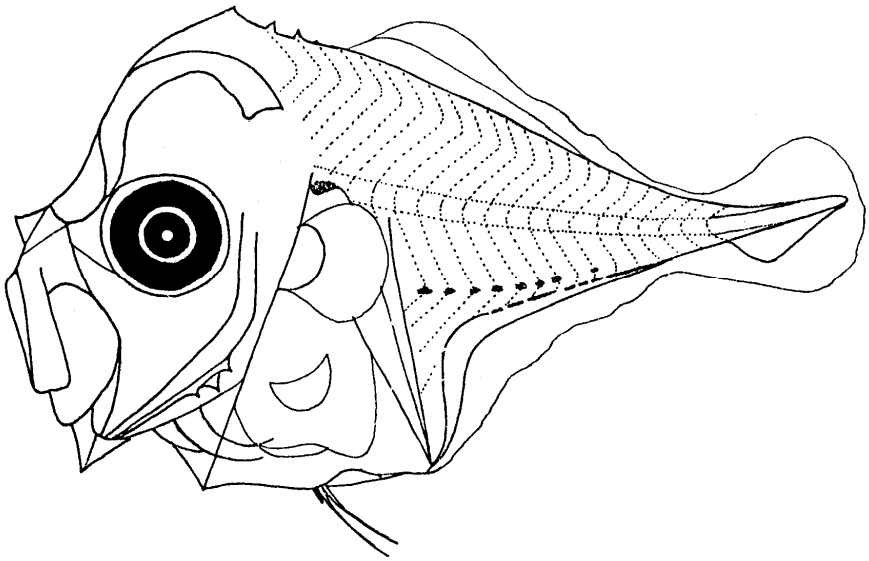
Family: Menidae (Moonfish)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Deep and compressed (body width is very thin), becomes deeper with growth. The tail tapers	Very deep and compressed (body width is very thin). The tail tapers	Very deep and compressed (body width is very thin). The tail tapers
Gut	Coiled and deep, reaches to anterior to the mid body	Coiled and deep, reaches to about the mid body. Hindgut becomes vertically prolonged as the body deepens	Coiled and deep, reaches beyond the mid body
Gas bladder	Conspicuous, located over the hindgut	Conspicuous, located over the hindgut	Conspicuous, located over the hindgut
Head	Large and kidney shaped with a domed cranium	Large and kidney shaped	Large and roundly triangular due to the straight profile in the dorsal margin
Snout	Moderate, rounded and deeply concave in the dorsal profile	Moderate, rounded and concave in the dorsal profile	Moderate, somewhat triangular
Mouth	Large and oblique	Large, vertical and extremely protrusible	Large, vertical and extremely protrusible
Eyes	Moderate and round	Moderate and round	Moderate and round
Head spination	Small supraoccipital crest with serration and a single series of the small pre-opercular spines form	Small supraoccipital crest and a single series of the small pre-opercular spines remain	Preopercle spines disappear by 8 mm. Supraoccipital crest becomes reduced and dis-appears at about 11 mm
Fin formation	Dorsal and anal fin anlagen appear and the incipient anal fin rays form. Pelvic fins with a single spine and rays form. Pectoral fin buds form	Rays of the dorsal and anal fins form. Anterior-most several dorsal soft rays and 1st soft ray of the pelvic fin become pro-longed. Three supraneural bones are visible in the predorsal portion	Pectoral fin rays begin to form. Spines and first several soft rays of the anal fin develop into 'Y' or 'T' shape, and the remaining anal soft rays become bifurcate. Full completion of all fins is achieved by about 7 mm
Pigment	Light pigment is present on the midbrain, gas bladder, hindgut, ventrally and dorso-laterally on the tail, and on the anal fin bases, lower jaw and caudal fin membrane	Lightly to moderately pigmented	Moderately pigmented over the brain, on the anal fin base, laterally on the tail. Internal pigment develops on the tail in association with vertebrae and myosepta
Similar families	Acanthuridae, Carangidae, Lampridae, Zanclidae		

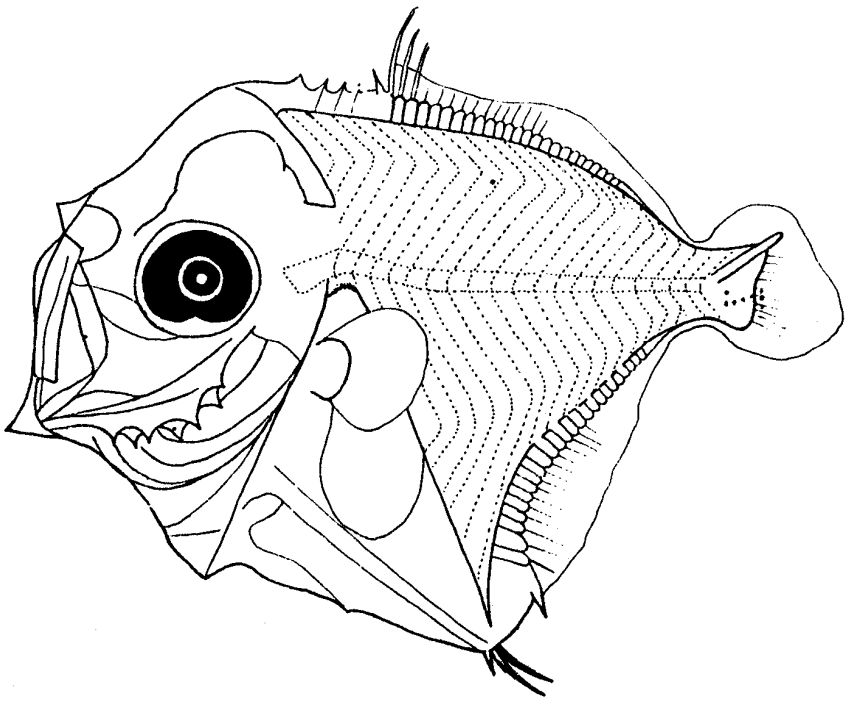
Meristic characters of the Indo-Pacific menid genus (Leis and Carson-Ewart, 2000)

	D	A	P_1	P_2	C	VERTEBRAE
Mene	III-IV, 38-45	III, 28-33	15-16	I, 4[a]	9+8	10+14 = 24

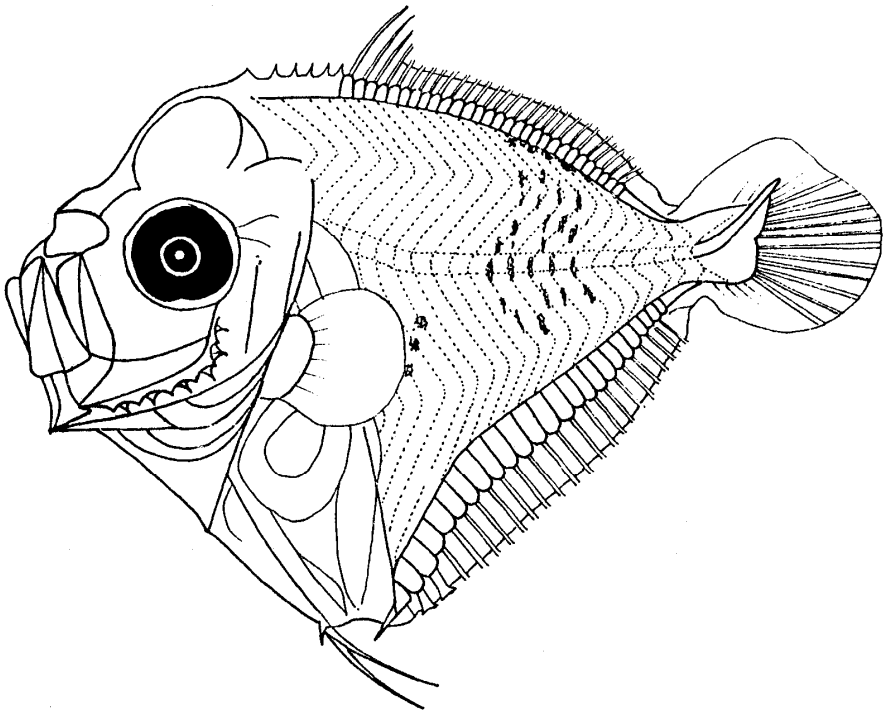
[a] The first ray branches basally (which gives the impression of two rays, hence some published accounts of I, 5).



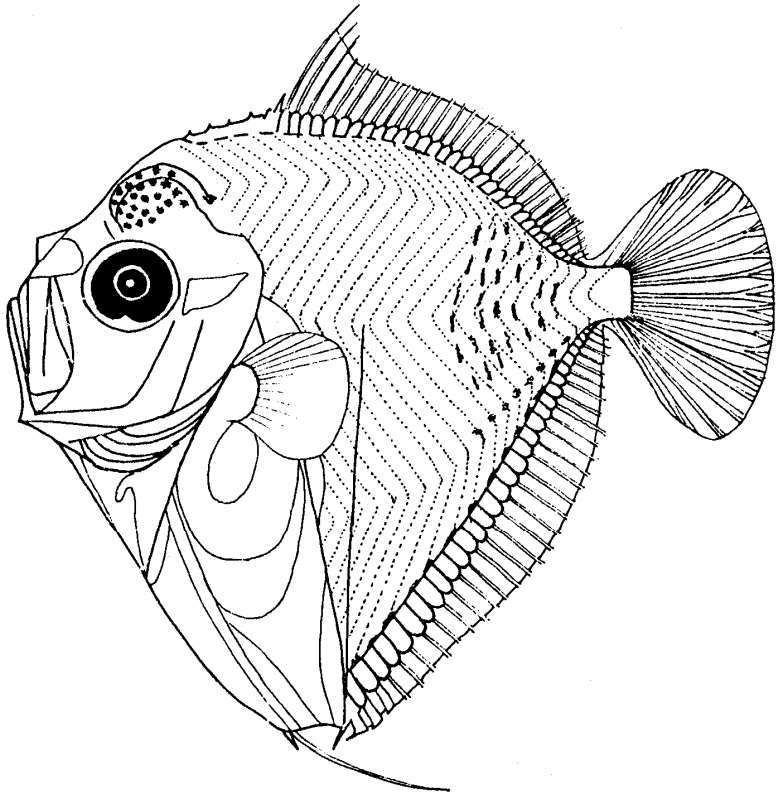
a 3.49 mm TL



b 3.67 mm TL



c 4.73 mm TL



d 6.86 mm TL

Fig. 56 Larvae of *Mene maculata* from Thailand (Termvidchakorn 1989)

Order: Perciformes

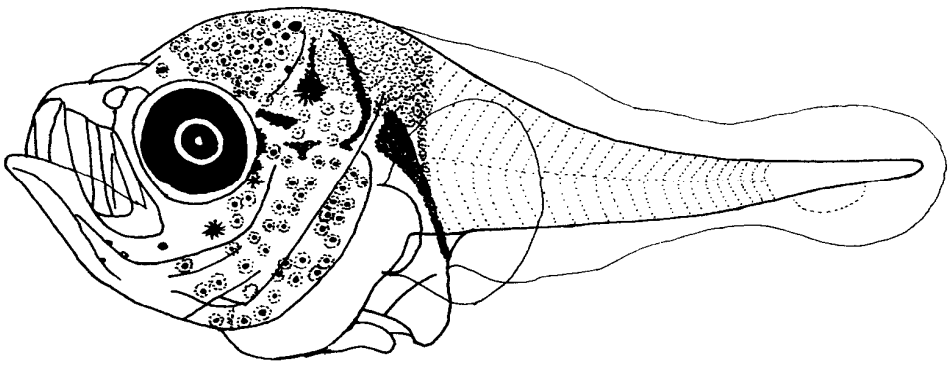
Family: Bramidae (Pomfrets)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Moderate to deep with the slender tail	Moderate to deep and compressed with the slender or tapering tail	Moderate to deep and compressed with the tapering tail
Gut	Coiled and short, extends much before the mid body. Anus moves relatively forward (Pteraclinae: *Pteraclis* and *Pterycombus*?) or backward (Braminae) with growth	Coiled, reaches to about 40% BL	Coiled, reaches around the mid body except Pteraclinae (less than 40% BL)
Gas bladder	Inconspicuous, located above the anterior gut	Inconspicuous, located above the anterior gut	Inconspicuous due to heavy pigment
Head	Small to large and rotund, becomes larger with growth	Moderate to large and round	Large to very large and round
Snout	Short, and round or somewhat pointed	Short, and round or somewhat pointed	Short and steep in the dorsal profile
Mouth	Moderate and oblique, reaches near or beyond the mid eye. Large, recurved canine teeth (*Pteraclis*, *Pterycombus*, *Taractichthys*) or small teeth (*Brama*, *Eumegistus*, *Taractes*) appear at the anterior tip of both jaws or upper jaw	Large and oblique, reaches beyond the mid eye (*Brama*, *Eumegistus*, *Taractes*) or near the posterior margin of the eye (*Pteraclis*, *Pterycombus*, *Taractichthys*). Teeth increase in number in the anterior half of both jaws	Large and oblique, reaches beyond the mid eye (*Brama*, *Eumegistus*, *Taractes*) or near the posterior margin of the eye (*Pteraclis*, *Pterycombus*, *Taractichthys*). Small teeth are present on the posterior half of both jaws
Eyes	Round and large to very large	Round and large to very large	Round and large to very large
Head spination	Not yet appear except *Pteraclis* with preopercle spines	Preopercle spines appear in other genera and increase in number. Several preopercle spines at angle become large	A series of tiny spines forms in the margin of the interopercle at large postflexion and juvenile (*Taractes*, *Taractichthys*)
Fin formation	Pectoral fin buds appear	Pectoral fins are precocious and fan-shaped. Pelvic fin buds appear. Dorsal and anal fin anlagen appear and the incipient fin rays form	All fins are large and formed completely. Origin of the dorsal fin is ahead (*Pteraclis*, *Pterycombus*) or behind (other genera) vertical of the pectoral fin base. Sequence of fin completion: P_1-P_2-D_2-A-D_1 or P_1-D_2-A-D_1-P_2

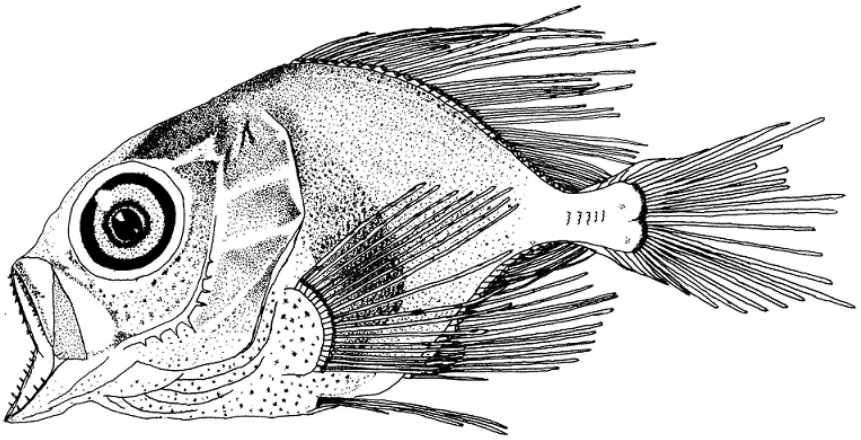
Pigment	Light pigment develops on the brain, nape, opercle, preopercle, pectoral-fin base, branchiostegal membrane, and notochord tip	Heavy pigment is present on the entire head except the snout, and on the mouth, gut and dorsolateral portion of the trunk. Pelvic and pectoral fins are pigmented in some species	Heavy pigment develops on anterior half of the body, thereafter extending to the caudal peduncle. Dorsal and caudal fins, and caudal fin base are pigmented in some large postfelxion larvae more than about 10 mm
Similar families	Blenniidae, Emmelichthyidae (*Erythrocles*), Macrouridae, Moridae, Pinguipedidae		

Meristic characters of the Southeast Asian bramid genera

	D	A	P_1	P_2	C	VERTEBRAE
Braminae						
Brama	30-36	23-31	19-22	I, 5	9+8=17	15-17+21-26=37-42
Eumegistus	33-35	24-26	20-22	I, 5	9+8=17	16-18+23-25 = 40-42
Taractes	30-35	21-26	18-22	I, 5	9+8=17	17-19+20-25=39-43
Taractichthys	33-38	26-30	19-22	I, 5	9+8=17	19-22+22-26=42-47
Pteraclinae						
Pteraclis	46-57	40-50	15-20	I, 3-5	9+8=17	20-22+23-33 = 45-54
Pterycombus	47-49	37-40	19-22	I, 5	9+8=17	20-23+24-26 = 45-48



a 3.60 mm TL (Bramidae sp.)



b 8.1 mm SL (*Taractes* sp.)

Fig. 57 Larvae of Bramidae spp. from the Andaman Sea (a: Termvidchakorn 1987a; b: by Thu, D. D.)

Order: Perciformes

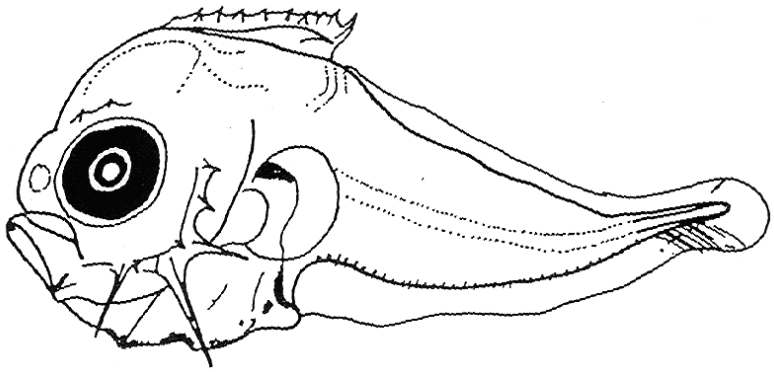
Family: Leiognathidae (Slimys, slipmouths, ponyfishes)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Moderate and strongly compressed	Deep and strongly compressed	Deep and strongly compressed
Gut	Coiled and compact, reaches to anterior to the mid body and protrudes beyond the body margin	Coiled and compact, reaches to anterior to the mid body and protrudes beyond the body margin	Coiled and compact, never exceeds the mid body
Gas bladder	Small, located dorsal to the apex of the gut	Small, located dorsal to the apex of the gut	Moderate, located dorsal to the apex of the gut
Head	Moderate to large and deeply ovate	Large and deeply ovate	Large, becomes shallower
Snout	Steep, blunt and concave	Steep, blunt and concave	Slightly pointed
Mouth	Small, reaches to about the anterior margin of the eye	Small and protrusible, reaches to about the anterior margin of the eye. A large, conspicuous ascending premaxillary process develops	Small and protrusible, reaches to about the anterior margin of the eye
Eyes	Round and moderate to large	Round and moderate to large	Round and moderate to large
Head spination	Preopercular spines (either smooth, finely or strongly serrate) and serrate supra-occipital crest with a pos-teriorly directed spine (either smooth, serrate or multipronged) appear. Supraocular ridge with serration forms	Single posttemporal spine, one or two supracleithral spines and a nasal spine develop	Supraocular ridge reduces to a low, smooth ridge with a separated small spine. Sphenotic ridge appears
Fin formation	Anlagen of the dorsal and anal fins and pectoral fin buds form	Dorsal- and anal-fin spines and rays appear. Serration and enlargement of the dorsal and anal spines develop in some species	Pectoral and pelvic fin rays form. Dorsal spine 2 and anal spines 1 and 2 are serrate on the anterior edge in some species. Full completion of all fins is achieved by at latest 10.5 mm. Sequence of fin completion: D, A, C-P_1-P_2
Pigment	Lightly pigmented through larval stage. Vertically elongate melanophores align the ventral midline of the tail, later move onto the	Brain, angle of the lower jaw (some species possess from the preflexion stage), and the caudal fin and the base are pigmented	Head, trunk and tail in some species are widely pigmented

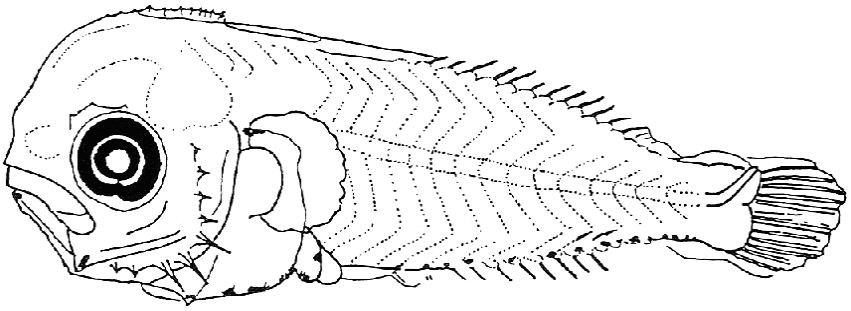
	anal finfold (onto the anal-fin base in flexion and post-flexion). Large melanophore appears on the fin-fold anterior to the anus. Pigment appears over the gut and gas bladder, and often on the ventral midline of the gut and the cleithral symphysis. Some species bears pigment on the pre-opercular-angle spine through larval stage		
Similar families	Acanthuridae, Carangidae, Caproidae, Cepolidae, Holocentridae, Lethrinidae, Lobotidae (and *Hapalogenys*), Priacanthidae, Siganidae		

Meristic characters of the Indo-Pacific Leiognathid genera (Leis and Carson-Ewart, 2000)

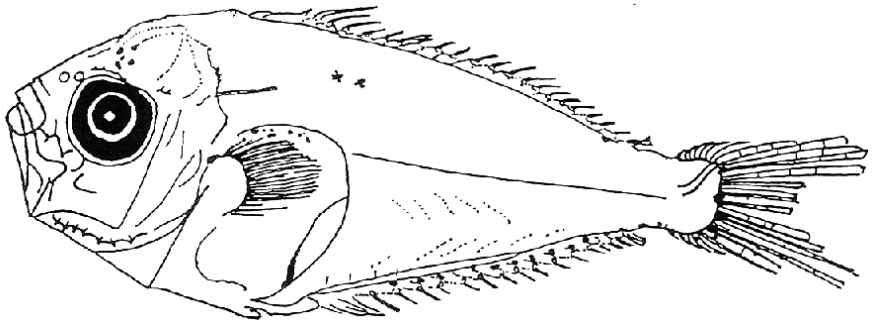
	D	A	P_1	P_2	C	VERTEBRAE
Gazza	VII-VIII, 15-17	III, 13-14	16-18	I, 5	9+8	10+14 = 24
Leiognathus	VIII, 16	III, 14	16-21	I, 5	9+8	10+14 = 24
Secutor	VIII-IX, 15-17	III, 14	16-19	I, 5	9+8	10+14 = 24



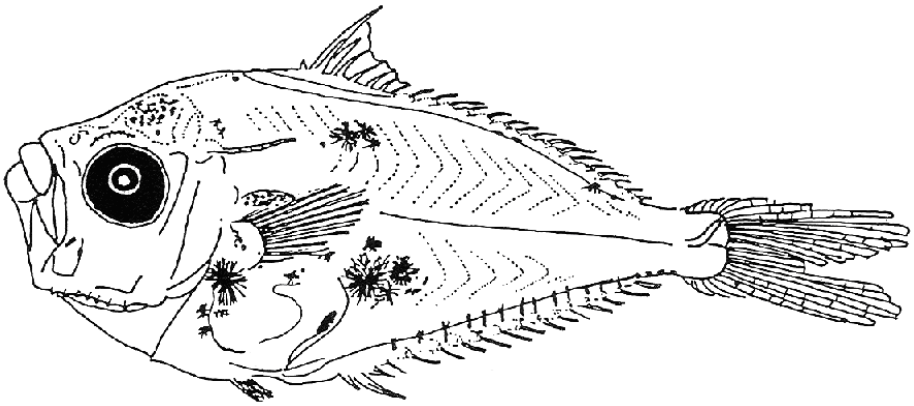
a 2.4 mm TL



b 4.1 mm TL



c 10.5 mm TL



d 13.1 mm TL

Fig. 58 Larvae of Leiognathidae spp. from the Gulf of Thailand (Chayakul 1996)

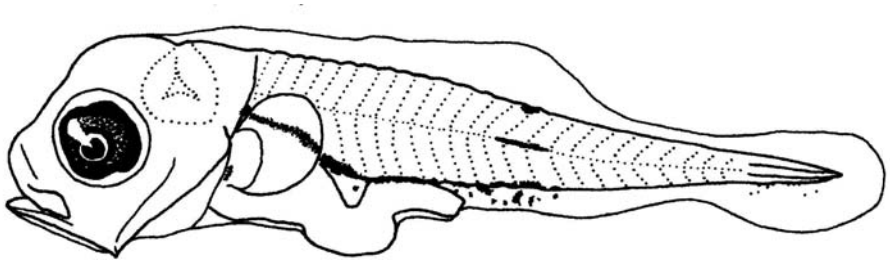
Order: Perciformes

Family: Emmelichthyidae (Rovers)

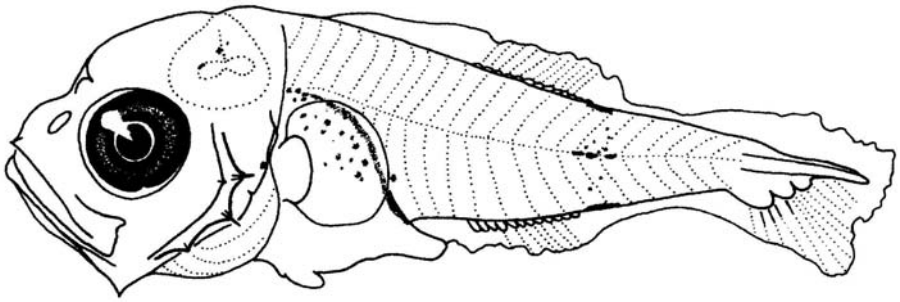
Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Initially elongate, later moderate	Moderate and compressed	Moderate and compressed
Gut	Coiled and thereafter triangular, reaches beyond the mid body	Coiled and triangular, reaches beyond the mid body. A gap between the anus and the anal fin origin is visible	Coiled and triangular, reaches beyond the mid body. Anus-anal origin gap is prominent
Gas bladder	Moderate and conspicuous, located over the anterior portion of the gut	Moderate and conspicuous, located over the anterior portion of the gut	Moderate and conspicuous, located over the anterior portion of the gut
Head	Moderate	Large	Large
Snout	Short and slightly convex	Short and convex	Short and slightly convex
Mouth	Oblique, usually reaches to the mid pupil	Oblique, usually reaches to the mid pupil	Oblique, usually reaches to the mid pupil
Eyes	Round and large	Round and large	Round and large
Head spination	Small spines appear on the outer and inner margins of the preopercle	Small preopercle spines increase in number	Small spines develop on the opercle, interopercle, post-temporal and supracleithrum. Posterior margins of the pre-opercle, interopercle and subopercle are serrated in juvenile stage
Fin formation	Anlagen of the dorsal and anal fins appear oppositely. Pelvic fin buds appear	Soft rays of the dorsal and anal fins develop, later dorsal spines begin to form	Sequence of fin completion: D_2-A-D_1-P_2-P_1
Pigment	Sparsely pigmented through larval stage. Melanophores are present over the gut, on the dorsal, ventral and lateral midlines of the tail near the anus, notochord tip and otic region in *Emmelichthys*	Pigment patches on the dorsal and ventral midlines of the tail in *Emmelichthys* are located at the posterior ends of the dorsal and anal fins, respectively	Additional pigment on the brain, opercle, pectoral fin base and pelvic fin appears in *Emmelichthys*. Pelagic juveniles in *Emmelichthys* and *Erythrocles* are heavily pigmented with dark and vertical bands
Similar families	Carangidae, Nomeidae, Oplegnathidae, Pomacentridae , Terapontidae		

Meristic characters of the Indo-Pacific emmelichthyid genera (Leis and Carson-Ewart, 2000)

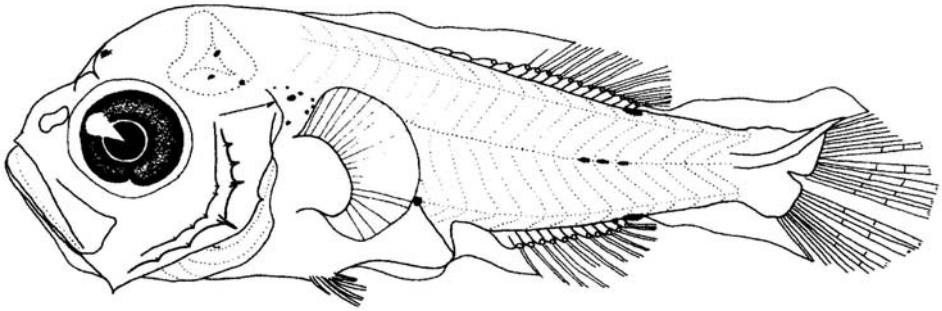
	D	A	P_1	P_2	C	VERTEBRAE
Emmelichthys	XI-XIV, 9-12	III, 9-10	19-23	I, 5	9+8	10+14 = 24
Erythrocles	XI, 10-12	III, 9-10	17-20	I, 5	9+8	10+14 = 24
Plagiogeneion	XII-XIII, 10-12	III, 9-11	18-23	I, 5	9+8	10+14 = 24



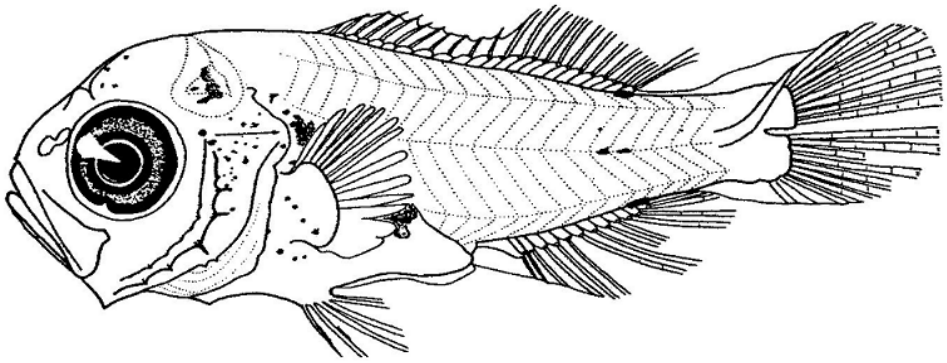
a 3.3 mm SL



b 4.5 mm SL

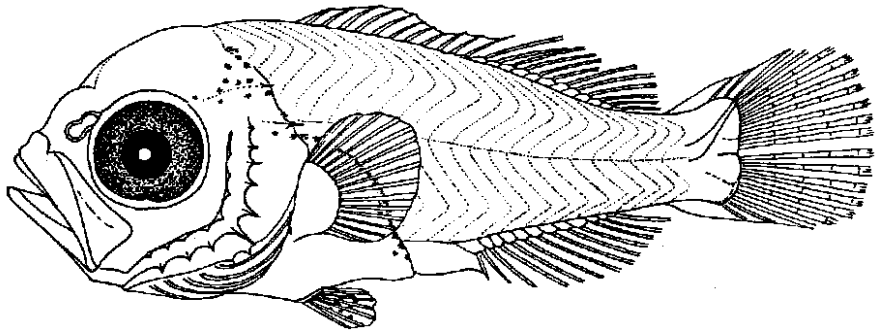


c 5.2 mm SL

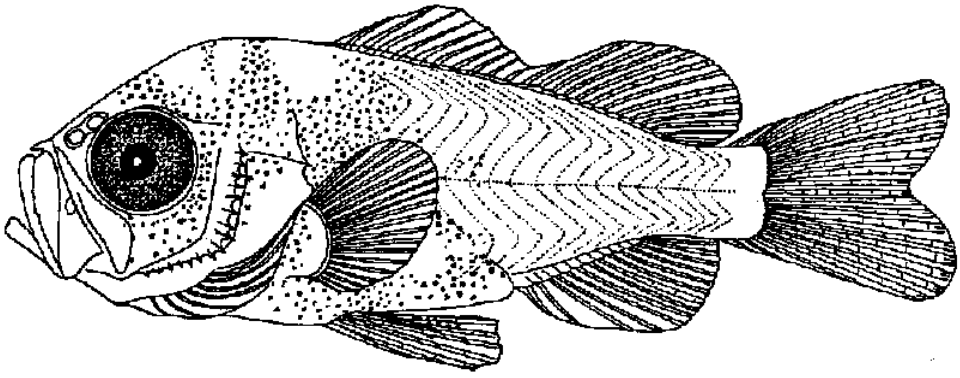


d 6.2 mm SL

Fig. 59 Larvae of *Emmelichthys struhsakeri* from southern Japan (Konishi 1988e)



a 7.5 mm TL



b 14.5 mm TL

Fig. 60 Juveniles of *Erythrocles schlegelii* from southern Japan (Mito 1966)

Order: Perciformes

Family: Lutjanidae (Snappers)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Initially elongate, soon moderate, compressed and tapering, becomes deeper with growth except Caesioninae of which body depth increases until flexion stage, but thereafter decrease	Mostly moderate, but deep in some lutjaninine *Lutjanus*, *Macolor* and *Pinjalo*, and compressed	Moderate (apsiline *Paracaesio*, Caesioninae, Etelinae, some lutjanine *Lutjanus* and Paradicichthyinae) to deep (some *Lutjanus*, *Macolor* and *Pinjalo*), and compressed with the slightly long caudal peduncle
Gut	Coiled, never exceeds the mid body. Preanal length becomes longer with growth	Coiled and triangular, extends to around the mid body	Coiled and triangular, extends beyond the mid body
Gas bladder	Moderate, located above the anterior portion of the gut	Large, located above the anterior portion of the gut	Large, located above the gut
Head	Mostly moderate, but large in some of Caesioninae, Etelinae and Lutjaninae, and compressed, rounded, becomes larger with growth	Mostly large, but still moderate in some lutjanine *Lutjanus*, and compressed	Large and compressed, reduces roundness to become triangular-shaped
Snout	Short and concave in the dorsal profile	Moderate, concave in the dorsal profile and slightly pointed	Moderate and slightly pointed or steep
Mouth	Moderate and oblique, reaches to anterior edge of the eye. Tiny villiform teeth appear on both jaws	Moderate and oblique, reaches to anterior edge of the eye	Moderate and oblique, mostly reaches to anterior edge of the eye, but reaches to the mid eye in Etelinae. Many species develop prominent canine teeth on both jaws
Eyes	Round and large to moderate, becomes relatively smaller with growth	Round and moderate to large	Round and moderate to large
Head spination	Preopercular spines appear	Spines form on the supracleithrum, interopercle, posttemporal, opercle. Preopercle spines become larger and more numerous, and the largest spine at angle is serrate in some of	Postcleithrum spine develops. Subopercle spines and low frontal and pterotic ridges form in most taxa. Anterior end of the maxillar develops fine serration in lutjanine *Pinjalo*

		Caesioninae and Lutjaninae. Supraocular ridge is serrate in Lutjaninae (at postflexion stage in Caesioninae and paradicichthyinine *Symphorichthys*)	
Fin formation	Pelvic spine and the second dorsal spine first develop (these two spines are serrated in Caeosioninae, Lutjaninae and eteline *Aprion*) and become prolonged, thereafter several dorsal spines and pelvic-fin rays form. First pelvic ray is longer than the spine. Pectoral fin buds form	All pelvic fin rays form. Second dorsal spine and first pelvic ray become more elongate, in particular like whip in *Paracaesio* and eteline *Randallichthys*. Soft rays of the dorsal and pectoral fins, and spines and soft rays of the anal fin form. Third anal-fin spine is early formed in *Paracaesio* and Etelinae at latest by 7 mm	All fin spines have serration in some species of Caeosioninae, Lutjaninae and eteline *Aprion*. Full completion of all fins is achieved at latest by 14 mm. Sequence of fin completion: D_1-P_2-C-D_2-A-P_1
Pigment	Light pigment is present on the dorsal surface of the gut and gas bladder, the spiny dorsal- and pelvic-fin membranes, on the ventral midline of the tail, on the midbrain (at preflexion stage in *Paracaesio* and Etelinae, at flexion or postflexion stage in others), laterally on the caudal peduncle, and at the cleithral symphysis (disappear at postflexion stage in Caesioninae, Etelinae and Lutjaninae)	Melanophores on the ventral midline of the tail decrease in number	Some species have heavy pigment in the spiny dorsal-fin membrane, dorsal fin base and dorsal margin of the caudal peduncle
Similar families	Gempylidae, Melamphaidae, Serranidae (Anthiinae, Epinephelinae), Siganidae, Terapontidae, Trichiuridae		

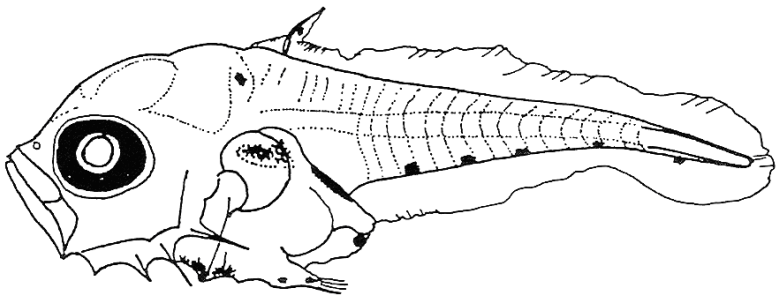
Meristic characters of the Indo-Pacific lutjanid genera (modified from Leis and Carson-Ewart (2000))

	D	A	P_1	P_2	C	VERTEBRAE
Apsilinae						
Lipocheilus	X, 10	III, 8	15-16	I, 5	9+8	10+14
Paracaesio	X, 9-10	III, 8-9	16-18	I, 5	9+8	10+14
Parapristipomoides [b]	X, 10	III, 8	16	I, 5	9+8	10+14
Caesioninae [a]						
Caesio	X, 13-16	III, 10-13	17-23	I, 5	9+8	10+14
Dipterygonotus	XII-XV, 8-11	III, 9-11	16-19	I, 5	9+8	10+14
Gymnocaesio	X-XI, 14-16	III, 11-13	20-22	I, 5	9+8	10+14
Pterocaesio	X-XII, 14-22	III, 11-13	18-24	I, 5	9+8	10+14
Etelinae						
Aphareus	X, 10-11	III, 8	15-16	I, 5	9+8	10+14
Aprion	X, 11	III, 8	16-18	I, 5	9+8	10+14
Etelis	X, 11	III, 8	15-17	I, 5	9+8	10+14
Pristipomoides	X, 11	III, 8	15-17	I, 5	9+8	10+14
Randallichthys [c]	X, 11	III, 9	16-17	I, 5	9+8	10+14
Lutjaninae						
Lutjanus	X-XII, 12-16	III, 7-11	15-17	I, 5	9+8	10+14
Macolor	IX-X, 13-15	III, 10-11	16-18	I, 5	9+8	10+14
Pinjalo	XI-XII, 13-14	III, 9-10	17-19	I, 5	9+8	10+14
Paradicichthyinae						
Symphorichthys	X, 17-19	III, 11	16-17	I, 5	9+8	10+14
Symphorus	X, 14-17	III, 9-10	16-17	I, 5	9+8	10+14

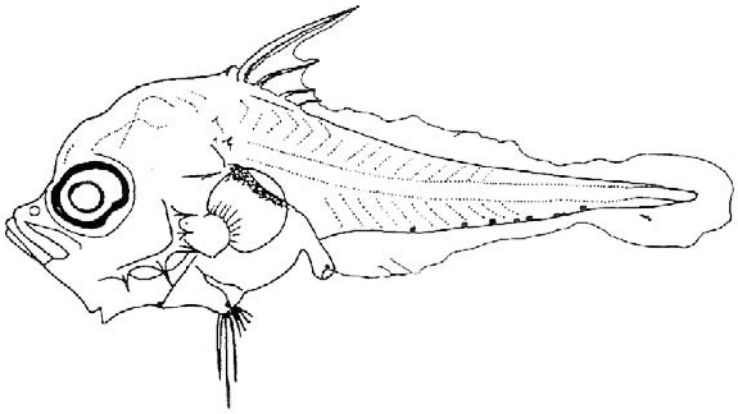
[a] Nelson (2006) upgraded this taxon to family level.

[b] Only *P. squamimaxillaris* is reported from Tonga, New Caledonia and the Coral Sea.

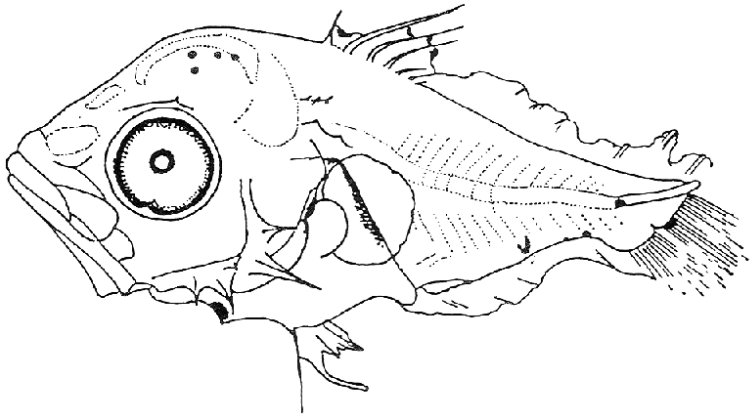
[c] Only *R. filamentosus* is reported from Japan, New Caledonia, Tonga and Hawaii.



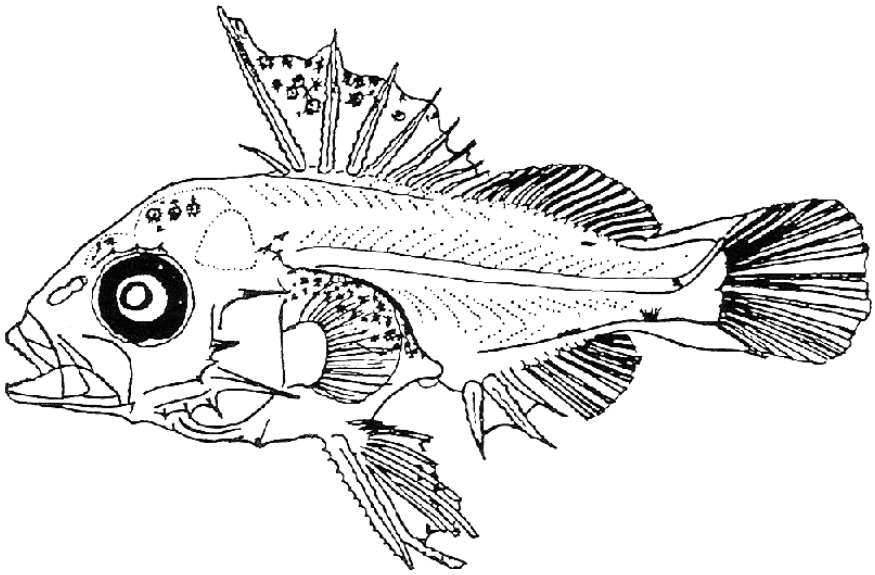
a 2.5 mm TL



b 3.5 mm TL



c 3.8 mm TL



d 5.4 mm TL

Fig. 61 Larvae of Lutjanidae spp. from the Gulf of Thailand (Chayakul 1996)

Order: Perciformes

Family: Lobotidae (Tripletails)

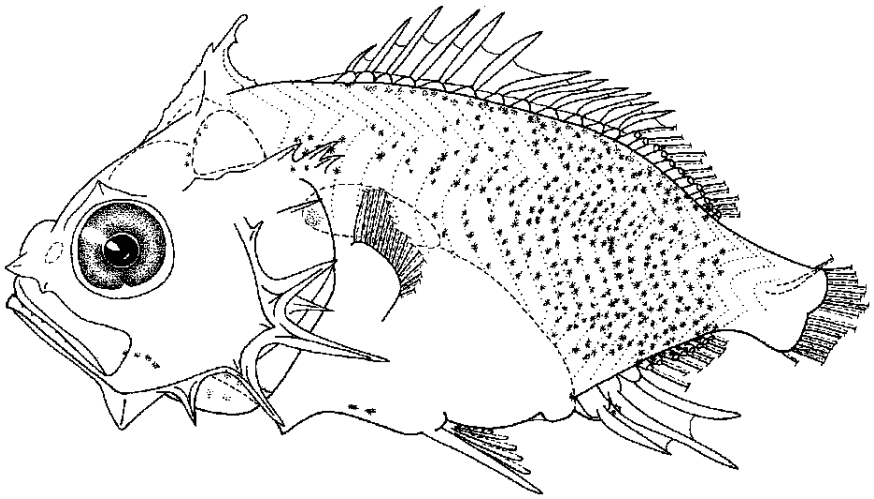
Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Moderate and compressed, becomes deeper with growth	Moderate to deep and fairly compressed	Deep and ovate and strongly compressed (*Coius* is not so deep like *Lobotes*)
Gut	Initially straight and broad, later coiled, extends past the mid body. Preanal length becomes longer with growth	Widely triangular and extends fairy beyond the mid body	Widely triangular, reaches to 70-80% BL
Gas bladder	Small, located above the anterior gut	Moderate, located above the anterior to middle of the gut	Moderate, located above the anterior to middle of the gut
Head	Moderate, becomes larger with growth	Large and deep	Large and deep
Snout	Short and slightly concave	Moderate and truncated	Moderate and slightly concave
Mouth	Initially short and oblique, later becomes enlarged	Large and oblique, extends to about the mid eye	Large and oblique, extends to about the mid eye
Eyes	Large and round, becomes proportionally smaller with growth	Moderate and round	Moderate and round
Head spination	Serrate supraoccipital crest and preopercular spines appear. The crest becomes relatively reduced after preflexion	Supraorbital ridge and small posttemporal and supra-cleithral spines develop. Preopercle spines become larger (smooth spine at angle is the largest)	Low pterotic ridge, sub-opercle spine and small opercle spine develop. Pre-oprcle spine at the angle becomes smaller
Fin formation	Pelvic and pectoral fin buds form	Pelvic fins have a full com-plement of elements and extend to near the anus. Dorsal and anal fin anlagen, and later the rays develop. Pectoral rays form	Full completion of all fins is achieved by 7 mm. Sequence of fin completion: P_2-C, D_1-D_2, A-P_1
Pigment	Light pigment , on head, visceral mass and ventral midline of the gut and tail	Pelvic fins are heavily pig-mented. Pigmentation rapidly increases over the head and trunk	Heavily pigmented. Pigment blotches and mottled area appear on the head, trunk and tail, thereafter various bars and pigment bands form. Spiny dorsal and anal fins are pigmented
Similar families	Anomalopidae, Caproidae, Carangidae, Cepolidae, Drepaneidae, Ephippidae, *Hapalogenys*, Leiognathidae, Lethrinidae, Priacanthidae		

Morphological characters described above are mainly based on *Lobotes surinamensis*.

Meristic characters of the Indo-Pacific lobotid genera (modified from Leis and Carson-Ewart (2000))

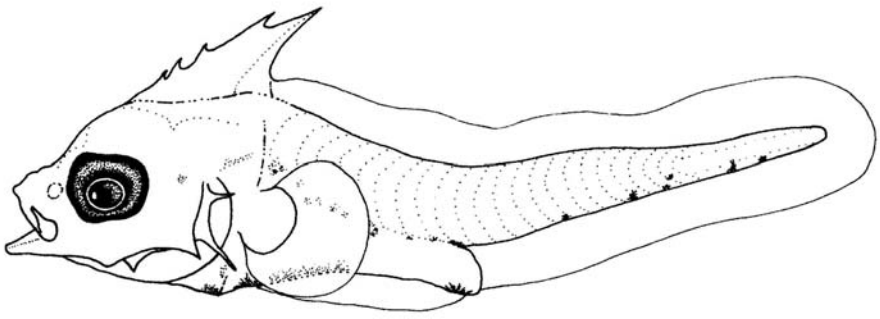
	D	A	P_1	P_2	C	VERTEBRAE
Coius	XII, 12-18	III, 8-10	16-20	I, 5	9+8	10+13 = 23
Lobotes	XI-XII, 15-16	III, 10-12	15-17	I, 5	9+8	(11-12)+(12-13) = 24

Meristic cahracters of the *incertae sedis* genus (*Hapalogenys*), of which larvae share the nearly same morphological characteristics with lobotid larvae, are following: D X-XI, 13-17; A III, 9-10; P_1 17-19; P_2 I, 5; C 9+8; Vertebrae 10+14=24.

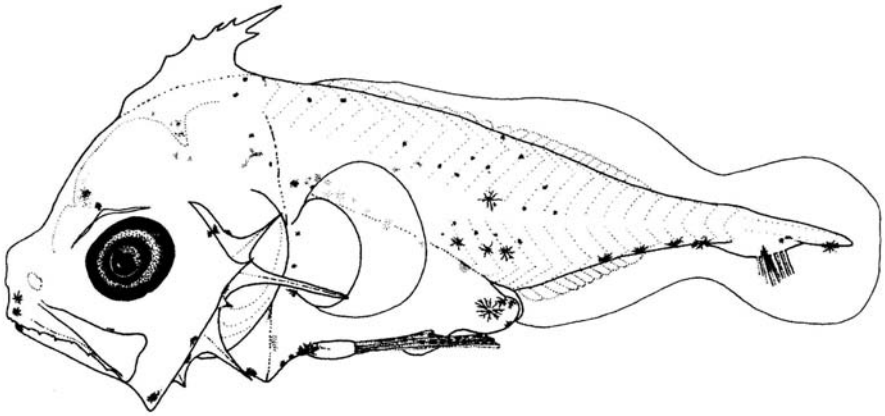


a 7.8 mm SL

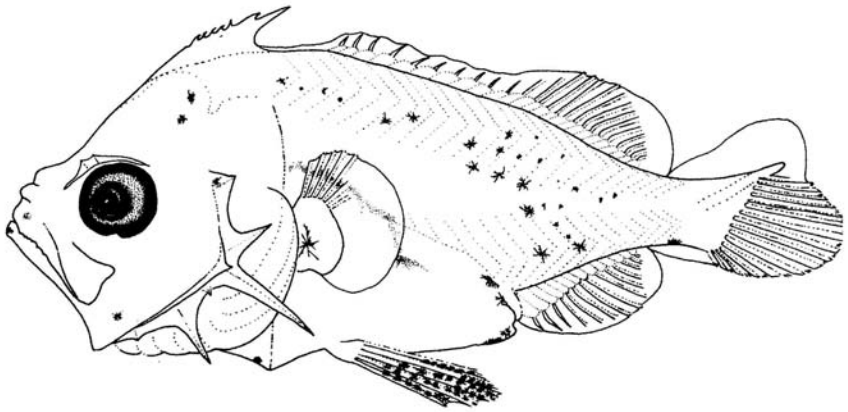
Fig. 62 Larva of *Coius polota* from estuarine waters of the Malay Peninsula (Ditty 2000)



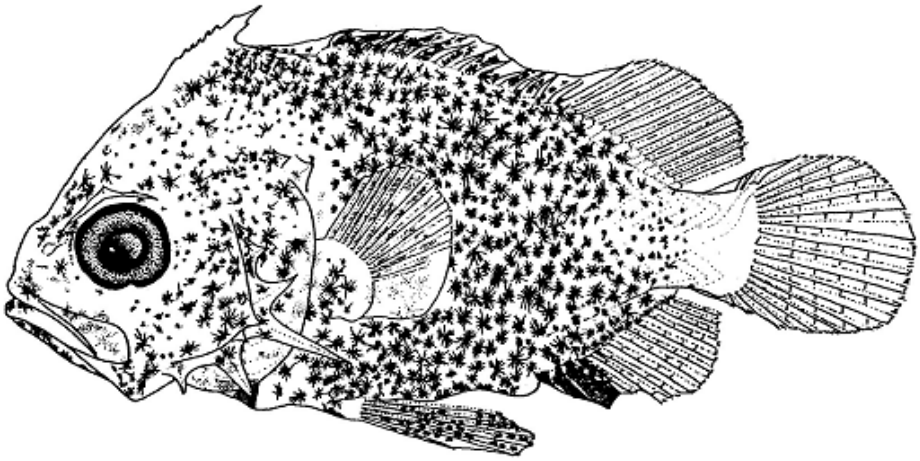
a 2.4 mm SL



b 3.9 mm SL



c 5.3 mm SL



d 5.9 mm SL

Fig. 63 Larvae of *Lobotes surinamensis* from the East Pacific (Watson 1996)

Order: Perciformes

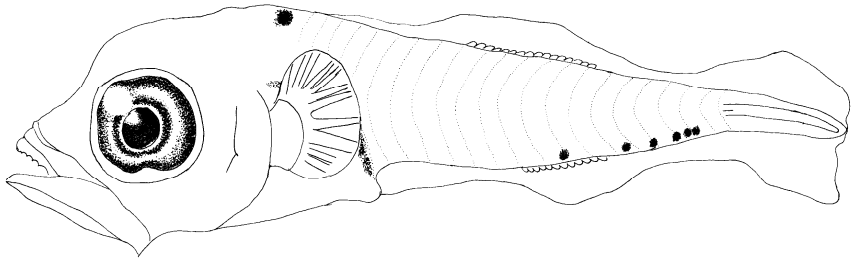
Family: Gerreidae (Mojarras)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Moderate	Moderate and compressed	Moderate and compressed
Gut	Coiled and compact, extends to less than half the body length	Coiled and compact, reaches to about the mid body	Coiled and compact, reaches to about the mid body
Gas bladder	Small, inconspicuous, above the anterior portion of the gut	Small, inconspicuous, above the anterior portion of the gut	Small, inconspicuous, above the anterior portion of the gut
Head	Moderate, broad and round	Large and compressed	Large and compressed
Snout	Short and round	Somewhat short, triangular and compressed	Somewhat short, triangular and compressed
Mouth	Slightly oblique, reaches to about the anterior edge of the eye. Tiny teeth form in the upper jaw	Slightly oblique, reaches near the mid eye. Tiny teeth form in the lower jaw	Slightly oblique and protractile, reaches to the mid eye
Eyes	Large and round	Large to moderate and round	Moderate and round
Head spination	Not yet appears	Small, low and wide-spaced preopercle spines and supracleithral spine (in some species) appear	Preopercle and supracleithral spines become somewhat reduced
Fin formation	Pectoral buds form	Dorsal and anal fin anlagen and pelvic fin buds appear, thereafter the fin rays form. A gap exists between the anus and the origin of the anal fin	The gap in the abdomen becomes wider. All fins form completely by 7 mm. Sequence of fin completion: C-D_2-A-D_1-P_2-P_1.
Pigment	Gas bladder and gut are pigmented dorsally. 3-15 melanophore series appear along the ventral midline of the tail	Anal- and caudal-fin bases and the ventral midline of the gut are pigmented	Pigment develops over the brain, on the throat, operculum, dorsal and ventral midlines of the caudal peduncle (some species have pigment along the lateral midline of the tail)
Similar families	Ambassidae, Haemulidae, Microcanthidae, Mullidae, Pomacentridae, Sciaenidae, Sparidae, Terapontidae		

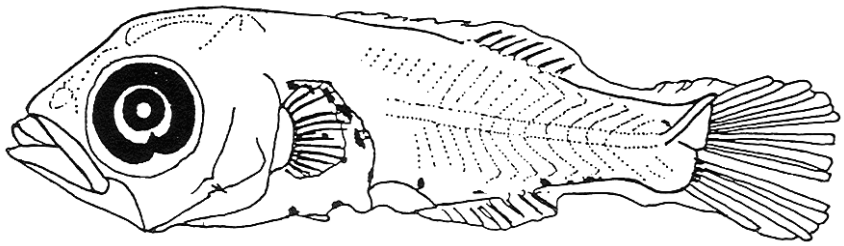
Morphological characters described above are based on larvae of the genus *Gerres*.

Meristic characters of the Indo-Pacific gerreid genera (Leis and Carson-Ewart, 2000)

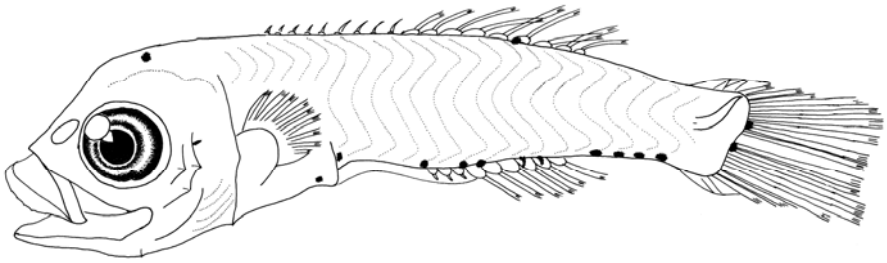
	D	A	P_1	P_2	C	VERTEBRAE
Gerres	IX-X, 9-11	III, 7-10	15-17	I, 5	9+8	10+14 = 24
Pentaprion	IX-X, 12-14	V-VI, 12-14	12-15	I, 5	9+8	10+14 = 24



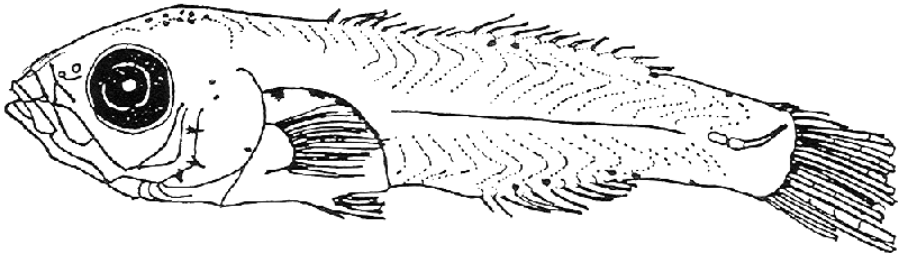
a 3.30 mm SL



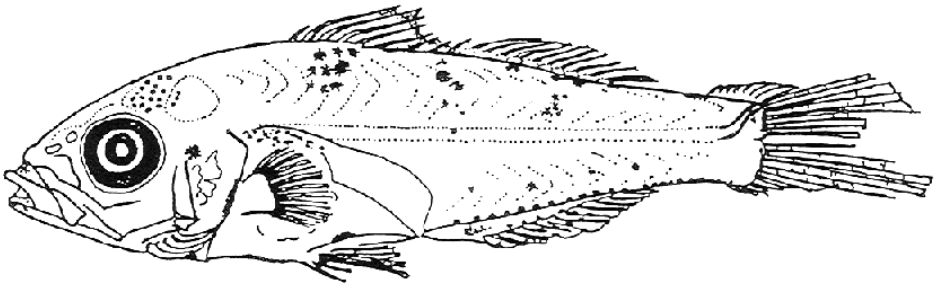
b 3.9 mm TL



c 6.40 mm SL



d 7.9 mm TL



e 13.0 mm TL

Fig. 64 Larvae of *Gerres* spp. from the Gulf of Thailand (a, c: by Puewkhao, P.; b, d, e: Chayakul 1996)

Order: Perciformes

Family: Haemulidae (Grunts)

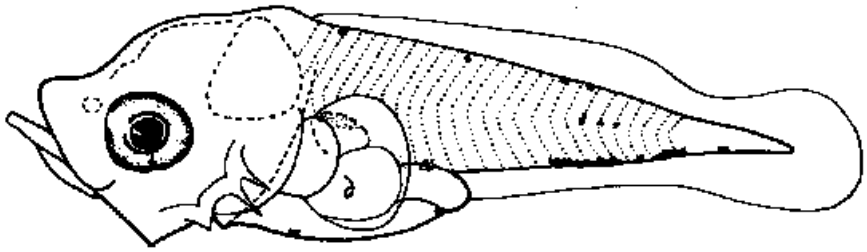
Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Moderate	Moderate (body becomes deeper than in preflexion) and compressed	Moderate to deep (some species in *Plectorhinchus*) and compressed
Gut	Coiled, extends to 45-60% BL	Coiled and triangular, extends to 50-70% BL	Coiled and triangular, extends to 50-70% BL
Gas bladder	Inconspicuous, located above the anterior portion of the gut	Inconspicuous, located above the anterior portion of the gut	Inconspicuous, located above the anterior portion of the gut
Head	Moderate to large and somewhat round	Mostly large and hunch-backed or progressively steep in dorsal profile	Mostly large and hunch-backed or progressively steep in dorsal profile
Snout	Short and slightly concave	Moderate and somewhat pointed	Moderate, slightly pointed or blunt
Mouth	Oblique, reaches to the anterior edge of the eye	Oblique, reaches to the mid eye	Oblique, reaches to the mid eye or beyond it
Eyes	Round and large to moderate	Round and moderate	Round and moderate
Head spination	Preopercular spines appear	Posttemporal, supracleithral, opercular and subopercular spines appear. A low, spineless ridge or 1-2 spines form on the pterotic in a few species of *Plectorhinchus*. A serrate supraocular ridge is present in all genera but *Parapristipoma*	One to two spines are present on the interopercle in most taxa
Fin formation	Dorsal and anal fin anlagen and pectoral fin buds form	Pelvic fin buds appear. Dorsal and anal soft rays form	All fins completely form by about 9 mm (the last dorsal and third anal spines form as soft rays and change into spine after settlement). Sequence of fin completion: D_2-A-D_1-P_2-P_1
Pigment	Lightly pigmented. Melanophores appear on the gas bladder, ventral midlines of the gut and tail and isthmus. Pigment is present on the dorsal midline of the body and the lateral midline of the tail in some	*Parapristipoma* and *Pomadasys* are lightly pigmented through larval stage with the nearly same pigment pattern at preflexion. *Diagramma* and *Plectorhinchus* become more fairly pigmented. Caudal peduncle (*Diagramma*) and	*Diagramma* and *Plectorhinchus* becomes more heavily pigmented: whole body except the pectoral, caudal, anal and dorsal soft rays becomes heavily pigmented (*Plectorhinchus*); large melanophores appear on the trunk,

	species	anterior half of the body (*Plectorhinchus*) are well pigmented	tail, and base of the caudal fin appear (*Diagramma*)
Similar families	Gerreidae, Lethrinidae, Lutjanidae, Mullidae, Nemipteridae, Opistognathidae, Plesiopidae, Pomacentridae, Priacanthidae, Sciaenidae, Serranidae (Serraninae), Sparidae, Terapontidae		

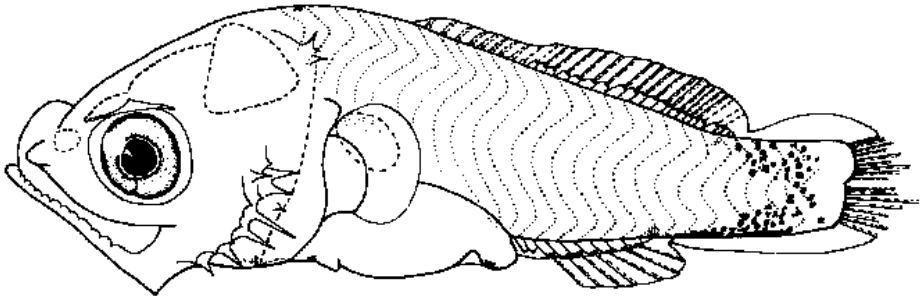
Meristic characters of the Indo-Pacific haemulid genera (modified from Leis and Carson-Ewart (2000))

	D	A	P_1	P_2	C	VERTEBRAE
Haemulinae						
Pomadasys	XI-XIII, 12-18	III, 6-12	15-17	I, 5	9+8	10+16 = 26
Plectorhinchinae						
Diagramma	IX-X, 21-26	III, 6-8	16-17	I, 5	9+8	11+16 = 27
Parapristipoma [a]	XII-XIV, 16-17	III, 7-9	17-19	I, 5	9+8	11+16 = 27
Plectorhinchus	XI-XIV, 15-23	III, 7-9	16-18	I, 5	9+8	11+16 = 27

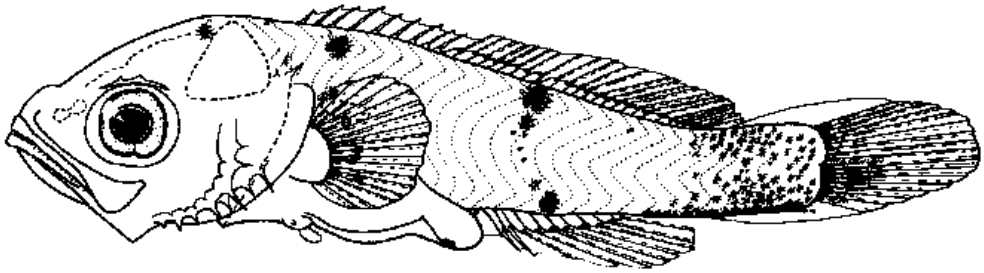
[a] *P. trilineatum* is known from southern Japan, the East China Sea and Taiwan.



a 2.8 mm SL

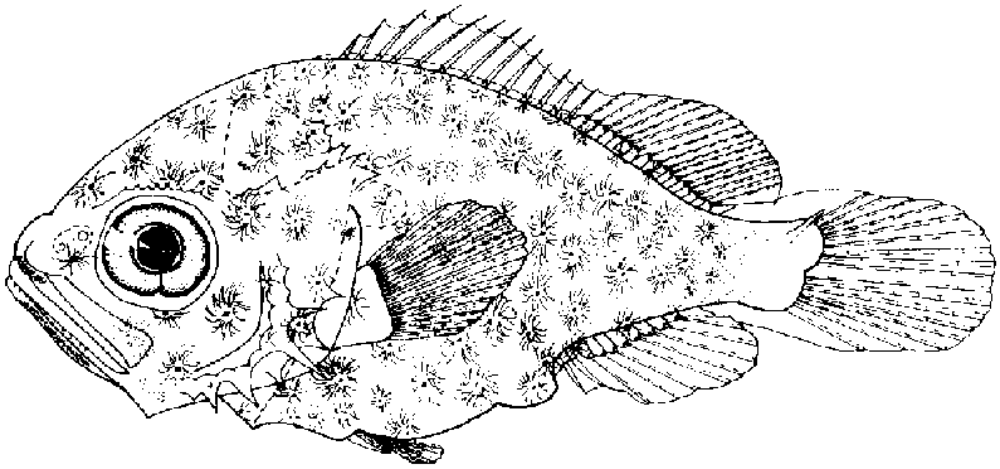


b 5.2 mm SL



c 8.2 mm SL

Fig. 65 Larvae of *Diagramma pictum* from the Great Barrier Reef (Leis and Rennis 2000a)



a 5.8 mm SL

Fig. 66 Larva of *Plectorhinchus gibbosus* from the Great Barrier Reef (Leis and Rennis 2000a)

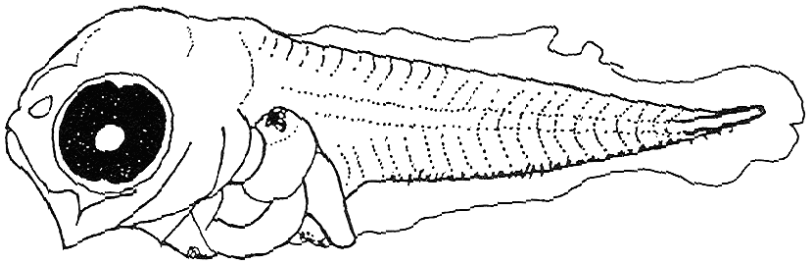
Order: Perciformes

Family: Nemipteridae (Threadfin breams, whiptail breams)

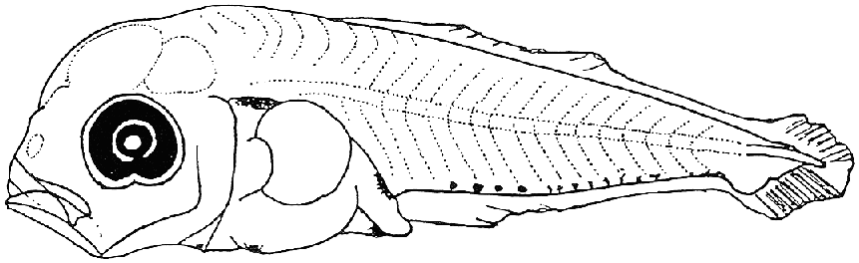
Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Moderate and compressed	Moderate and compressed	Moderate and compressed
Gut	Tightly coiled, triangular and small, extends to anterior to the mid body	A small gap between the anus and anal-fin origin is present, and extends to near the mid body	Anus is located beyond the mid body
Gas Bladder	Large, located above the anterior portion of the gut	Large, located above the anterior portion of the gut	Large, located above the anterior portion of the gut
Head	Moderate and rounded dorsally	Moderate to large and rounded dorsally	Moderate to large and rounded dorsally
Snout	Short and steeply sloped	Short and steeply sloped	Short and round
Mouth	Small and oblique, reaches to the anterior edge of the eye or pupil	Moderate and oblique, reaches to the anterior edge of the eye or pupil	Moderate and oblique, reaches to the anterior edge of the eye or pupil
Eyes	Large and round	Moderate to large, and round	Moderate to large, and round
Head spination	None	None	Most species have no spination. If present, the preopercle, supracleithral and opercle have week spination
Fin formation	Pectoral fin buds form	Pelvic buds, dorsal- and anal-fin anlagen form	Soft rays of the pectoral, anal and dorsal fins begin to form prior to formation of the fin spines. All fin elements become ossified at latest by 8 mm (third anal spine forms as a soft ray and changes into a spine after settlement). Sequence of fin completion: D_2-A-D_1-P_2-P_1
Pigment	Many tiny, evenly spaced melanophores (about two per myomere) extend along the entire ventral midline of the tail. Pigment appears on the dorsal surface of the gas bladder, anus and ventrally on the gut	Pigment on the tail is restricted to a few melanophores along the anal base, and several ventrally on the caudal peduncle	Melanophores form on the brain in some species. Lateral stripes develop from the caudal fin to the snout, along the dorsal midline and on the head at juvenile stage
Similar families	Ambassidae, Haemulidae, Mullidae, Pinguipedidae, Plesiopidae, Pomacentridae, Scombridae (*Rastrelliger*, *Scomber*), Sparidae, Terapontidae		

Meristic characters of the Indo-Pacific nemipterid genera (Leis and Carson-Ewart, 2000)

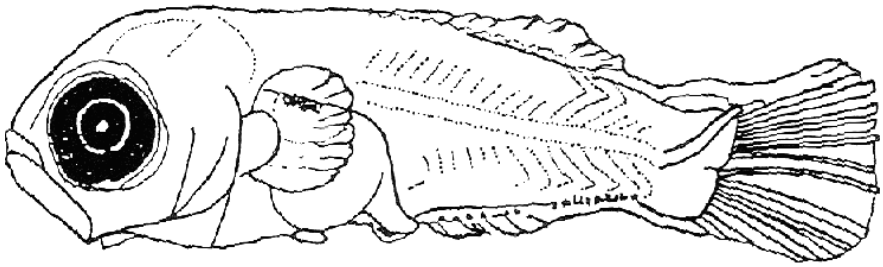
	D	A	P_1	P_2	C	VERTEBRAE
Nemipterus	X, 9	III, 7-8	15-18	I, 5	9+8	10+14 = 24
Parascolopsis	X, 9	III, 7	14-17	I, 5	9+8	10+14 = 24
Pentapodus	X, 9	III, 7	15-17	I, 5	9+8	10+14 = 24
Scaevius	X, 9	III, 7	16-19	I, 5	9+8	10+14 = 24
Scolopsis	X, 9	III, 7	14-19	I, 5	9+8	10+14 = 24



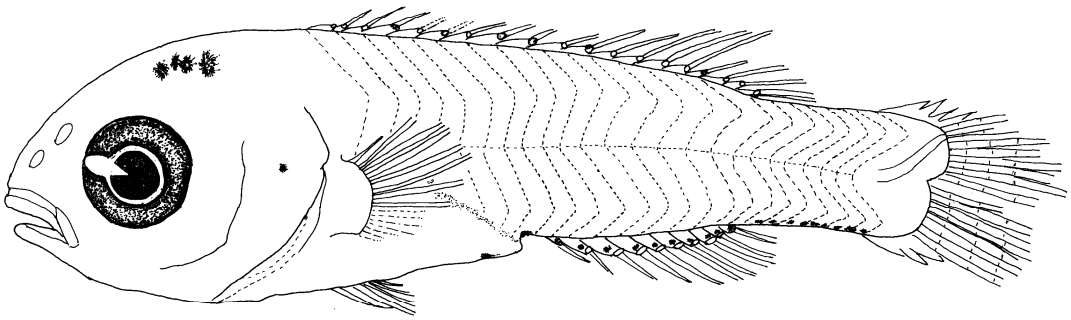
a 2.6 mm TL



b 3.1 mm TL



c 4.6 mm TL



d 7.8 mm SL

Fig. 67 Larvae of Nemipteridae spp. from the Gulf of Thailand (a-c: Chayakul 1996) and the South China Sea (d: by Suharti, S. R.)

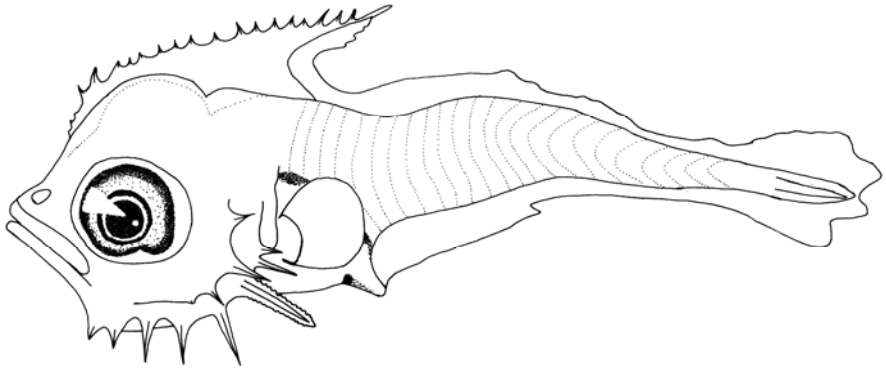
Order: Perciformes

Family: Lethrinidae (Emperors, large-eye breams)

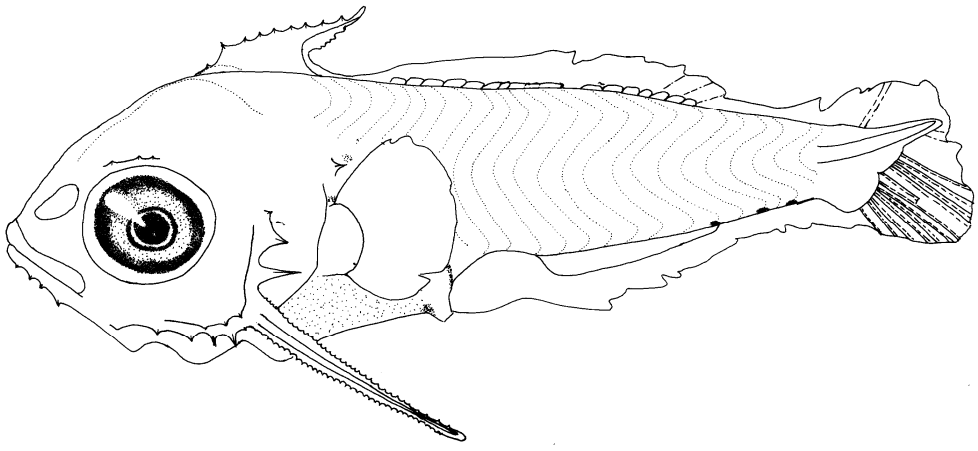
Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Moderate	Moderate and compressed	Moderate and compressed
Gut	Coiled, extends to less than the mid body	Coiled and compact, extends to the mid body	Coiled and compact, extends slightly beyond the mid body
Gas bladder	Small, located above the anterior portion of the gut	Small, located above the anterior portion of the gut	Small, located above the anterior portion of the gut
Head	Initially moderate and round, later becomes large and triangular	Large and triangular	Large and triangular
Snout	Initially short and round, later becomes larger	Moderate and triangular	Moderate and triangular
Mouth	Moderate and oblique, reaches to about the anterior edge of the eye	Moderate and oblique, reaches to about the anterior edge of the eye	Moderate and oblique, reaches to about the anterior edge of the eye
Eyes	Round and large	Round and large	Round and moderate
Head spination	Well developed through larval stage. Serrate supraoccipital crest with a posteriorly-directed, elongate spine, and preopercular spines (spine at the angle longest, later serrate) appear. Serrate ridge forms on the supraocular region and dentary	Serrate ridge(s) forms on the maxilla, infraorbitals, pterotic, posttemporal and supracleithrum. Spines develop on the opercle, subopercle and interopercle. Origin of the supraoccipital crest moves posteriorly and the spine decreases in relative length	Preopercular spines and supraoccipital crest become reduced
Fin formation	Pectoral fin buds form	Dorsal and anal fin anlagen appear, thereafter the soft rays begin to form. Pelvic fin buds form	Formation of the pectoral and pelvic fin rays begins. Full completion of all fins is achieved by 10 mm. Sequence of fin completion: D_2-A-D_1-P_2-P_1
Pigment	Light pigment is present along the dorsal surface of the gut, on the ventral midline of the tail and around the anus	Ventral-midline pigment in the tail is lost, and pigment appears on the brain	Settlement-stage juveniles have melanophores on the dorsal, anal and pelvic fins, on the head, and pigment bars or patches on the trunk and tail
Similar families	Acropomatidae, Apogonidae, Caproidae, Carangidae, Cepolidae (Cepolinae), Holocentridae, Leiognathidae, Lobotidae (and *Hapalogenys*), Priacanthidae, Serranidae (Anthiinae), Sparidae		

Meristic characters of the Indo-Pacific lethrinid genera (Leis and Carson-Ewart, 2000)

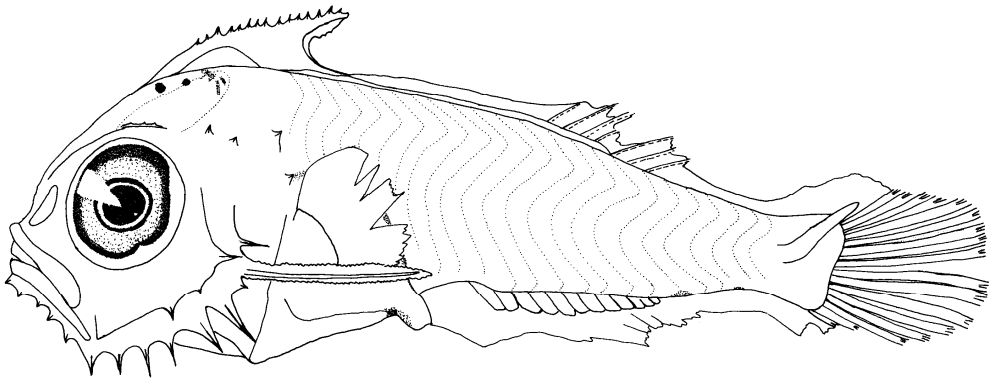
	D	A	P_1	P_2	C	VERTEBRAE
Gnathodentex	X, 10	III, 8-9	15	I, 5	9+8	10+14 = 24
Gymnocranius	X, 10	III, 9-10	14	I, 5	9+8	10+14 = 24
Lethrinus	X, 9	III, 8	13	I, 5	9+8	10+14 = 24
Monotaxis	X, 10	III, 9	14	I, 5	9+8	10+14 = 24
Wattsia	X, 10	III, 10	14	I, 5	9+8	10+14 = 24



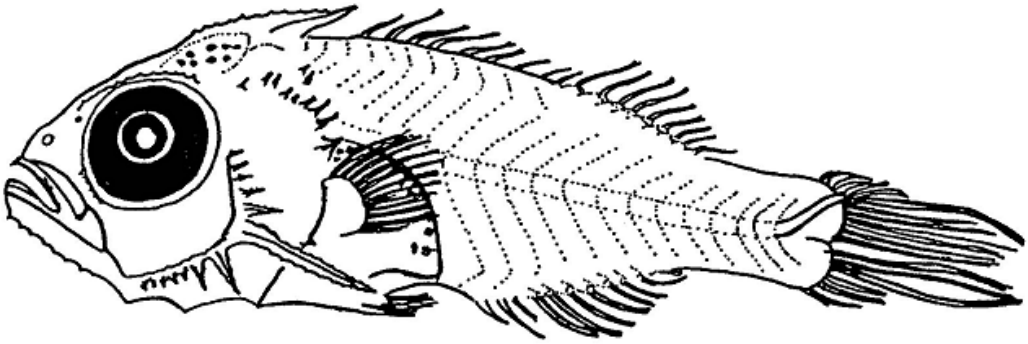
a 3.1 mm SL



b 4.9 mm SL



c 5.3 mm SL



d 7.8 mm TL

Fig. 68 Larvae of Lethrinidae spp. from the Gulf of Thailand (a-c: by Phuttharaksa, K.; d: Chayakul 1996)

Order: Perciformes

Family: Sparidae (Breams, porgies)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Moderate and compressed, becomes deeper with growth	Moderate (most taxa) to deep (*Argyrops*) and compressed. BD/BL: *Argyrops* > *Dentex*, *Chrysophrys*, *Evynnis* > *Acanthopagrus*, *Rhabdosargus*	Moderate (most taxa) to deep (*Argyrops*) and compressed. BD/BL: *Argyrops* > *Dentex*, *Chrysophrys*, *Evynnis* > *Acanthopagrus*, *Rhabdosargus*
Gut	Coiled and triangular, reaches anteriorly to the mid body. Preanal length becomes longer with growth	Coiled and triangular, reaches near the mid body (most taxa) or beyond it (*Argyrops*). A small to moderate gap between the anus and anal-fin origin is present (which becomes shorter as growth)	Coiled and triangular, reaches to about the mid body (*Acanthopagrus*, *Rhabdosargus*) or posterior to it (*Argyrops*, *Dentex*, *Chrysophrys*, *Evynnis*)
Gas bladder	Located dorsally to the gut apex and not apparent except at night	Located dorsally to the gut apex and not apparent except at night	Located dorsally to the gut apex and not apparent except at night
Head	Moderate and round, becomes larger with growth	Moderate (most taxa) to large (*Argyrops*), and round (most taxa) or steep (*Argyrops*) in dorsal profile	Large, and round (most taxa) or steep (*Argyrops*) in dorsal profile
Snout	Initially somewhat pointed, sometimes concave, thereafter round	Round and blunt (most taxa) or steep (*Argyrops*) in dorsal profile	Round and blunt (most taxa) or steep (*Argyrops*) in dorsal profile
Mouth	Oblique and moderate, reaches at least the anterior edge of the eye. Small teeth are present in both jaws	Oblique and moderate, reaches near the mid eye	Oblique and moderate, reaches to about the mid eye. Lips become fleshy
Eyes	Large and round, become smaller with growth	Large to moderate and round	Moderate and round
Head spination	Preopercular spines varying with species from short to long are present. Low and smooth to prominent and serrate ridges form on the supraocular region and supracleithral	Interopercular spines of which the number and size vary among species are present. Some taxa have spine(s) on the opercle, subopercle, cleithral, extrascapular and sphenotic, a ridge with spine(s) on the posttemporal and tabular, and the rugose frontal during flexion or postflexion stage	Preopercular spines become mostly reduced in size and increase in number in some species

Fin formation	Dorsal and anal fin anlagen appear in late preflexion.	Incipient rays of the dorsal and anal fins form. Pelvic fin buds form	Second spine of the dorsal fin of *Argyrops spinifer* become elongate (most taxa do not have any elongate spines). The first spine and first two rays of the pelvic fin become elongate in some species. A full complement of all fin rays is attained at latest by 10.0 mm. Sequence of fin completion: D_2-A-D_1-P_2-P_1
Pigment	Lightly pigmented through the larval stage. Melano-phores are present on the dorsal and ventral surfaces of the gut, along the ventral midline of the tail	Base of the caudal fin rays and dorsal surface of the head are pigmented	As larvae approach settle-ment and transition, mela-nophores spread laterally on the head and over the lateral surface of the trunk and tail, often forming bars
Similar families	Ambassidae, Dichistiidae, Gerreidae, Haemulidae, Kuhliidae, Microcanthidae, Mullidae, Nemipteridae, Plesiopidae, Pomacentridae, Sciaenidae, Scombridae (*Rastrelliger*, *Scomber*), Terapontidae		

Meristic characters of the Indo-Pacific sparid genera (modified from Leis and Carson-Ewart (2000))

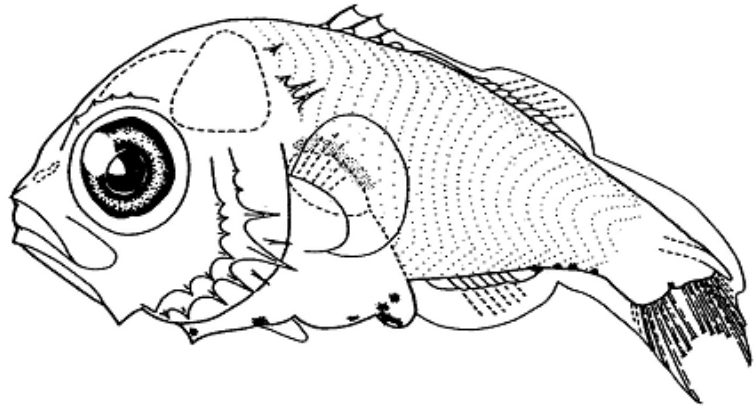
	D	A	P_1	P_2	C	VERTEBRAE
Boopsinae						
Boops [b]	XIII, 13-14	III, 13-14	-	I, 5	9+8	24
Crenidens [b]	XI, 11	III, 10	13-14	I, 5	9+8	10+14 = 24
Denticinae						
Cheimerius [c]	XI-XIII, 10-11	III, 8	15-16	I, 5	9+8	10+14 = 24
Dentex	XII-XIII, 9-10	III, 8-10	15-16	I, 5	9+8	10+14 = 24
Polysteganus [b]	XII-XIII, 10	III, 8	15-16	I, 5	9+8	10+14 = 24
Sparidentex [b]	XI, 9-12	III, 7-9	15-16	I, 5	9+8	10+14 = 24
Pagellinae						
Lithognathus [b]	XI-XII, 11-13	III, 10-13	15-17	I, 5	9+8	-
Pagellus [b]	XII, 10-11	III, 10	16	I, 5	9+8	10+14 = 24
Pagrinae						
Chrysophrys[*Pagrus*] [a, d]	XII-XIII, 10	III, 8	15-16	I, 5	9+8	10+14 = 24
Evynnis	XII, 10-11	III, 8-9	15	I, 5	9+8	10+14 = 24
Sparinae						
Acanthopagrus[*Mylio*] [a]	XI-XIII, 10-15	III, 8-12	14-17	I, 5	9+8	(9-10)+(14-15) = 24
Argyrops	XI-XII, 8-11	III, 8-9	15	I, 5	9+8	10+14 = 24
Diplodus [b]	X-XIII, 12-15	III, 10-14	15-17	I, 5	9+8	10+14 = 24
Rhabdosargus[*Sparus*] [a]	XI-XII, 11-15	III, 10-13	13-15	I, 5	9+8	10+14 = 24

[a] Generic names in parentheses are often applied to Indo-Pacific species of these genera.

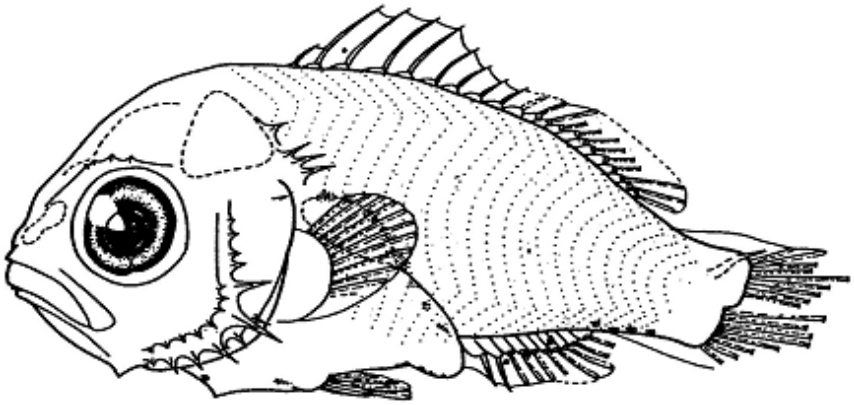
[b] Known from the western Indian Ocean.

[c] Known from the western Indian Ocean and Sri Lanka.

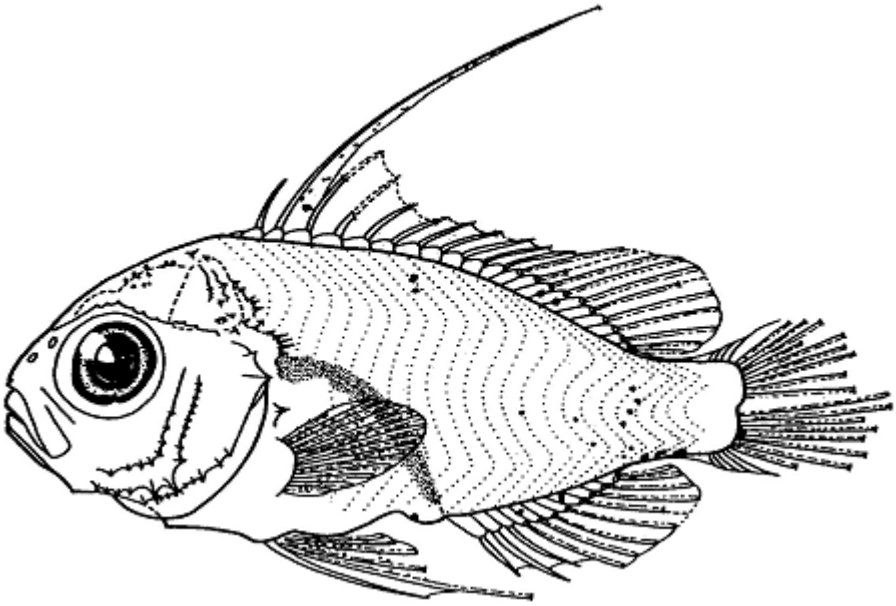
[d] Known from Japan and Australia.



a 4.5 mm SL

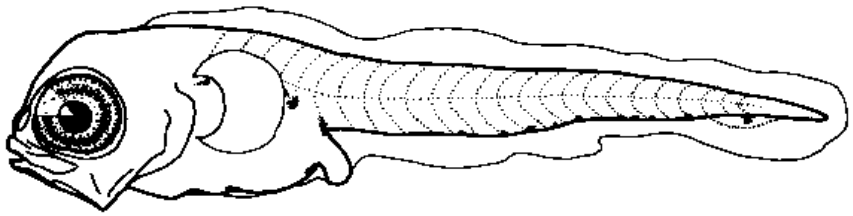


b 5.3 mm SL

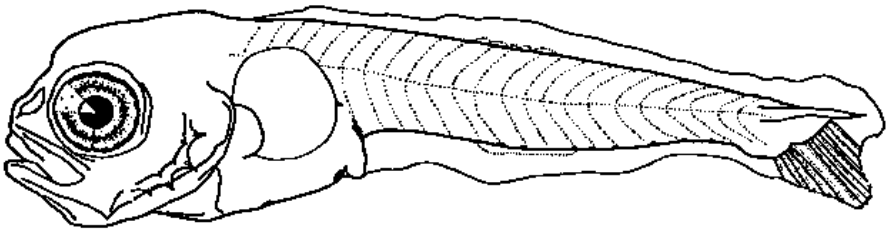


c 10.0 mm SL

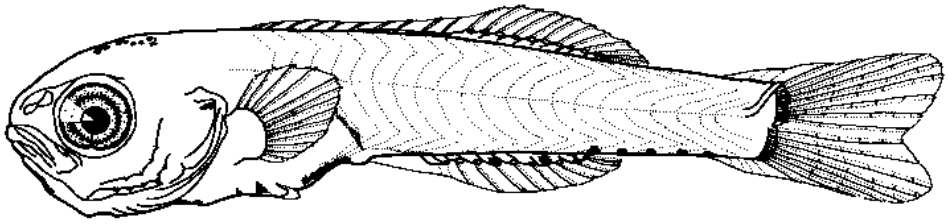
Fig. 69 Larvae of *Argyrops spinifer* from eastern Australia (Trnski and Leis 2000)



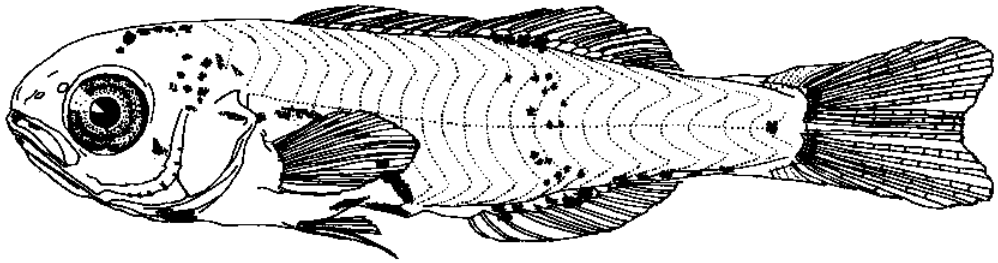
a 3.5 mm SL



b 4.6 mm SL



c 8.1 mm SL



d 10.9 mm SL

Fig. 70 Larvae of *Acanthopagrus latus* from southern Japan (Kinoshita 1988)

Order: Perciformes

Family: Polynemidae (Threadfins)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Moderate to deep and compressed. The head and trunk are deeper than the tail	Moderate and compressed. The head and trunk are deeper than the tail	Moderate and compressed. The caudal peduncle is long and nearly straight in profile
Gut	Coiled and triangular, reaches to less than 50% BL and becomes larger with growth	Coiled and triangular, reaches to the mid body. A gap in variable size is present between the anus and anal fin origin	Coiled and triangular, reaches beyond the mid body. A gap between the anus and anal fin origin becomes shorter but still remains
Gas bladder	Conspicuous, located near the apex of the gut mass	Conspicuous, located near the apex of the gut mass	Conspicuous, located near the apex of the gut mass
Head	Moderate to large and round, becomes larger with growth	Moderate to large and round	Large and round
Snout	Short and variable in profile	Short	Round and enlarged, becomes bulbous and extends beyond the mouth
Mouth	Large and oblique, reaches to the mid pupil. Villiform teeth are present in both jaws	More or less horizontal, reaches to the posterior margin of the eye	Inferior due to protrusion of the snout, reaches beyond the posterior margin of the eye
Eyes	Large and round, becomes relatively smaller with growth	Moderate and round	Relatively small and round
Head spination	Not yet appear	Very small spine develops at the anterior tip of the maxilla. A few of very small preopercular spines appear	The spine at the anterior tip of the maxilla disappears. Very small preopercular spines can be prominent on the outer margin by settlement
Fin formation	Dorsal and anal fin anlagen appear oppositely in the middle of the tail. Pectoral fin base is level with the top of the gut	Soft rays of dorsal and anal fin develop. Pectoral fin rays begin to differentiate. Small, abdominal pelvic fin buds are present at late flexion	Feeble spines of the anal and separate first dorsal fins start to form at early postflexion. Pectoral fin base begins to move ventrally, divides into two lobes as it moves and is eventually located near the ventral margin of the body except in *Polynemus*. The detached lower rays of the lower lobe of the pectoral fin become long and thicker than the upper rays and lack a

			membrane. Full completion of all fins is achieved at latest by 11.5 mm. Sequence of fin completion: C-D_2, A-D_1-P_1-P_2
Pigment	Lightly to moderately pigmented with considerable variation in location and density among taxa. Melanophores typically occur along the ventral midlines of the tail and gut, on dorsal surfaces of the gas bladder and gut, and on the jaw angle and nape through larval stage	Base of soft dorsal fin, lateral midline of the tail, operculum and caudal-fin base are pigmented in some species	Large pigment spots align on the dorsal, lateral and ventral midlines, and scatter on the caudal fin in some species
Similar families	Apogonidae, Pinguipedidae, Sciaenidae		

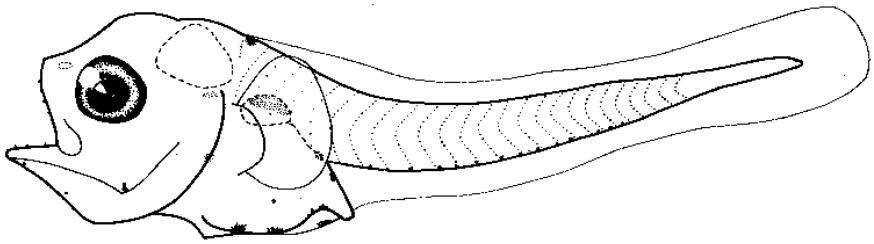
Meristic characters of the Indo-Pacific polynemid genera (modified from Leis and Carson-Ewart (2000))

	D	A	P_1[a]	P_2	C	VERTEBRAE
Eleutheronema	VII-VIII+I-II, 13-15	I-III, 15-17	(16-18)+(3-4)	I, 5	9+8	10+15 = 25
Filimanus	VIII+I, 10-13	III, 10-15	(13-16)+(5-8)	I, 5	9+8	10+14 = 24
Parapolynemus [b]	VIII+I, 11-14	III, 10-12	(12-14)+(6-7)	I, 5	9+8	10+14 = 24
Polydactylus	VIII+I, 11-16	II-III, 10-18	(12-18)+(5-8)	I, 5	9+8	10+14 = 24
Polynemus [c]	VII-VIII+I, 13-16	II-III, 11-12	(13-17)+7	I, 5	9+8	10+15 = 25

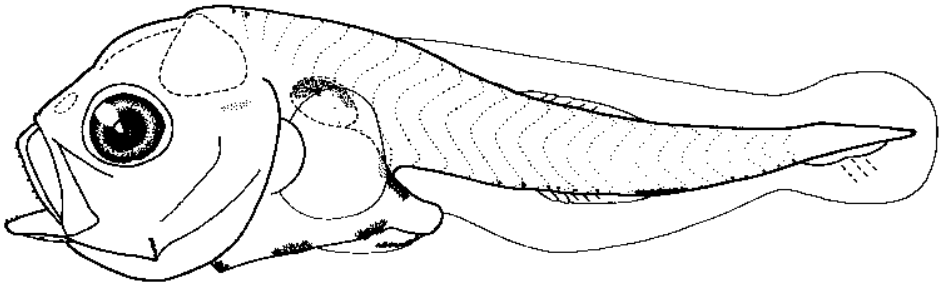
[a] Numbers following '+' indicate free ventral rays.

[b] Only *P. verekeri* is reported from the Gulf of Papua and northern Australia.

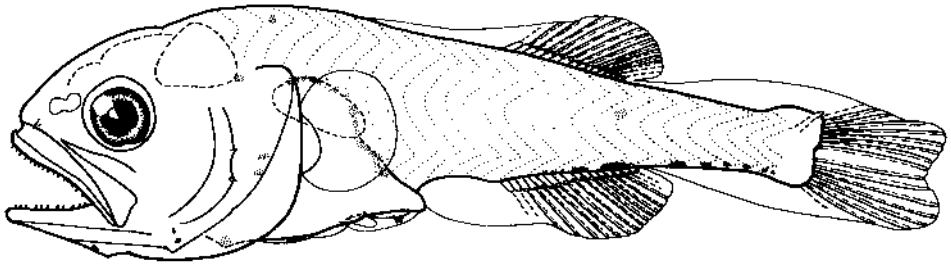
[c] Freshwater and brackishwater species.



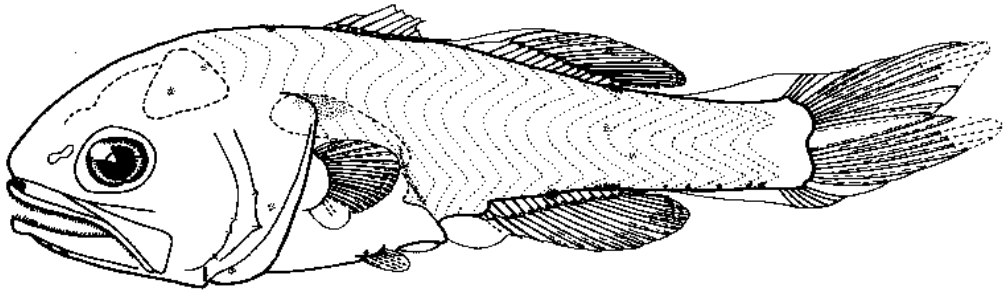
a 2.5 mm SL



b 4.1 mm SL



c 5.9 mm SL



d 7.3 mm SL

Fig. 71 Larvae of *Eleutheronema tetradactylum* from the Great Barrier Reef Lagoon (Leis and Trnski 2000)

Order: Perciformes

Family: Sciaenidae (Drums, croakers)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Moderate and somewhat compressed. Head and trunk are deeper than the tapering tail	Moderate and compressed. Head and trunk are deeper than the tapering tail	Moderate and compressed. Head and trunk are deeper than the tapering tail
Gut	Coiled and triangular, extends anterior to the mid body. Preanal length becomes longer with growth. A gap is present between the anus and the origin of the anal anlage	Coiled and triangular, extends near or beyond the mid body. The gap between the anus and anal fin origin becomes shorter with growth	Coiled and triangular, extends beyond the mid body
Gas bladder	Conspicuous, over the apex of the gut	Conspicuous, over the apex of the gut	Conspicuous, over the apex of the gut
Head	Round and initially moderate, thereafter large, becomes larger with growth	Large and round	Large and round
Snout	Short to moderate and somewhat triangular or concave to uneven in profile	Short to moderate and somewhat triangular or round	Moderate and round
Mouth	Large and oblique, rarely reaches to the pupil	Large and oblique, reaches to the pupil	Large, becomes increasingly horizontal and reaches to the posterior margin of the eye
Eyes	Round and large to moderate, becomes smaller with growth	Moderate and round	Moderate and round
Head spination	Greatly different among species, but all species have small to moderate preopercular spines. Small supraocular and subopercular spines develop (at flexion in some species)	Spines appear on the supracleithrum, opercle and interopercle in some species	Additional spines form in some taxa: a smooth or serrate ridge on the infraorbital, pterotic, supraoccipital, posttemporal and nasal, and small extrascapular spines. The spines and ridges are slightly reduced by about 15 mm
Fin formation	Dorsal and anal fin anlagen form	Soft rays of the dorsal, anal and pectoral fins begin to form. Pelvic fin buds present	Spines of the dorsal and anal fins and soft rays of the pelvic fin form. A full complement of all fin rays is attained at latest by 9 mm. Sequence of

			fin completion: C-D_2, A-D_1-P_2-P_1
Pigment	Highly variable from light to moderate at larval stage. Melanophores are usually present on the dorsal surfaces of the gas bladder and gut, along the ventral midlines of the gut and tail and at lower jaw angle. Pigment appears on the head and pectoral-fin base, posteriorly on the dorsal midline of the tail in some species	Usually pigment spots on the ventral midline of the tail decrease in number, and a spot at the end of the anal-fin base become enlarged	Pigment on the head becomes heavily, and longitudinal pigment rows form dorsally and laterally on the trunk and tail in large postflexion larvae
Similar families	Bregmacerotidae, Centrogeniidae, Gerreidae, Haemulidae, Pinguipedidae, Sparidae		

Meristic characters of the Indo-Pacific sciaenid genera (modified from Leis and Carson-Ewart (2000))

	D	A	P_1	P_2	C	VERTEBRAE
Argyrosomus	X-XI, 25-33	II, 6-8	16-18	I, 5	9+8	11+14 = 25
Aspericorvina	XI, 22-25	II, 7-8	-	I, 5	9+8	10+15 = 25
Atractoscion [a]	X-XI, 25-32	II, 9-10	-	I, 5	9+8	-
Atrobucca	X-XI, 24-33	II, 7-8	17-19	I, 5	9+8	(10-11)+(14-15) = 25
Austronibea [b]	XI, 26-30	II, 7	-	I, 5	9+8	25
Bahaba	IX-XI, 21-29	II, 7	-	I, 5	9+8	11+14 = 25
Boesemania	X-XI, 30-33	II, 7	18	I, 5	9+8	11+14 = 25
Chrysochir	XI, 25-28	II, 6-7	17	I, 5	9+8	25
Collichthys	VIII-X, 23-29	II, 11-13	15	I, 5	9+8	c. 13+16 = 28-29
Daysciaena [c]	X-XI, 23-27	II, 7	-	I, 5	9+8	25
Dendrophysa	XI, 24-28	II, 7-8	-	I, 5	9+8	25
Johnius	IX-XIII, 23-34	II, 6-9	16-20	I, 5	9+8	(10-12)+(13-15) = 24-25
Kathala [c]	X-XI, 26-29	II, 7-8	-	I, 5	9+8	10+15 = 25
Larimichthys [d]	IX-X, 30-36	II, 7-9	15-17	I, 5	9+8	(10-12)+(13-15) = 25-26
Macrospinosa [c]	XI, 27-28	II, 6-7	-	I, 5	9+8	(10-11)+(14-15) = 25
Nibea	X-XII, 22-32	II, 6-8	16-19	I, 5	9+8	25
Otolithes	X-XII, 27-32	II, 7-8	15-17	I, 5	9+8	11+14 = 25
Otolithoides	VI-XI, 27-45	II, 7-9	-	I, 5	9+8	12+13 = 25
Panna	VI-XI, 33-44	II. 6-8	18-21	I, 5	9+8	(10-12)+(13-15) = 25
Paranibea	X-XII, 27-31	II, 7-8	-	I, 5	9+8	25
Pennahia	X-XII, 21-30	II, 7-9	16-18	I, 5	9+8	10+15 = 25
Protonibea	X-XII, 22-25	II, 7-8	16-19	I, 5	9+8	25
Pterotolithus	X-XII, 24-34	II, 7-12	-	I, 5	9+8	11+14 = 25

Sonorolux	X-XI, 28-29	II, 7-8	-	I, 5	9+8	11+14 = 25
Umbrina [e]	XI, 22-32	II, 7	18	I, 5	9+8	(10-11)+(14-15)=25

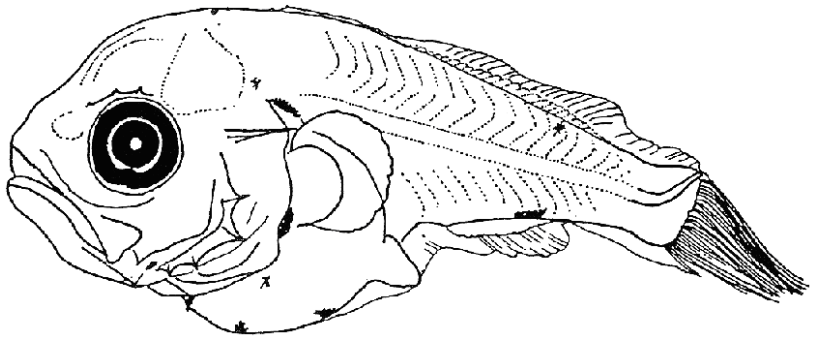
[a] *A. aequidens* is known from east Australia and the western Indian Ocean.

[b] Only *A. oedogenys* is reported from northern and northwestern Australia and south of Papua New Guinea.

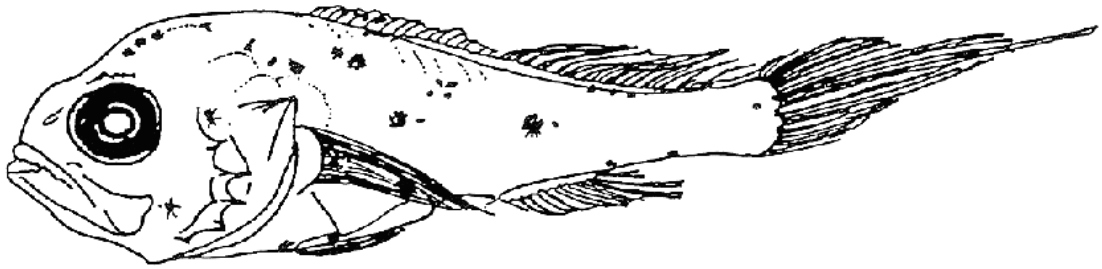
[c] Only *D. albida*, *K. axillaris* and *M. cuja* are reported from India, Sri Lanka and Bangladesh.

[d] *L. pamoides* is known from northwestern Australia and south of Papua New Guinea.

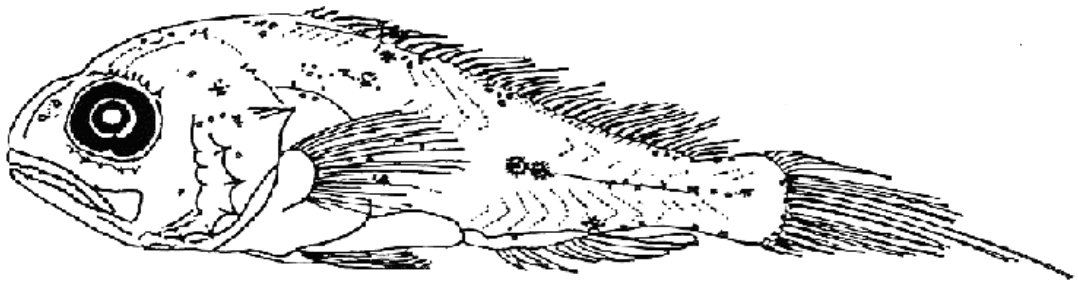
[e] Two species, *U. canariensis* and *U. ronchus* are known only from the western Indian Ocean.



a 4.3 mm TL



b 8.0 mm TL



c 5.60 mm TL

Fig. 72 Larvae of Sciaenidae spp. from the Gulf of Thailand (Chayakul 1996)

Order: Perciformes

Family: Mullidae (Goatfishes)

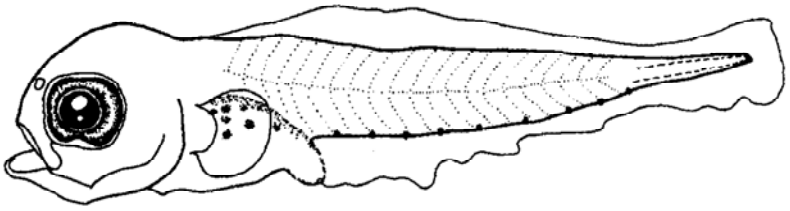
Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Elongate and laterally compressed	Elongate to moderate and laterally compressed	Elongate to moderate and laterally compressed
Gut	Coiled, short and compact, reaches to about 30-40% BL. Preanal length becomes longer with growth	Coiled and compact, reaches to 35-50% BL. Large gap between the anus and the anterior border of the anal fin is present (the gap becomes shorter with growth and is eventually gone by 10 mm in postflexion)	Coiled, reaches to 50-60% BL
Gas Bladder	Inconspicuous	Inconspicuous	Inconspicuous by heavy pigment
Head	Moderate and dorsally rounded	Moderate and dorsally rounded	Moderate and dorsally rounded
Snout	Short and steeply sloped	Short, less steep and slightly round	Short and round
Mouth	Terminal, slightly oblique and small in size, extends to about the anterior edge of the pupil	Terminal, oblique and moderate in size, extends to the anterior edge of the pupil	Terminal and oblique, extends to the anterior edge of the pupil. Small teeth begin to form. A pair of chin barbels begins to form along the edge of the branchiostegal membrane, and is completely formed and free of the membrane by 17-18 mm (but is hidden under the lower jaw)
Eyes	Large and round to slightly ovoid, become relatively smaller with growth	Large to moderate, and round to slightly ovoid	Large to moderate and round
Head spination	None	Mostly none, but one to three very small spines appear near the angle of the preopercle in some species	Mostly none. Preopercle spines which develop at flexion in some species dissapear
Fin formation	Second dorsal and anal fin anlagen form oppositely at about the half of the tail	Anal, dorsal and pectoral soft rays form. Pelvic fin buds are present	Spines of the first dorsal fin begin to form. Full completion of all fins is achieved by 8 mm. Sequence of fin completion: C-D_2 & A-D_1-P_2-P_1

Pigment	Dorsal surface of the gut and the midbrain are pigmented. Small melanophores align along the ventral midline of the tail, and are generally lost before flexion. Several linear melanophores along the mid-lateral surface of the tail and an internal stripe over the notochord in the tail begin to form	Pigment on the brain and gut becomes more extensive. Melanophores appear on the opercular region	Rows of melanophores on the mid-dorsal and mid-ventral edges of the tail and trunk form. Mid-lateral melanophore series extends over the entire length of the body. Thereafter, pigment appears on the dorso- and ventro-lateral surfaces of the body (sometimes along myosepta), and the body except fins becomes heavily pigmented
Similar families	Gerreidae, Haemulidae, Kuhliidae, Microcanthidae, Nemipteridae, Pomacentridae, Siganidae, Sparidae, Terapontidae,		

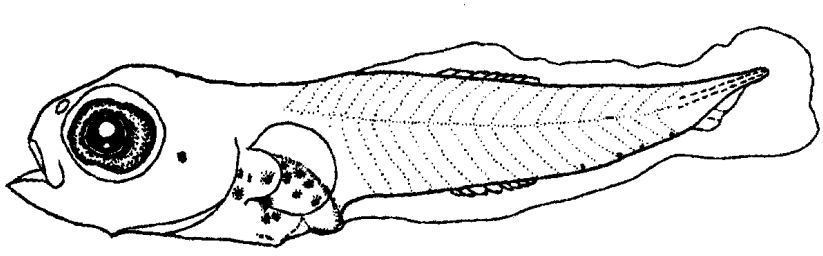
Meristic characters of the Indo-Pacific mullid genera (modified from Leis and Carson-Ewart (2000))

	D	A	P_1	P_2	C	VERTEBRAE
Mulloidichthys	VIII+9	I, 7	16-17	I, 5	8+7	10+14 = 24
Parupeneus	VIII+9	I, 7	14-18	I, 5	8+7	10+14 = 24
Upeneichthys [a]	IX+8	I, 6	15-16	I, 5	8+7	24
Upeneus	VII-VIII+9	I, 7	13-18	I, 5	8+7	10+14 = 24

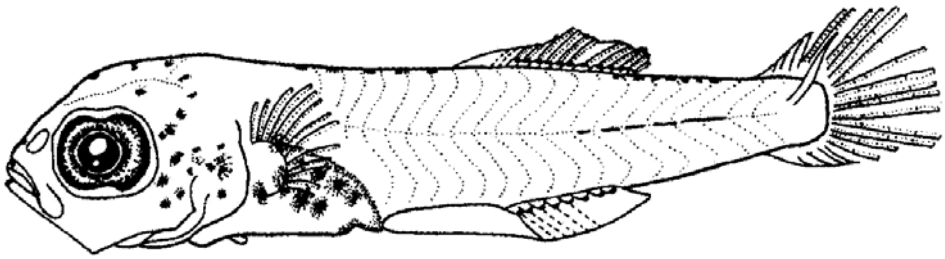
[a] *U. lineatus* is known only from eastern Australia.



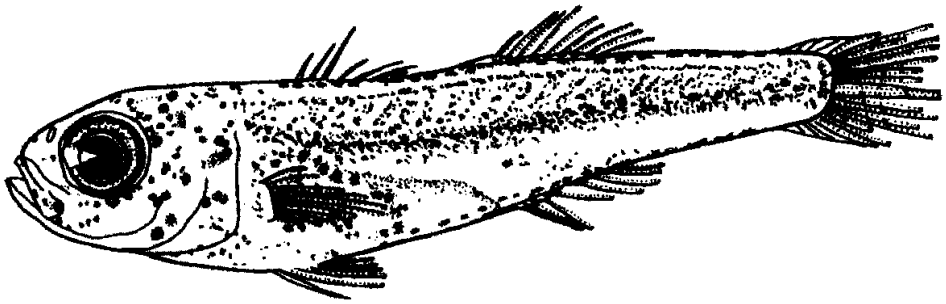
a 2.7 mm SL



b 3.8 mm SL



c 4.1 mm SL



d 10.0 mm SL

Fig. 73 Larvae of Mullidae sp. from the South China Sea (Zulkifli et al. 2006)

Order: Perciformes

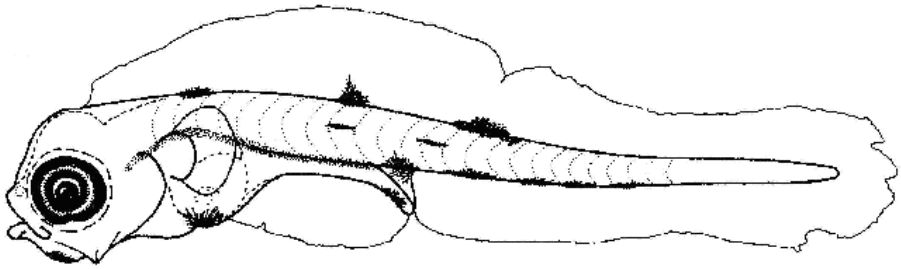
Family: Glaucosomatidae (Pearl perches)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Initially elongate, thereafter moderate, becomes deeper with growth	Moderate to deep	Deep and ovate
Gut	Initially coiled in the fore-gut, and elongate and uncoiled in the hindgut, thereafter coiled in the whole. Anus is located around the mid body	Coiled and triangular, reaches much beyond the mid body	Coiled and triangular, reaches much beyond the mid body
Gas bladder	Small, over the dorsal surface of the anterior gut	Small, over the dorsal surface of the anterior gut	Indistinct by pigment on the body
Head	Initially small, thereafter moderate	Large and round	Larger and deep
Snout	Short and slightly concave due to a swell of the ascending process of the premaxilla	Short and rounded, and slightly concave due to a swell of the ascending process of the premaxilla	Short and rounded
Mouth	Oblique, initially short, thereafter large, reaches to about the mid pupil	Large and oblique, reaches to about the mid pupil	Large and oblique, reaches to about the mid pupil
Eyes	Round and large	Round and large	Round and large
Head spination	Two small spines form in the outer margin of the preopercle	Small spine(s) appear in the inner margin of the pre-opercle margin, on the sub-opercle and interopercle. Wide-spaced, outer pre-opercle spines become larger. Supraocular and post-temporal ridges form	Supracleithral spine forms. Preopercle spines increase in number
Fin formation	Dorsal and anal fin anlagen appear. Pelvic fin buds appear	Rays of all fins begin to form	All fins form completely by 8.1 mm. Sequence of fin completion: D, A, P_2-C-P_1
Pigment	Initially moderately pig-mented on the lower jaw, dorsal and ventral surfaces of the gut, and dorsally and ventrally on the midlines of the trunk and tail. Thereafter anterior half of the body is heavily pigmented.	Pelvic fin buds is pigmented and pigment in the anterior half of the body become more dense	Whole body is heavily pig-mented except the caudal, pectoral and anal fins, soft dorsal fin and caudal peduncle

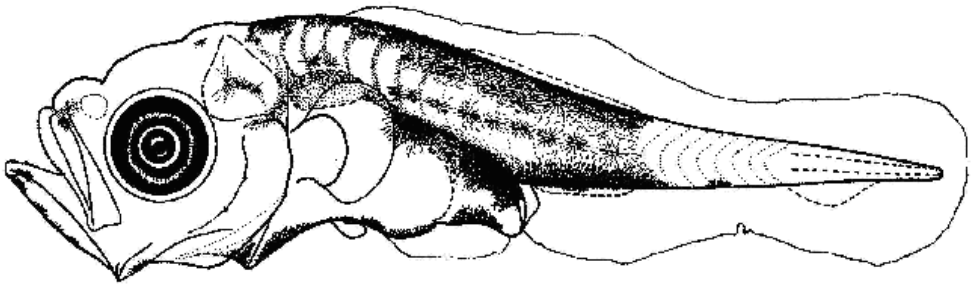
	Internal pigment forms on the snout, forebrain, ventrally along the midbrain and hindbrain, cleithrum, nape and dorsally along the notochord		
Similar families	Apogonidae, Berycidae, Carangidae (*Trachinotus*, *Caranx*), Haemulidae (*Plectorhinchus*), Monodactylidae (*Monodactylus*), Pempheridídae, Stromateidae, Trachichthyidae		

Meristic characters of the Indo-Pacific glaucosomatid genus (Leis and Carson-Ewart, 2000)

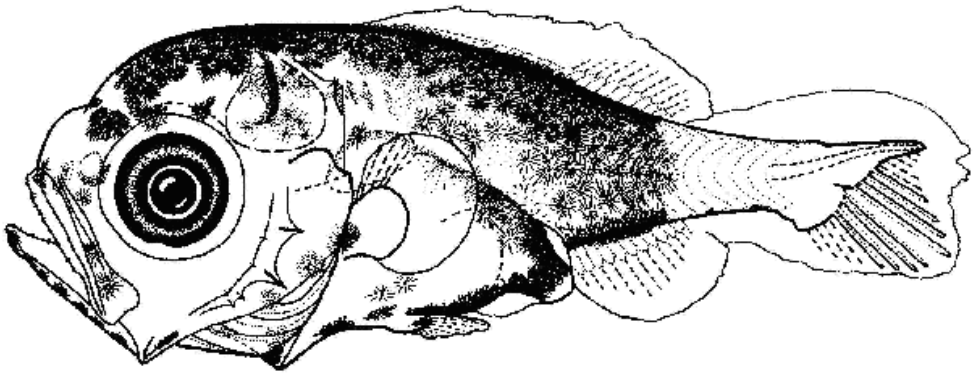
	D	A	P_1	P_2	C	VERTEBRAE
Glaucosoma	VIII, 11-14	III, 9-12	15-16	I, 5	9+8	10+15 = 25



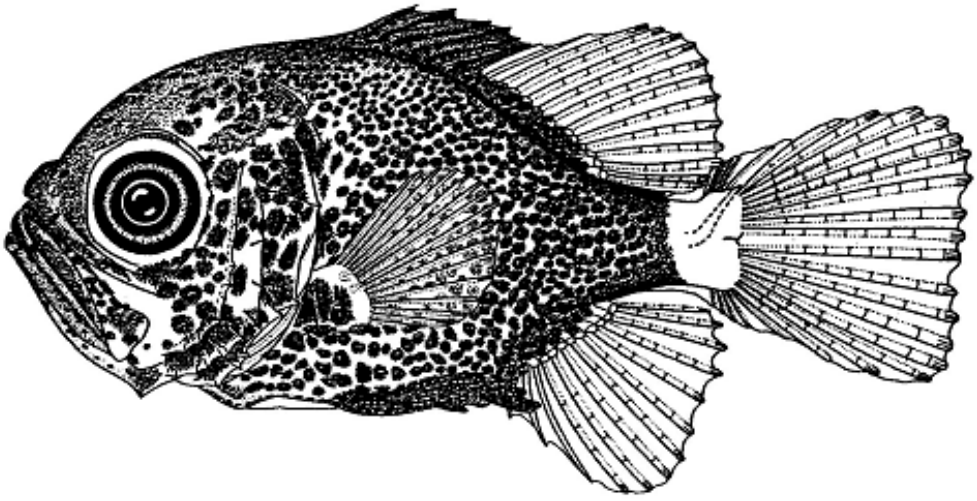
a 2.4 mm SL (rearing, 3 days after hatching)



b 3.8 mm SL (rearing, 15 days after hatching)



c 4.6 mm SL (rearing, 19days after hatching)



d 8.1 mm SL (rearing, 45 days after hatching)

Fig. 74 Larvae of *Glaucosoma hebraicum* endemic to the Australian waters (Pironet and Neira 1998)

Order: Perciformes

Family: Monodactylidae (Moonyfishes, fingerfishes)

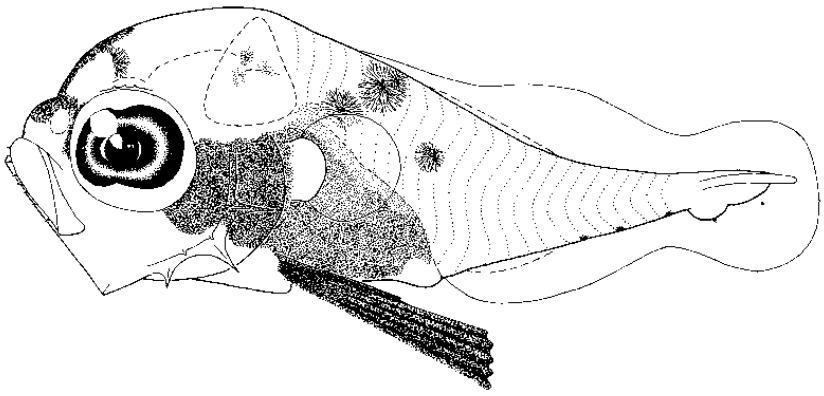
Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Moderate and compressed, becomes deeper with growth	Moderate and compressed	Deep and compressed
Gut	Coiled and triangular, reaches to the mid body or slightly beyond	Coiled and triangular, reaches beyond the mid body	Coiled and triangular, reaches beyond the mid body
Gas bladder	Small, located over the apex of the gut	Small, located over the apex of the gut	Small, located over the apex of the gut
Head	Large and convex in dorsal profile	Large and convex in dorsal profile	Large and steep in dorsal profile
Snout	Short, concave in dorsal profile	Short, concave in dorsal profile	Short, steep and slightly convex in dorsal profile
Mouth	Oblique, reaches to about the mid eye	Oblique, reaches to about the mid eye	Oblique, reaches to about the mid eye
Eyes	Large and round	Large and round	Large and round
Head spination	Preopercle develops small spines on the inner margin and moderate spines on the outer margin. A serrate ridge is present in the supraocular region	Spines are present on the interopercle, posttemporal, supracleithral and opercle. Preopercle spines increase in number and become elongate	Preopercle spines and supra-ocular ridge become slightly reduced
Fin formation	Pelvic fins completely form and reach to the anus (the fin become smaller with growth and eventually rudimentary or absent in adults). Dorsal and anal fin anlagen appear	Rays of the dorsal, anal and pectoral fins form and ossify	Full completion of all fins is achieved by about 7 mm. Sequence of fin completion: P_2-C-D_2-A-D_1-P_1
Pigment	A characteristic wide band of heavy pigment forms from the snout across the operculum to the pelvic-fin base and ventrally to the anus. Pelvic fins and gut are heavily pigmented. Large melanophores and small melanophore series appear dorsolaterally on the trunk and the ventral midline of the posterior	Pigment spreads on the snout and dorsolateral trunk. Mela-nophore series on the ventral midline of the tail disappear except for one large melano-phore on the peduncle	Pigment covers heavily on the head, trunk, anterior half of the tail and spinous dorsal fin. Enlarged melanophore develops dorsally on the peduncle. By 14 mm the entire body except for the caudal and pectoral fins and the distal portions of the dorsal and anal fins is heavily pigmented

	half of the tail, respectively		
Similar families	Apogonidae (Pseudaminae), Glaucosomatidae, Pempheridídae, Stromateidae		

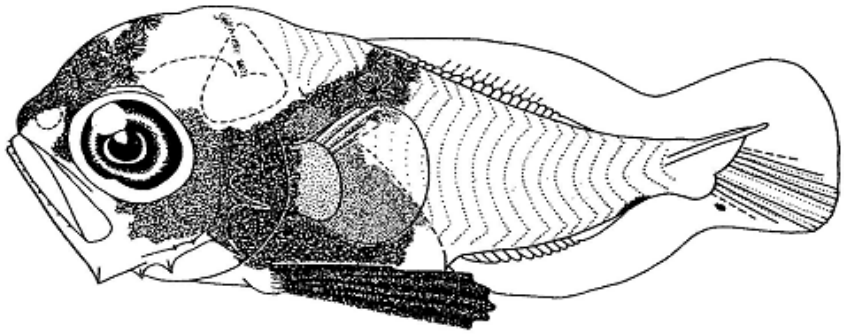
Meristic characters of the Indo-Pacific monadactylid genera (modified from Leis and Carson-Ewart (2000))

	D	A	P_1	P_2	C	VERTEBRAE
Monadactylus	VII-VIII, 25-31	III, 25-32	16-18	I, 5	9+8	10+14 = 24
Schuettea [a]	V, 28-30	III, 28-32	14-15?	I, 5	-	-

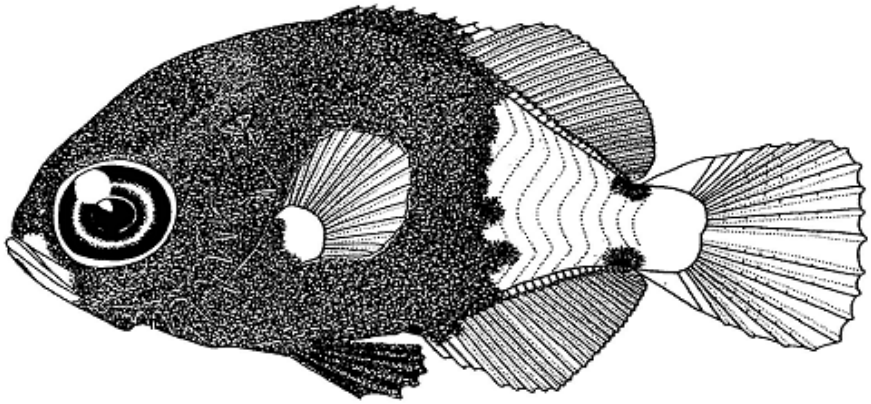
[a] Nelson (2006) includes this genus (with two species in eastern and western Australia) in the Monodactylidae, provisionally.



a 3.2 mm SL



b 3.6 mm SL



c 5.8 mm SL

Fig. 75 Larvae of *Monodactylus argenteus* from eastern Australia (Miskiewicz 1998)

Order: Perciformes

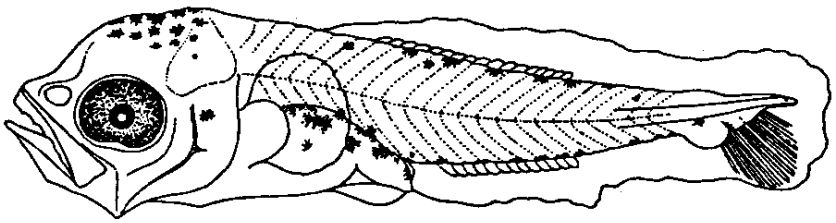
Family: Kyphosidae (Rudderfishes, sea chubs)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Initially elongate, thereafter moderate	Moderate	Moderate and robust
Gut	Loosely coiled, extends to the mid body	Coiled and massive, extends beyond the mid body	Coiled and massive, extends beyond the mid body
Gas bladder	Small, inconspicuous over the foregut	Small, inconspicuous over the foregut	Small, inconspicuous over the foregut
Head	Moderate, becomes relatively larger with growth	Large and fairly broad	Large and fairly broad
Snout	Short and slightly pointed	Short and slightly pointed	Short and blunt
Mouth	Oblique, reaches to the mid eye	Oblique, reaches to the mid eye	Oblique, becomes relatively smaller after flexion
Eyes	Round and large	Round and large	Round and moderate
Head spination	Not appears yet	Small preopercular spines appear	A small spine appears on the opercle, postcleithral and supracleithral. Preopercle spines become reduced
Fin formation	Pectoral fin buds form	Dorsal and anal fin anlagen form and later all soft rays appear. Pectoral fin rays and pelvic fin buds form	All fins have a full complement at about 7 mm. Sequence of fin completion: D_2-A-D_1-P_2-P_1
Pigment	Dorsum of the head and gut, and the dorsal and ventral midlines of the tail are pigmented	Large to small melanophores spread widely on the head, trunk and tail except the caudal peduncle	Melanophores cover the whole body except fins. At juvenile stage the dorsal, anal and pelvic fins are pigmented and pigment bands appear on the trunk and tail
Similar families	Apogonidae, Carangidae, Latidae, Mugilidae, Pomacentridae, Toxotidae		

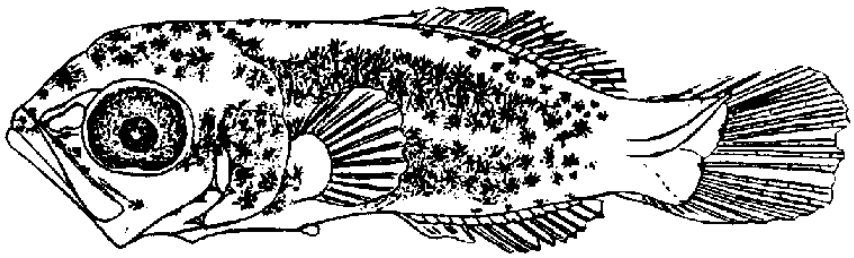
Meristic characters of the Indo-Pacific kyphosid genera (modified from Leis and Carson-Ewart (2000))

	D	A	P_1	P_2	C	VERTEBRAE
Kyphosus Sectator [a]	X-XII, 10-16 XI, 13-16	III, 10-14 III, 13-14	17-20 19-20	I, 5 I, 5	9+8 = 17 9+8 = 17	9-10+16 = 25-26 10+16 = 26

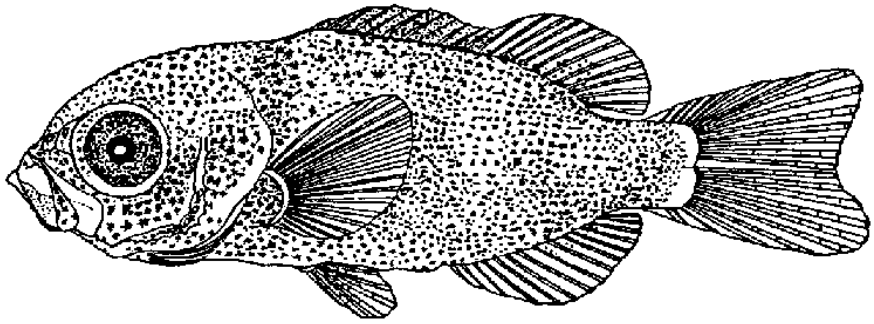
[a] *S. ocyurus* is known from Japan, Hawaii and California to Peru.



a 4.5 mm TL



b 5.1 mm TL



c 13.6 mm TL

Fig. 76 Larvae of *Kyphosus cinerascens* from southern Japan (a, c: Mito 1966; b: Uchida et al. 1958)

Order: Perciformes

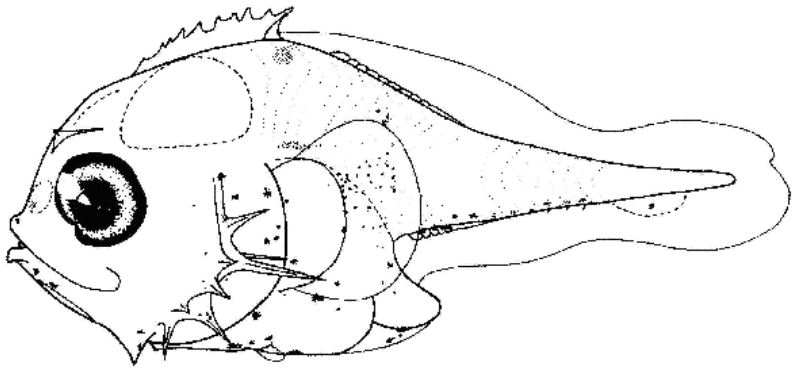
Family: Drepaneidae (Sicklefishes)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Deep, rotund in the head and trunk portions, compressed in the tail portion	Deep, rotund in the head and trunk portions, compressed in the tail portion	Deep, rotund in the head and trunk portions, compressed in the tail portion
Gut	Large, triangular and coiled, reaches beyond the mid body	Large, triangular and coiled, reaches beyond the mid body	Large, triangular and coiled, reaches beyond the mid body
Gas bladder	Inconspicuous, over the anterior gut	Well develop, expands posteriorly	Relatively larger and elongate
Head	Round and large	Large, steep in dorsal profile	Large, steep in dorsal profile. Paired barbels appear from the chin to the isthmus
Snout	Short and slightly concave	Short and rounded	Short and rounded
Mouth	Large and slightly oblique, reaches to the posterior margin of the pupil. Small teeth develop on the lower jaw (upper jaw teeth at flexion)	Large and slightly oblique, reaches to the posterior margin of the pupil	Inferior and relatively smaller, reaches to the posterior margin of the pupil (from 16 mm the maxilla reaches to the anterior edge of the eye)
Eyes	Large and round	Large to moderate and round	Moderate to small and round
Head spination	A strongly serrate, large supraoccipital crest and the smooth, small to large preopercle spines (the longest at angle) develop conspicuously. A smooth ridge forms on the supraocular region (with serration at postflefion). A single spine appears on the interopercle and posttemporal	A bony ridge projects anteriorly at the tip of the maxilla. Infraorbital spines appear beneath the posterior margin of the pupil and the anterior margin of the eye, and on the lachrymal. One or two weak spines are present on the subopercle	A serrate supraoccipital ridge becomes reduced. Parietal and tabular spines form. The serrate ridges on the supraocular, pterotic, sphenotic, posttemporal and supracleithral become nearly continuous. A low ridge on the nasal and a weak spine on the opercle appear
Fin formation	Dorsal and anal fin anlagen, and pelvic fin buds appear	Soft rays and then spines of the dorsal and anal fins form. Pelvic fins are complete by the end of flexion and reach to a maximum 23% BL. Pectoral fins form completely	All dorsal and anal fin elements are present. Pelvic fin rays increase in length to 46% BL and the first ray reaches beyond the anal fin origin. Supraneurals are apparent between the supraoccipital crest and the dorsal fin origin
Pigment	Lightly pigmented. Melanophores scatter in the	Melanophores in the snout, operculum and gut become	Moderately pigmented. Large melanophores cover the majo-

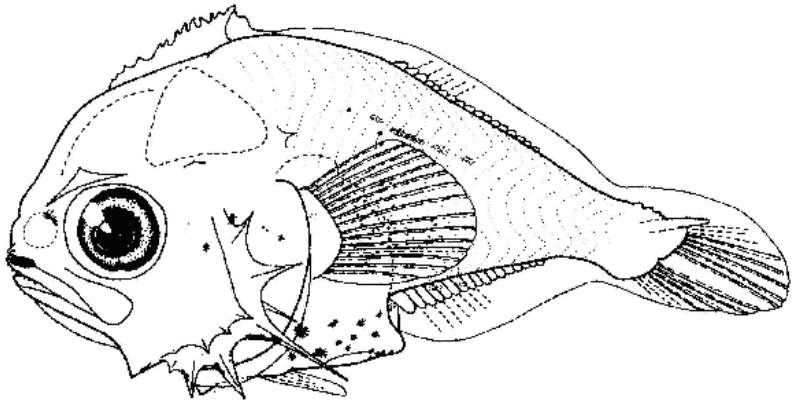
	snout, operculum, abdomen, pelvic and pectoral fin buds, gas bladder, gut and ventral margin of the tail	larger in size	rity of the body except for the caudal peduncle and caudal fin
Similar families	Bramidae, Carangidae, Cepolidae, Ephippidae, Lobotidae (and *Hapalogenys*), Uranoscopidae		

Meristic characters of the Indo-Pacific drepaneid genus (Leis and Carson-Ewart, 2000)

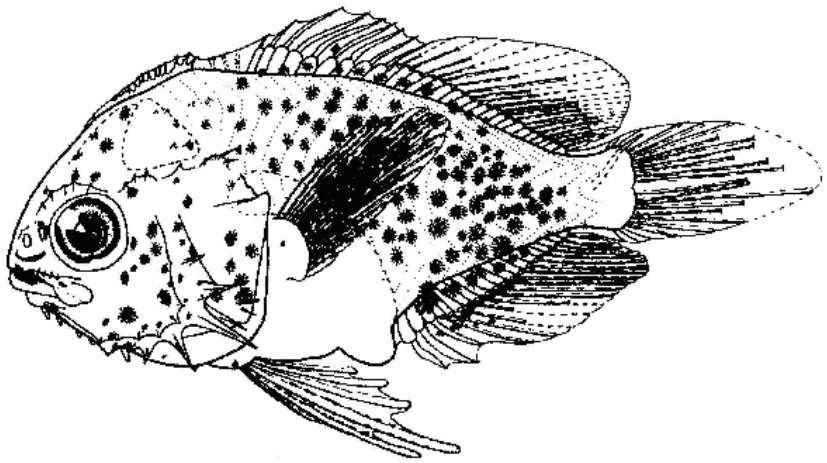
	D	A	P_1	P_2	C	VERTEBRAE
Drepane	VIII-IX, 19-23	III, 17-19	15-18	I, 5	9+8	10+14 = 24



a 2.3 mm SL



b 3.6 mm SL



c 7.1 mm SL (*D. punctata*)

Fig. 77 Larvae of *Drepane* spp. from the Great Barrier Reef (Cavalluzzi et al. 2000a)

Order: Perciformes

Family: Terapontidae (Grunters, tigerperches)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Initially elongate, thereafter elongate to moderate and laterally compressed. (BD/BL: *Pelates quadrilineatus* < *Terapon theraps* < *T. jarbua*)	Elongate to moderate and compressed	Elongate to moderate and compressed
Gut	Triangular and compact, reaches to 35-45% BL. The anus moves posteriorly with growth (except for *P. quadrilineatus*)	Triangular and compact, reaches to 35-55% BL. A moderate to large gap between the anus and the anal fin origin is present, and becomes smaller in postflexion stage as the anus moves posteriorly	Triangular and compact, reaches to about 35% BL (*P. quadrilineatus*) or about 55% BL (*Terapon*)
Gas bladder	Small or invisible	Small or invisible	Small or invisible
Head	Moderate and round, becomes larger with growth (except for *P. quadrilineatus*)	Moderate (*P. quadrilineatus*) to large (*Terapon*) and round	Moderate (*P. quadrilineatus*) to large (*Terapon*) and round
Snout	Short and usually somewhat concave	Short, becomes convex and more pointed with growth	Short and slightly pointed
Mouth	Oblique, reaches to the anterior margin of the pupil. Small premaxillary teeth are present in most species	Oblique, reaches to the anterior margin of the pupil	Oblique, reaches to the anterior margin of the pupil
Eyes	Moderate (*P. quadrilineatus*) to large (*Terapon*) and round, become smaller as growth (*Terapon*)	Moderate (*P. quadrilineatus*) to large (*Terapon*) and round	Moderate and round
Head spination	Preopercular spines appear	Preopercular spines vary among species from short to long (relative spine length: *P. quadrilineatus* < *T. theraps* < *T. jarbua*). A spine on the interopercle and a low, spineless ridge on the supracleithrum and supraocular region form	Spine(s) appear on the opercle and cleithrum. Additional spination develops on the opercle (2nd spine), subopercle, tabular and infraorbital in some taxa
Fin formation	Pectoral fin buds form	Anlagen of the dorsal and anal fins appear, thereafter the incipient rays form. Pelvic fin buds appear	Dorsal and anal fin spines and pectoral fin rays begin to form. A full complement of all fin elements is attained at

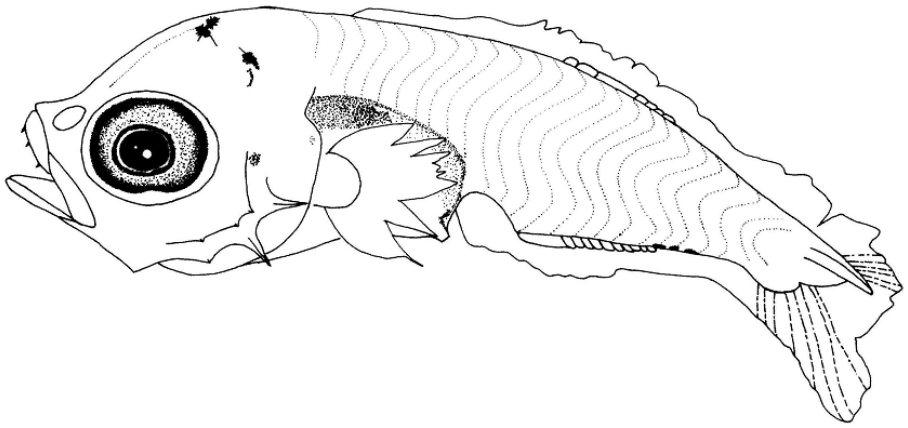
			latest by 9 mm. Sequence of fin completion: D_2-A-D_1-P_2-P_1
Pigment	Mostly lightly pigmented, but some taxa become heavily pigmented from the flexion stage. Pigment develops along the ventral midlines of the tail and gut, and over the gut and gas bladder	Pigment is commonly present on the dorsal midline of the tail, midlaterally on the tail, internally over the notochord, and on the caudal-fin base and head (and on the membrane of the spinous dorsal fin in *T. jarbua*)	Melanophores increase laterally on the body in *Terapon*, eventually in the juvenile stage all body except part of fins become pigmented (*T. theraps* develop vertical, wide pigment bands in the trunk and tail)
Similar families	Ambassidae, Gerreidae, Kuhliidae, Lutjanidae, Microcanthidae, Mullidae, Nemipteridae, Plesiopidae, Pomacentridae, Scombridae (*Rastrelliger*, *Scomber*), Sillaginidae, Sparidae, Tripterygiidae		

Meristic characters of the Indo-Pacific terapontid genera (modified from Leis and Carson-Ewart (2000))

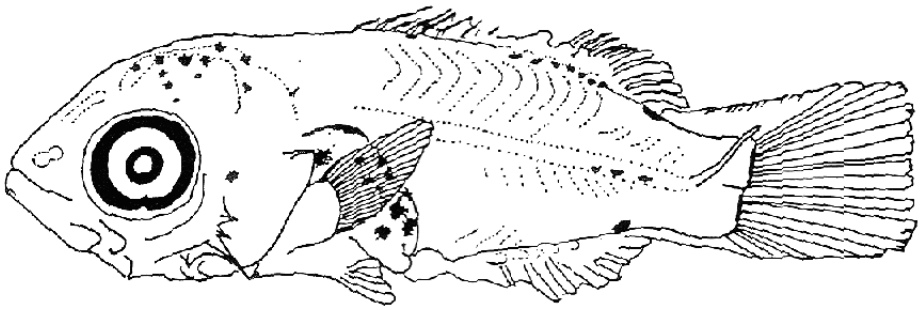
	D	A	P_1	P_2	C	VERTEBRAE
Amniataba [b]	XII-XIII, 8-10	III, 8-9	13-17	I, 5	9+8	10+15 = 25
Mesopristes	XI-XII, 10-11	III, 8-9	12-16	I, 5	9+8	10+15 = 25
Pelates	XI-XIII, 9-11	III, 9-11	13-16	I, 5	9+8	10+15 = 25
Rhyncopelates	XII, 9-11	III, 7-9	13-15	I, 5	9+8	10+15 = 25
Terapon	XI-XII, 9-11	III, 7-10	13-15	I, 5	9+8	10+15 = 25

[a] Marine and estuarine species only.

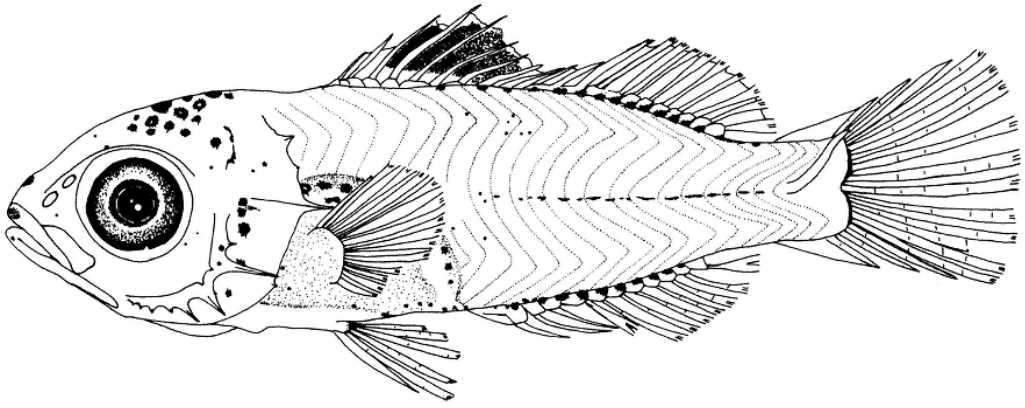
[b] Known from southern and northern Australia and southern Papua New Guinea.



a 3.6 mm SL (from the Gulf of Thailand)



b 4.0 mm TL (from the Gulf of Thailand)



c 6.7 mm SL (from the Bay of Bengal)

Fig. 78 Larvae of *Terapon* spp. (a, c: by Phuttharaksa, K.; b: Chayakul 1996)

Order: Perciformes

Family: Cepolidae (Bandfishes)

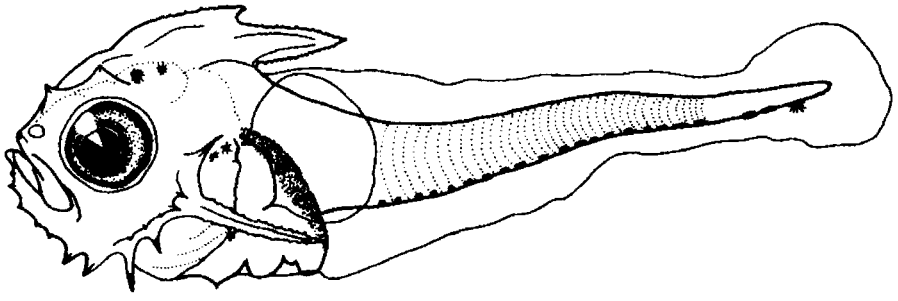
Main characters	Larval stage		
	Preflexion*	**Flexion***	**Postflexion**
Body shape	Initially elongate, later moderate	Moderate and hunchbacked. The tail is elongate, compressed and tapering	Moderate (Cepolinae) to deep (Owstoniinae) and hunchbacked. The tail is tapering
Gut	Triangular and strongly coiled, reaches anterior to the mid body	Triangular and strongly coiled, reaches anterior to the mid body	Triangular and strongly coiled, reaches anterior to the mid body (Cepolinae) or beyond it (Owstoniinae). Anterior shift of the anus appears in some cepolinii
Gas bladder	Conspicuous, located anteriorly above the gut	Conspicuous, located over the most gut	Conspicuous, located over the most gut
Head	Moderate and round. The lower jaw angle is prominent	Moderate and round. The lower jaw angle is prominent	Moderate (Cepolinae) to large (Owstoniinae) and round. The lower jaw angle is prominent
Snout	Short, sometimes somewhat concave or round	Short, sometimes somewhat concave or round	Short, sometimes somewhat concave or round
Mouth	Large and oblique, reaches to the anterior margin of the pupil	Large and oblique, reaches to the anterior margin of the pupil	Large and oblique, reaches to the mid eye or the posterior margin of the pupil
Eyes	Round, moderate to large (mostly large)	Round, moderate to large (mostly large)	Round, moderate to large (mostly large)
Head spination	A serrate supraoccipital ridge and a long, serrate preopercle spine at angle are prominent. A ridge with spine(s) or serration develops on the supraocular region and dentary. A small spine(s) appears on the supracleithral, opercle and at the anterior tip of the maxilla	Supraoccipital, supraocular and dentary ridges and preopercular spines become more serrate. Posttemporal spine and small pterotic spine appear. Lower jaw angle is sharp	Head spines become relatively reduced, in particular the supraoccipital ridge and preopercle spine at angle
Fin formation	Incipient rays of the dorsal and anal fins develop anteriorly. Pelvic-fin buds appear in jugular at latest in early flexion stage. Incipient rays of the pectoral fin develop	Fin-ray development of the dorsal and anal fins proceeds posteriorly, forming a long fin base. Pectoral and pelvic fins have a full complement	Sequence of fin completion: D_2-A-D_1-P_2-P_1 (Cepolinae)
Pigment	Light pigment is present	Pigment on the head and gut	Head mostly becomes more

	over the brain, gut, gas bladder, on the operculum, nape, and along the ventral midline of the tail. Notochord tip develops fine melanophores on the dorsal and ventral midlines or a large pigment spot on the ventral midline in some species	becomes more spread. Pigment patterns on the lower margin of the dentary, on the margin of the preopercle, on the pectoral fin, on the dorsal midline of the tail, on the caudal peduncle, caudal fin and its base are species-specific	pigmented
Similar families	Acropomatidae, Caproidae, Drepaneidae, Ephippidae, Holocentridae, Leiognathidae, Lethrinidae, Lobotidae (and *Hapalogenys*), Priacanthidae, Uranoscopidae		

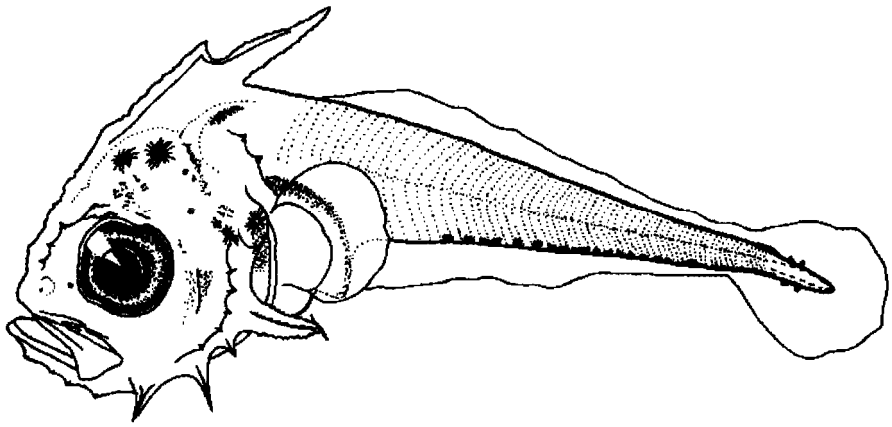
* Description is only for the Cepolinae.

Meristic characters of the Indo-Pacific cepolid genera (Leis and Carson-Ewart, 2000)

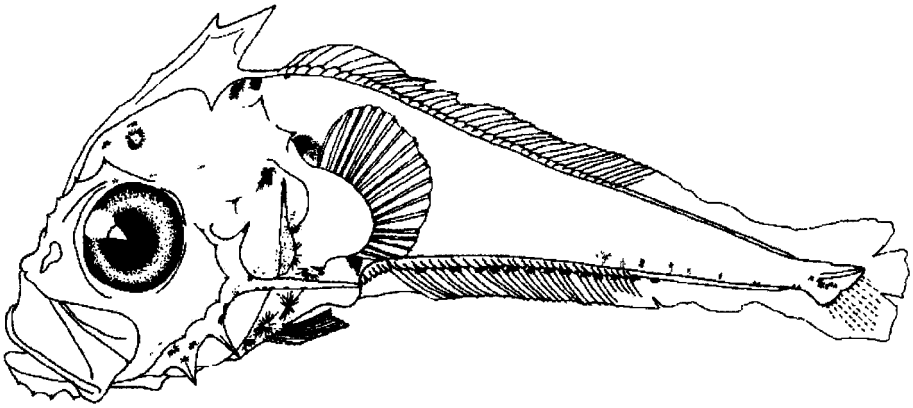
	D	A	P_1	P_2	C	VERTEBRAE
Cepolinae						
Acanthocepola	0, 73-106	0-II, 73-113	17-20	I, 5	13-14	(12-16)+(32-67) = 48-79
Cepola	III, 50-69	0-I, 50-64	18-19	I, 5	-	(14-16)+(47-58) = 61-74
Owstoniinae						
Owstonia	III-IV, 20-23	I-II, 13-18	15-21	I, 5	8+7 = 15	(11-14)+(15-17) = 26-30
Sphenanthias	III-IV, 22-28	I-II, 16-20	17-20	I, 5	7+6 = 13	(11-13)+(14-18) = 28-31



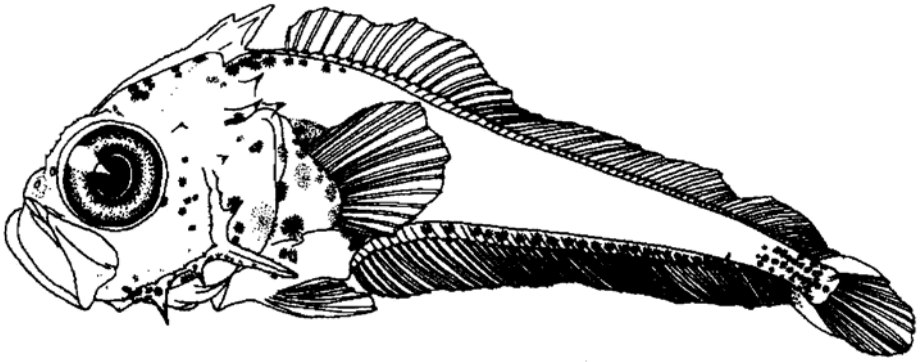
a 3.1 mm SL (type 1)



b 3.6 mm SL (type 2)



c 6.5 mm (type 3)



d 9.3 mm SL (type 3)

Fig. 79 Larvae of *Acanthocepola* spp. from the South China Sea (Zulkifli et al. 2006)

Order: Perciformes

Family: Labridae (Wrasses)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Elongate and compressed	Elongate to moderate and compressed	Moderate and compressed. Caudal peduncle is usually deep
Gut	Initially straight and swollen at the posterior portion, thereafter coiled at the anterior portion in some taxa (e.g. *Cheilinus*, *Halichoeres*, *Stethojulis*, *Thalassoma*). Preanal length extends to 81% BL prior to coiling (usually less than 67%) and ranges from 37 to 74% BL after fully coiling	Still straight in some taxa (e.g. *Cymolutes*, *Xyrichthys* which have a coiled gut at post-flexion)	Coiled
Gas bladder	Small and inconspicuous, located above the anterior to middle portion of the gut	Small and inconspicuous, located above the anterior to middle portion of the gut	Small and inconspicuous, located above the anterior to middle portion of the gut
Head	Moderate, triangular and compressed	Moderate to large, and compressed. Head shape varies from triangular to deep	Large and triangular to deep
Snout	Initially somewhat pointed, thereafter extremely variable in shape	Extremely variable in shape (blunt to elongate and very pointed)	Extremely variable in shape (blunt to elongate and very pointed)
Mouth	Small and oblique, mostly not reaches to the anterior edge of the eye	Small and oblique, mostly not reaches to the anterior edge of the eye	Small and oblique, mostly not reaches to the anterior edge of the eye. Small, conical teeth are present in both jaws in some species (teeth are hidden by the lips)
Eyes	Large to moderate, and ovoid, round or squarish	Large to moderate, and ovoid, round or squarish, frequently having choroid tissue on the ventral margin	Moderate, and ovoid, round or squarish, frequently having choroid tissue on the ventral margin
Head spination	None	None	Mostly none. Some species of cheilinin *Cirrhilabrus* develop 4-5 very small preopercle spines. A very weak, smooth supraocular ridge forms in some species
Fin	Pectoral fin buds are	Dorsal and anal fin anlagen	Pelvic fin buds form, there-

formation	present	form, thereafter the soft rays begin to form	after the rays are ossified. Some or all of the dorsal fin spines become elongate in some genera (e. g. *Bodianus*, *Thalassoma*, *Xyrichthys*). A gap between the second and third dorsal spines is present in some species of novaculinin *Cymolutes*, *Novaculichthys*, *Xyrichthys*. Dorsal fin origin is located at about the level of the pectoral base, except in *Xyrichthys* which has the origin on the head. Sequence of fin completion: C-D, A-P_1-P_2
Pigment	Most species are unpigmented just before settlement (larvae of tribe Hypsigenyini trend to be more heavily pigmented). In some species a few melanophores are present in the dorsal and anal finfolds, posteriorly on the dorsal and ventral midlines of the tail and on the gut	In some species a few melanophores are present along the myosepta of the tail, on the dorsal and anal fin elements, on the brain, on the lower jaw and over the gut	In some species a few melanophores are present along the myosepta of the tail, on the dorsal and anal fin elements, on the brain, on the lower jaw and over gut
Similar families	Callanthiidae, Cirrhitidae, Pseudochromidae (Pseudochrominae, Pseudoplesiopinae), Scaridae, Serranidae (Grammistini)		

Meristic characters of the Indo-Pacific labrid genera (modified from Leis and Carson-Ewart (2000))

	D	A	P_1	P_2	C	VERTEBRAE
Cheilinini						
Cheilinus	IX-X, 8-11	III, 8-9	12	I, 5	7+6	9+14 = 23
Cirrhilabrus	XI-XII, 8-10	III, 8-10	14-16	I, 5	13	9+16 = 25
Conniella [a]	XI, 9	III, 9	15	0	7+6	9+16=25
Epibulus	IX, 10-11	III, 8-9	12	I, 5	13	9+14 = 23
Oxycheilinus	IX, 10	III, 8	12	I, 5	7+6	9+14 = 23
Paracheilinus	VIII-X, 11	III, 9	13-15	I, 5	13	9+16 = 25
Pseudocheilinops	IX, 11	III, 9	13	I, 5	-	9+16 = 25
Pseudocheilinus	IX, 10-12	III, 9	13-17	I, 5	13	9+16 = 25
Pteragogus	IX-XI, 9-12	III, 8-10	12-15	I, 5	7+7	9+16 = 25
Wetmorella	IX, 10-11	III, 8	11-12	I, 5	13	9+14 = 23

Hypsigenyini						
Bodianus	XII, 9-11	III, 11-13	15-18	I, 5	(7-8)+7	11+17 = 28
Choerodon	XII-XIII, 7-8	III, 9-10	15-19	I, 5	7+7	(10-11)+(16-17) = 27
Decodon [b]	XI, 9-10	III, 10	16-18	I, 5	7+7	11+17=28
Polylepion [c]	XI-XII, 11	III, 11-12	19-21	I, 5	7+7	11+17=28
Pseudodax	XI, 12-13	III, 14	15	I, 5	14	13+15 = 28
Terelabrus	X, 11	III, 12	15-16	I, 5	14	11+17 = 28
Xiphocheilus	XII, 8	III, 9	16	I, 5	14	11+16 = 25
Julidini						
Anampses	IX, 11-13	III, 10-13	13-14	I, 5	7+7	9+16 = 25
Cheilio	IX, 12-13	III, 11-12	12	I, 5	7+7	9+16 = 25
Coris	IX, 12	III, 12	13-15	I, 5	(7-8)+7	(9-10)+(15-16) = 25
Frontilabrus [d]	IX, 12	III, 12	13	I, 5	7+7	(9-10)+(15-16)=25
Gomphosus	VIII, 12-13	III, 10-12	14-16	I, 5	7+7	9+16 = 25
Halichoeres	IX-X, 11-14	III, 10-13	12-15	I, 5	7+7	(9-10)+(15-16) = 25
Hemigymnus	IX, 11	III, 11	14	I, 5	13	10+15 = 25
Hologymnosus	IX, 12	III, 12	13	I, 5	14	9+16 = 25
Leptojulis	IX, 11-12	III, 10-12	12-13	I, 5	14	9+16 = 25
Minilabrus [e]	VIII, 13	III, 12	14	I, 5	14	-
Macropharyngodon	IX, 11-12	III, 11-13	12-13	I, 5	7+7	9+16 = 25
Parajulis [f]	IX, 14	III, 14	13-14	I, 5	14	27
Pseudocoris	IX, 12	III, 12-13	15	I, 5	-	-
Pseudolabrus	IX, 10-11	III, 10-11	12-14	I, 5	8+7	9+16 = 25
Pseudojuloides	IX, 11-12	III, 11-12	12-13	I, 5	14	(9-10)+(15-16) = 25
Stethojulis	IX, 10-12	III, 10-12	12-15	I, 5	7+7	10-15 = 25
Suezichthys	IX, 11	III, 10	13-14	I, 5	(7-8)+7	9+16 = 25
Thalassoma	VIII, 12-14	III, 10-12	14-17	I, 5	7+7	(9-10)+(15-16) = 25
Xenojulis	IX, 11	III, 11	13	I, 5	14	9+16 = 25
Labrichthyini						
Diproctacanthus	IX, 9-10	III, 9-10	12-14	I, 5	14	10+15 = 25
Labrichthys	IX, 11-12	III, 10-11	13-15	I, 5	14	10+15 = 25
Labroides	IX, 10-12	III, 9-11	13	I, 5	14	10+15 = 25
Labropsis	IX, 10-12	III, 9-11	13-15	I, 5	14	10+15 = 25
Larabicus [g]	IX, 11	III, 10	13	I, 5	14	10+15 = 25
Novaculini						
Ammolabrus [h]	IX, 12	III, 12	13	I, 5	14	9+16=25
Cymolutes	VIII-X, 12-15	III, 11-13	11-13	I, 5	14	9+17 = 26
Novaculichthys	IX, 12-14	III, 12-14	12-13	I, 5	14	9+16 = 25
Xyrichthys	IX, 12	III, 12-14	12-13	I, 5	7+7	9+16 = 25

[a] Only *C. apterygia* is known from northwest Australia.

[b] Two species are known from the western Indian Ocean, Japan and Taiwan.

[c] *P. russelli* is known only from Japan and Hawaii.

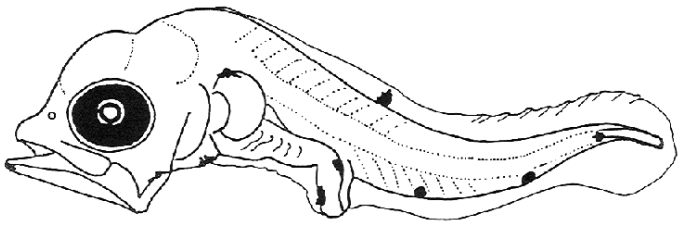
[d] Only *F. caeruleus* is reported from the western Indian Ocean.

[e] Only *M. striatus* is reported from the Red Sea.

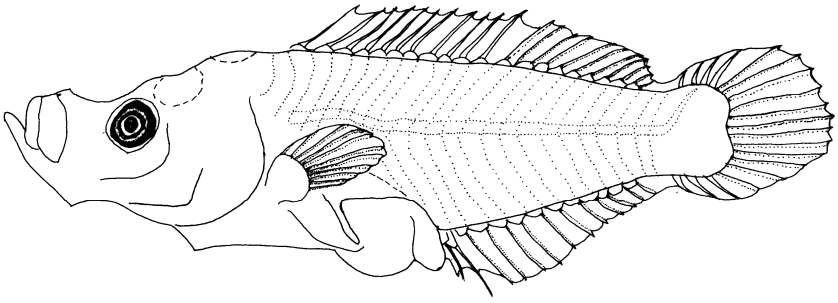
[f] Only *P. poecilepterus* is reported from Japan, Korea, Taiwan and Hong Kong.

[g] Only *L. quadrilineatus* is reported from the western Indian Ocean.

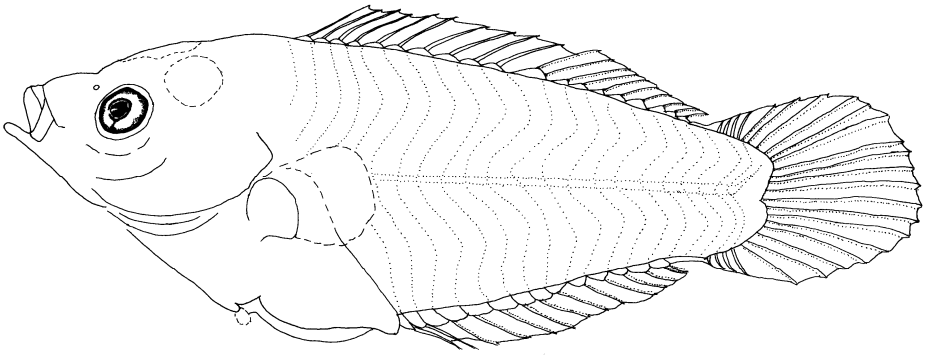
[h] Only *A. dicrus* is reported from Hawaii.



a 2.3 mm TL



b 6.0 mm SL



c 8.6 mm SL

Fig. 80 Larvae of Labridae spp. from the Gulf of Thailand (a: Chayakul 1996) and the Celebes Sea (b, c: by Estremadura, DM. G.)

Order: Perciformes

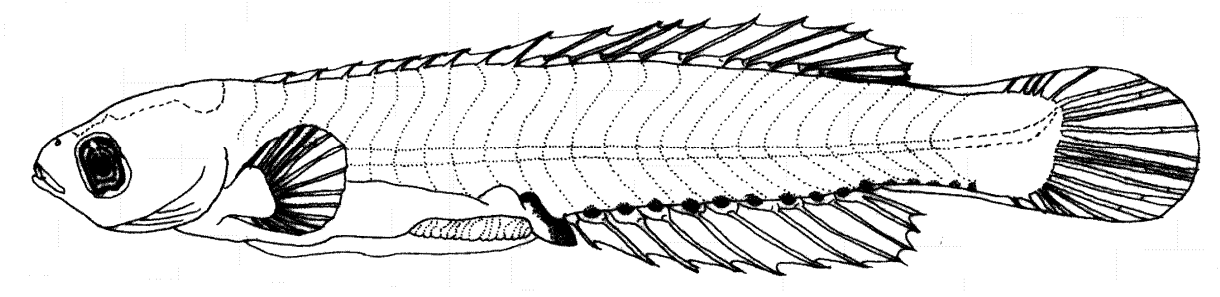
Family: Scaridae (Parrotfishes)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Elongate and increasingly laterally compressed with growth	Elongate and compressed	Elongate to moderate, and ovoid in cross-section with a deep caudal peduncle
Gut	Straight and rugose, reaches slightly beyond the mid body	Straight and rugose, reaches slightly beyond the mid body	Coiled at the anterior portion and rugose, reaches slightly beyond the mid body
Gas bladder	Large, located above the middle of the gut	Large, located above the middle of the gut	Large, moves posteriorly to near the end of the gut before settlement
Head	Small	Small to moderate	Moderate
Snout	Slightly pointed	Slightly pointed	Slightly pointed to round
Mouth	Small and nearly horizontal, reaches to about the anterior edge of the eye. No teeth are present until settlement	Small and nearly horizontal, reaches to about the anterior edge of the eye	Small and nearly horizontal, reaches to about the anterior edge of the eye
Eyes	Small, usually ovoid to rectangular. Some species have a distinctly narrow eye with a ventral mass of choroid tissue through larval stage	Small to moderate, usually ovoid to rectangular	Small to moderate, becomes rounded
Head spination	None	None	None
Fin formation	Dorsal fin anlage is present and the soft rays begin to form from posterior to anterior	Anal fin anlage appears and the rays begin to form	Dorsal and anal spines begin to form. Pelvic fin buds appear, thereafter the soft rays form. A full complement of all fin rays is attained at latest by 14 mm. Sequence of fin completion: C-D_2-A-D_1, P_1-P_2
Pigment	Lightly pigmented through larval stage. A series of pigment spot along the ventral midline of the tail is prominent. Pigment is present over the gut immediately anterior to the anus. Dorsal midline near the notochord	Nearly same pigmentation as in preflexion	Nearly same pigmentation as in earlier development stage. Dorsal midline of the caudal peduncle, the pectoral-fin base and the axil are pigmented in some species

	tip is pigmented in some species		
Similar families	Eleotrididae, Gobiidae, Labridae, Microdesmidae (Ptereleotrinae), Myctophidae, Pseudochromidae		

Meristic characters of the Indo-Pacific scarid genera (Leis and Carson-Ewart, 2000)

	D	A	P_1	P_2	C	VERTEBRAE
Bolbometopon	IX, 10	III, 9	15-16	I, 5	7+6	12+13 = 15
Calatomus	IX, 10	III, 9	13	I, 5	7+6	9+16 = 25
Cetoscarus	IX, 10	III, 9	14-15	I, 5	7+6	(10-11)+(14-15) = 25
Chlorurus	IX, 10	III, 9	14-16	I, 5	7+6	(10-11)+(14-15) = 25
Hipposcarus	IX, 10	III, 9	15	I, 5	7+6	(10-11)+(14-15) = 25
Leptoscarus	IX, 10	III, 9	13	I, 5	7+6	9+16 = 25
Scarus	IX, 10	III, 9	13-16	I, 5	7+6	(10-11)+(14-15) = 25



a 7.0 mm SL

Fig. 81 Larva of Scaridae sp. from the Celebes Sea (by Estremadura, DM. G.)

Order: Perciformes

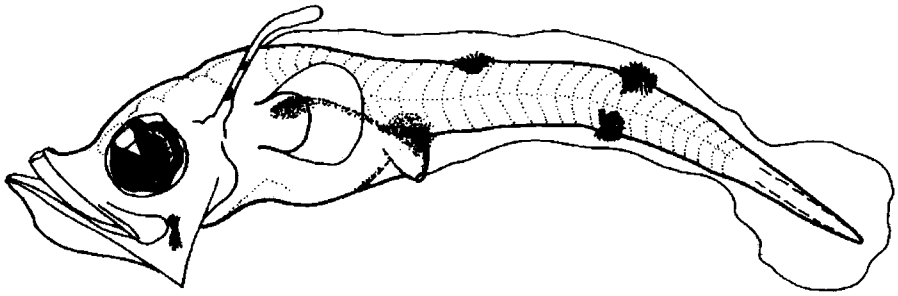
Family: Champsodontidae (Gapers)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Elongate	Moderately elongate	Moderately elongate
Gut	Coiled, reaches before the mid body	Coiled, reaches beyond the mid body	Coiled, reaches beyond the mid body
Gas bladder	Small and spherical, located above the anterior portion of the gut	Well develop, expands posteriorly	Oval and often extends nearly the length of the abdominal cavity
Head	Moderate and roughly triangular by the large lower jaw	Large and roughly triangular	Moderate to large
Snout	Slightly concave and pointed	Slightly concave and pointed	Straight and slightly pointed
Mouth	Very large and oblique, reaches to at least the posterior border of the eye. Lower jaw protrudes from the upper jaw through larval stage. Teeth appear in both jaws	Very large and oblique, reaches beyond the posterior margin of the eye	Very large and oblique, reaches beyond the posterior margin of the eye. Teeth in the lower jaw become long and needle like
Eyes	Round to slightly elongate and large to moderate, become smaller with growth	Round to slightly elongate and moderate to small	Round and small
Head spination	Spinous opercular appendage reaches a maximum 30-40% BL and becomes shorter with growth. Preopercular spines and low, serrate nasal, supraocular, frontal and parietal ridges appear	The opercular appendage remains 26-30% BL. One or two small spines near the ascending process of the premaxilla, and a small pterotic spine form	Small spines are present along the lower margins of the articular and dentary, on the posttemporal and infraorbitals. Postetior margins of the opercle and subopercle develop serrations. The degree of spination on the nasal, supraocular, frontal, parietal, premaxillary, dentary, articular and infraorbitals varies among species
Fin formation	Pectoral fin buds appear	Anal and soft dorsal fin anlagen form. Pelvic fin buds appear	Dorsal-fin spines form. Pelvic fin becomes long and reaches to the anus. All fins have a full complement from as early as 7.6 mm to as late as 11.5 mm. Sequence of fin completion: C-D, A, P_2-P_1

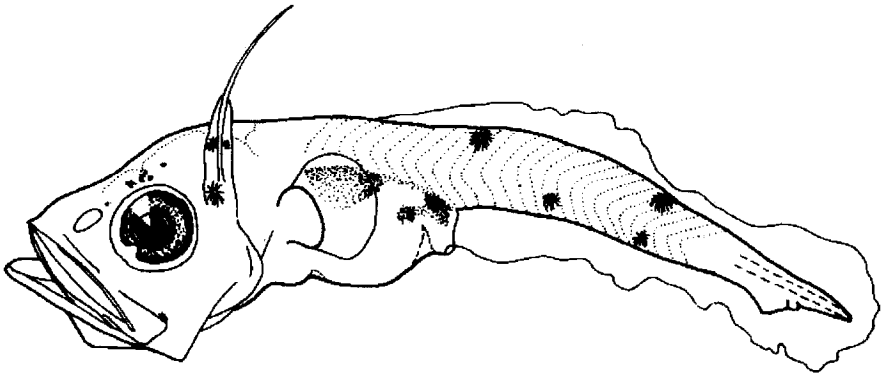
Pigment	Lightly pigmented. Pigment appears along the dorsal surface of the gut and gas bladder, on the trunk, tail, forebrain, midbrain, opercular appendage and lower jaw angle	Lightly pigmented as in the preflexion stage	More heavily pigmented. Dorsal pigment-saddles form on the trunk and tail, and counter-shading develops
Similar families	Ammodytidae, Chiasmodontidae, Creediidae, Trichiuridae, Trichonotidae.		

Meristic characters of the Indo-Pacific champsodontid genus (Leis and Carson-Ewart, 2000)

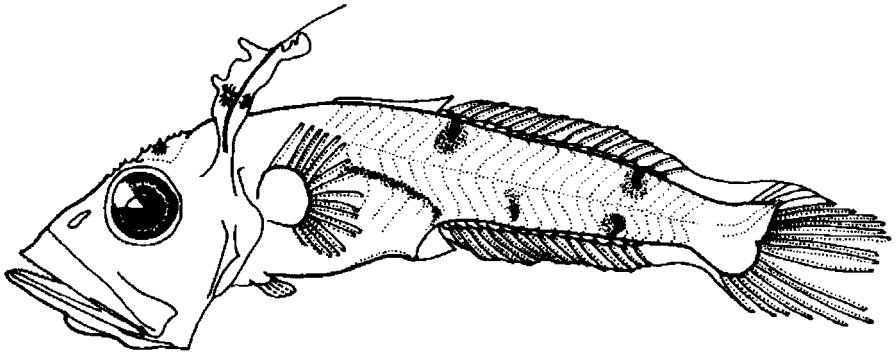
	D	A	P_1	P_2	C	VERTEBRAE
Champsodon	IV-VI+18-23	16-21	12-16	I, 5	8+7	(10-13)+(17-22) = 29-33



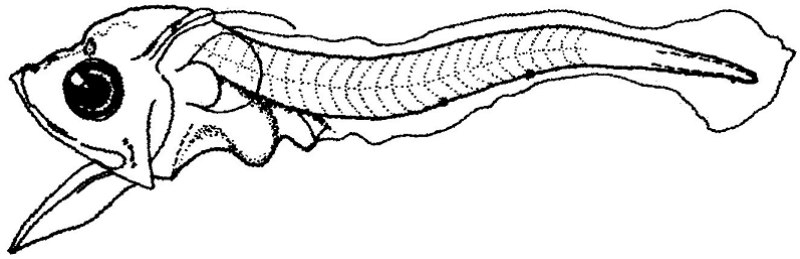
a 4.3 mm SL (type 1)



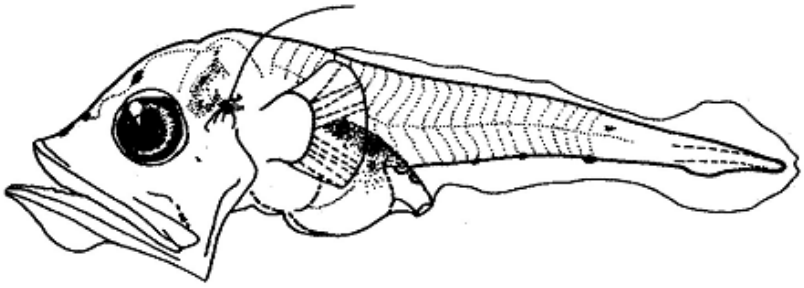
b 5.7 mm SL (type 1)



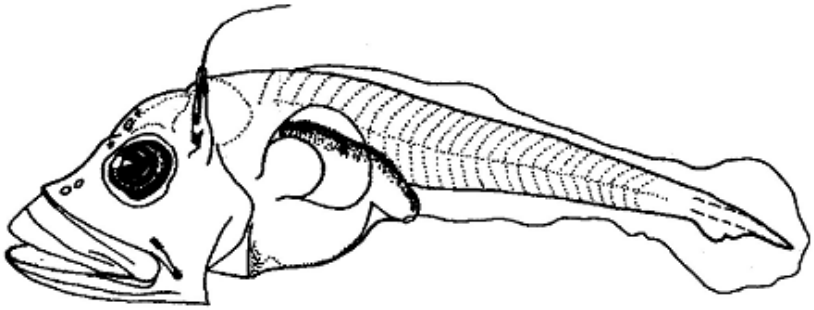
c 6.4 mm SL (type 1)



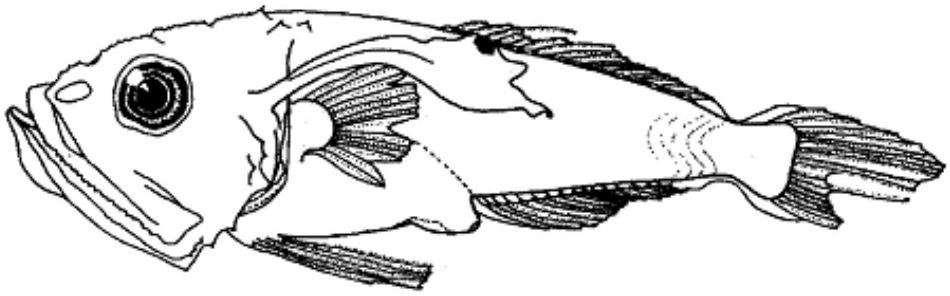
d 2.9 mm SL (type 2)



e 3.8 mm SL (type 3)



f 4.0 mm SL (type 4)



g 6.3 mm SL (type 5)

Fig. 82 Larvae of *Champsodon* spp. from the South China Sea (Zulkifli et al. 2006)

Order: Perciformes

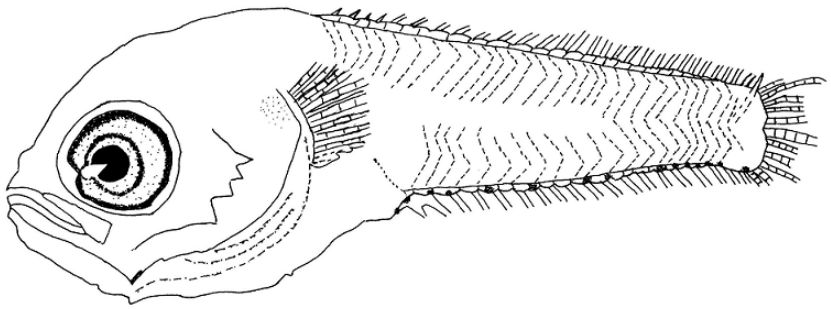
Family: Pinguipedidae (Sandperches)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Laterally compressed and moderate depth (head and gut are deeper than the tail)	Trunk becomes rotund, and the tail deepens but remains compressed	Body becomes relatively slender
Gut	Fully coiled and compact, extends to the position anterior to the mid body	Coiled, reaches to about the mid body	Coiled, reaches to about the mid body
Gas bladder	Gas bladder is present above the anterior portion of the gut (conspicuous in larvae collected at night)	Gas bladder is present above the anterior portion of the gut (conspicuous in larvae collected at night)	Gas bladder present above the anterior portion of the gut (conspicuous in larvae collected at night)
Head	Moderate to large, deep and compressed	Large, becomes round, broad and slightly dorsoventrally flattened	Large, becomes more flattened before settlement
Snout	Short and round	Short and round	Triangular in profile, becomes slightly longer
Mouth	Initially strongly oblique, reaches to the middle of the eye through larval stage. Tiny villiform teeth begin to form	Oblique	Oblique, but becomes nearly horizontal by settlement at about 6 mm. Lips become fleshy
Eyes	Large and round, become smaller with growth	Moderate and round	Moderate and round, attain a more dorsal position as the head is depressed
Head spination	Small spines are present on the pereopercle (at flexion in some species) and opercle (at postflexion in some species)	Spines on the preoprcle and opercle become larger	Spination becomes reduced in size
Fin formation	Dorsal and anal fin anlagen form	Pelvic fin buds appear well forward of the pectoral fin base, thereafter the rays as well as the dorsal, anal and pectoral fin rays form	Soft rays of the pelvic fin begin to elongate and the fourth ray becomes the longest element. Spines of first dorsal fin appear. Full completion of all fins is achieved by about 7 mm
Pigment	Lightly pigmented through the larval stage. A series of melanophores is present on the ventral midline of the tail (one of the posterior melanophores is large and	Branchiostegal membrane, the pectoral fin and the base (surface and inside), and the pelvic fin are pigmented in some species	Dorsolateral portions of the trunk and tail, ventral surface of the anterior abdomen and the head become heavily pigmented before settlement

	stellate in most species). A few melanophores are present ventrally on the gut and over the gut, and a prominent pigment at the lower jaw angle usually appears. A pigment patch appears in the dorsal mid-line of the posterior tail in some species		
Similar families	Blenniidae, Nemipteridae, Pomacentridae, Sciaenidae, Scombridae (*Rastrelliger*, *Scomber*)		

Meristic characters of the Indo-Pacific pinguipedid genus (Leis and Carson-Ewart, 2000)

	D	A	P_1	P_2	C	VERTEBRAE
Parapercis	IV-V, 20-25	I, 16-20	13-21	I, 5	9+8 = 17	(9-10)+(18-23) = 28-33



a 4.6 mm SL

Fig. 83 Larva of *Parapercis* sp. from the South China Sea (by Abd. Haris Hilmi)

Order: Perciformes

Family: Callionymidae (Dragonets)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Robust, moderately deep and round in cross section of the trunk	Robust, moderately deep and round in cross section of the trunk	Moderate, becomes dorso-ventrally flattened
Gut	Round and coiled, reaches initially near the mid body, later beyond it	Round and coiled, reaches beyond the mid body	Round and coiled, reaches beyond the mid body
Gas bladder	Inconspicuous, located anteriorly above the gut	Inconspicuous, located anteriorly above the gut	Inconspicuous, located anteriorly above the gut
Head	Moderate to large, round and broad	Moderate to large, round and broad	Large and dorsoventrally flattened
Snout	Short and round, sometimes slightly concave	Round or slightly pointed	More elongate, slightly pointed
Mouth	Small, oblique and protru-sible, never reaches to the mid eye. No teeth are visible until before settle-ment	Small, slightly oblique and protrusible, never reaches to the mid eye	Small, slightly oblique and protrusible, never reaches to the mid eye
Eyes	Round and large	Round and moderate to large	Round and moderate to large, positioned dorsally in the head
Head spination	None	None	Posteriorly-directed pre-opercular spine begins to form
Fin formation	Anlagen of the dorsal and anal fins appear. Pelvic fin buds develop at the jugular	Soft rays of all fins develop	Pectoral-fin rays and spines of the first dorsal fin are formed. Sequence of fin completion: D_2-A-P_2-D_1-P_1
Pigment	Moderate pigment is present on the head and gut, on the dorsal, ventral and lateral midlines of the trunk and tail	Heavy pigment is present on the head, abdomen, trunk and tail	Pigment on the body becomes heavier. Pectoral-fin base, 1st dorsal fin and pelvic fin are pigmented additionally in some species
Similar families	Draconettidae, Mugilidae, Percophidae (*Bembrops*)		

Remark: The posterior end of the notochord is greatly produced beyond the last myomere in flexion stage.

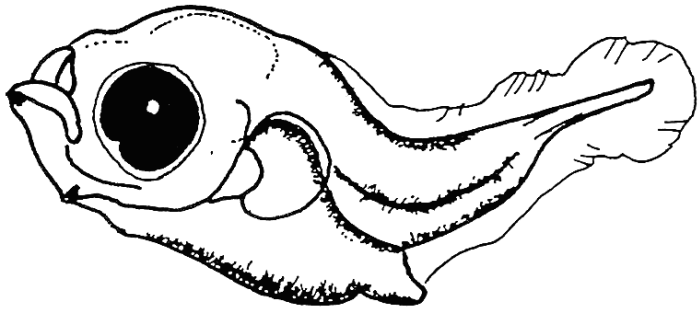
Meristic characters of the Indo-Pacific callionymid genera (modified from Leis and Carson-Ewart (2000))

	D	A	P_1	P_2	C	VERTEBRAE
Paradiplogrammus	IV, 8-9	7-8	16-21	I, 5	10	7+14 = 21
Pseudocalliurichthys	IV, 8	7	16-19	I, 5	10	7+14 = 21
Anaora	IV, 8	7	21-25	I, 5	10	7+13 = 20
Bathycallionymus	IV, 9	9	19-21	I, 5	10	7+(13-14) = 20-21
Callionymus (=*Calliurichthys*)	IV, 9	8	18-21	I, 5	10	7+(13-15) = 20-22
Dactylopus	IV, 8	7	19	I, 5	10	7+14 = 21
Diplogrammus	IV, 6-8	4-7	17-19	I, 5	10	7+(11-13) = 18-20
Eleutherochir	I-IV, 9-13	9-13	17-24	I, 5	10	7+(14-18) = 21+25
Foetorepus	IV, 8	7	19-21	I, 5	10	7+(14-15) = 21-22
Minysynchiropus	IV, 9	8	17-18	I, 5	10	7+(13-14) = 20-21
Neosynchiropus	IV, 8	7	18-22	I, 5	10	7+(14-15) = 21-22
Orbonymus [a]	IV, 8	7	18-19	I, 5	10	7+14=21
Pterosynchiropus	IV, 8	7	30-31	I, 5	10	7+(12-13) = 19-20
Repomucenus	III-IV, 9	8-9	17-22	I, 5	10	7+(13-15) = 20-22
Spinicapitichthys [b]	IV, 8	8	19-21	I, 5	10	7+14=21
Synchiropus	IV, 8	7	19	I, 5	10	7+14 = 21

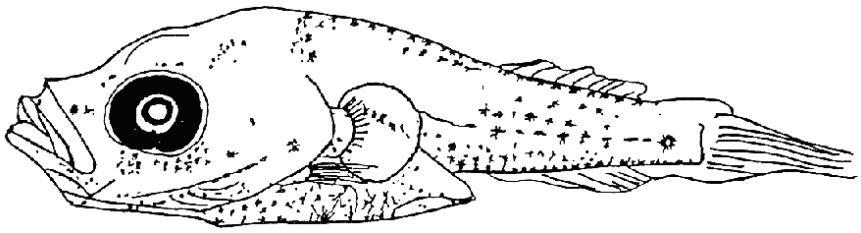
[a] Only *Synchiropus* (=*Orbonymus*) *rameus* is known from northwestern Australia and New Guinea.

[b] Only *Callionymus* (=*Spinicapitichthys*) *dracoris* is known from southern Japan.

Note: the classification above was partly revised in Nelson (2006).



a 1.7 mm TL



b 3.1 mm TL

Fig. 84 Larvae of Callionymidae spp. from the South China Sea (Chayakul 1996)

Order: Perciformes

Family: Ephippidae (Spadefishes, batfishes)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Moderate, rotund in the head and trunk, compressed in the tail	Deep, rotund in the head and trunk, compressed in the tail	Deep bodied and compressed
Gut	Coiled and triangular, reaches near the mid body. Preanal length becomes longer with growth	Coiled and round, reaches beyond the mid body	Coiled and round, reaches beyond the mid body
Gas bladder	Conspicuous, located anteriorly over the gut	Conspicuous, expands posteriorly with growth	Conspicuous over the gut
Head	Large, round and rotund	Larger, rhomboid and rotund	Large and deeply ovate
Snout	Short and steep	Short and steep	Short and steep
Mouth	Large and slightly oblique, reaches to the posterior margin of the eye. Distinct canine teeth appear	Large and slightly oblique, reaches to the posterior margin of the eye. Canine teeth increase in number	Moderate to small and oblique, reaches to the anterior margin of the eye
Eyes	Round and moderate	Round and small	Round and relatively smaller
Head spination	A supraoccipital crest and preopercle smooth spines are prominently formed. Small or weak spine appears on the opercle, interopercle and posttemporal. A supraocular, smooth ridge develops (the ridge bears serration at flexion in most species and disappears at postflexion in *Platax*)	Small spine in the supracleithral (*Ephippus*), pterotic and infraorbital series (serrate) appear. Supraoccipital spine, supraocular ridge and preopercle spines become larger (the crest and ridge bear a little serration)	Small spine forms in the tabular. Preopercle, supraoccipital and supraocular spines become reduced around 11 mm
Fin formation	Dorsal and anal fin anlagen form. Pectoral fin rays begin to form. Small pelvic fin buds appear	Incipient rays of the dorsal and anal fins appear	All fins have a full complement. Pigmented pelvic fin becomes extremely elongate and reaches beyond the anus in more than 8 mm
Pigment	Lightly pigmented. Melanophores are present on the head, abdomen, pectoral fin base, pelvic buds, gut, gas bladder, and ventral midline of the tail	Melanophores on the head and abdomen increase in size and number	Heavily pigmented. Pigment covers the majority of the body except distally on the caudal peduncle, caudal, dorsal and anal fins (the dorsal, anal and

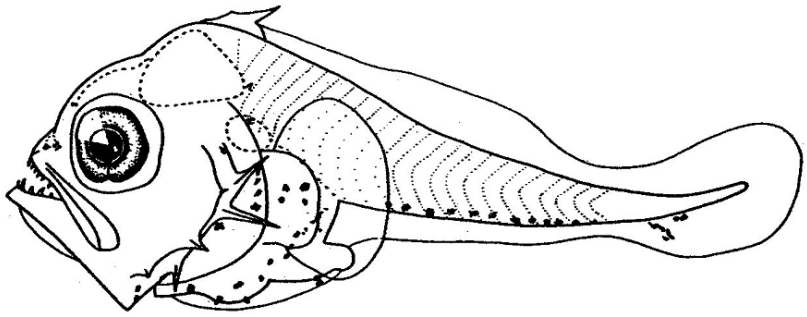
			caudal fins are pigmented at juvenile stage)
Similar families	Bramidae, Carangidae, Cepolidae, Drepaneidae, Lobotidae (and *Hapalogenys*), Uranoscopidae		

Meristic characters of the Indo-Pacific ephippid genera (modified from Leis and Carson-Ewart (2000))

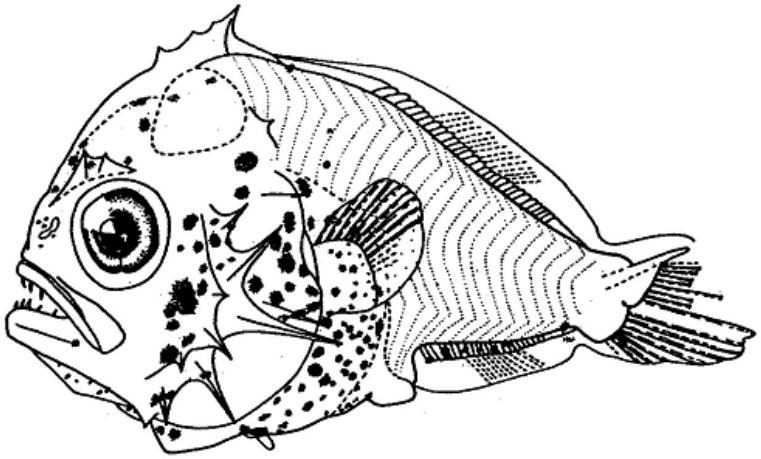
	D	A	P_1	P_2	C	VERTEBRAE
Ephippus	VIII-IX, 19-20	III, 15-16	18-19	I, 5	9+8	10+14 = 24
Platax	V-VII, 28-39	III, 19-29	16-20	I, 5	9+8	10+14 = 24
Proteracanthus	X, 14-16	III, 13-15	19	I, 5	9+8	10+14 = 24
Rhinoprenes [a]	VIII, 19-21	III, 16-19	19-21	I, 5	9+8	10+14 = 24
Tripterodon [b]	IX, 19-21	III, 15-17	17-19	I, 5	9+8	10+14 = 24
Zabidius [a]	IX, 27-29	III, 20-22	19-21	I, 5	9+8	10+14 = 24

[a] Known only from the north coast of Australia and New Guinea.

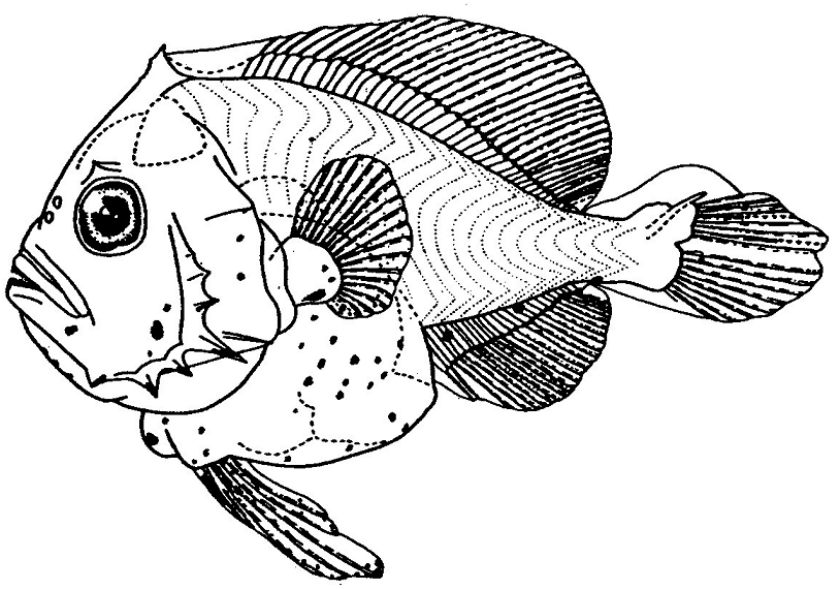
[b] Only *T. orbis* is known from the western Indian Ocean.



a 2.9 mm SL



b 4.5 mm SL



c 7.5 mm SL (*P. batavianus*)

Fig. 85 Larvae of *Platax* spp. from the Great Barrier Reef (Cavalluzzi et al. 2000b)

Order: Perciformes

Family: Siganidae (Rabbitfishes)

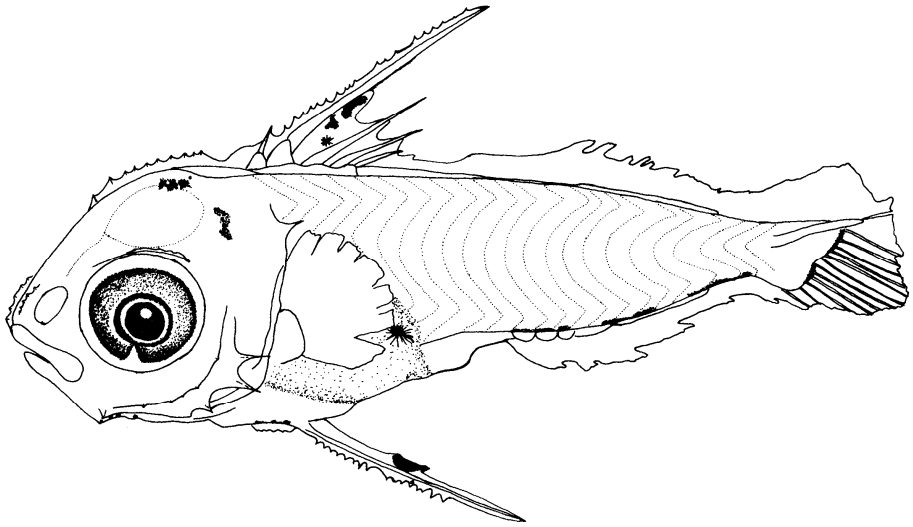
Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Initially elongate, thereafter moderate	Moderate in depth and laterally compressed	Moderate and compressed with a low caudal peduncle
Gut	Coiled, ovoid in shape and rugal, extends anteriorly to the mid body. Preanal length becomes slightly longer with growth	Coiled and compact, extends to about the mid body	Coiled, extends to the mid body
Gas bladder	Often inconspicuous, located above the anterior portion of the gut	Inconspicuous	Inconspicuous, moves posteriorly over the gut
Head	Moderate and round, becomes slightly larger with growth	Moderate to large and round, becomes deeper	Large and ovoid in shape
Snout	Short and blunt	Short and blunt	Blunt and square in shape, becomes slightly elongate
Mouth	Small, slightly oblique and terminal, never reaches to the pupil. Teeth are present in both jaws	Small, nearly horizontal and terminal, never reaches to the pupil	Nearly horizontal and terminal, never reaches to the anterior edge of the eye as the snout elongates. Mouth becomes inferior shortly before settlement
Eyes	Round and large	Round and large	Round and large to moderate
Head spination	Tiny spines appear on the preopercle	Serrate ridges form along the top of the head (supraoccipital and frontal), and laterally on the snout (nasal). Small spines or serrate ridges form on the supraocular, pterotic, post-temporal, supracleithrum, angular, infraorbital (lachrymal) and lateral ethmoid. The pelvic girdle develops a serrate ridge anterior to the fin	Most of the head spination is lost before settlement
Fin formation	Dorsal fin anlage begins to form just posterior to the head, and the second spine develops. Pelvic fin buds appear and the first spine forms	Second dorsal spine and first pelvic spine become longer and bear serration along the anterior margin. Other dorsal spines including an anterior extension of the first dorsal	The dorsal, anal and pectoral fin rays begin to form, and the soft rays and second spine of the pelvic fin form. A full complement of all fin rays is attained by about 7 mm, after

		pterygiophore form. Separate anlage of the dorsal fin forms posteriorly on the dorsal midline of the tail as well as the anal fin anlage located oppositely on the tail. Spines of the anal fin begin to form. Spines of the dorsal and anal fins have serration on the anterior edge	this the second dorsal spine and the first pelvic spine decrease in relative length. Sequence of fin completion: D_1 spine(s), P_2 spine -D_1-C-P_2 rays- P_1-D_2-A
Pigment	In general, the dorsal surface of the gut is pigmented and a series of spots forms on the ventral midline of the tail	Pigment spots along the ventral midline of the tail decrease in number. Melanophores appear on the membranes of the spinous dorsal and pelvic fins, over the brain, along the caudal fin base	Pigment develops on the upper and lower jaws and on the dorsal midline of the tail. Prior to settlement, further body pigment develops and late pelagic stages are very silvery
Similar families	Acanthuridae, Gerreidae, Leiognathidae, Lutjanidae, Luvaridae, Mullidae, Pomacentridae, Serranidae (Epinephelinae), Zanclidae		

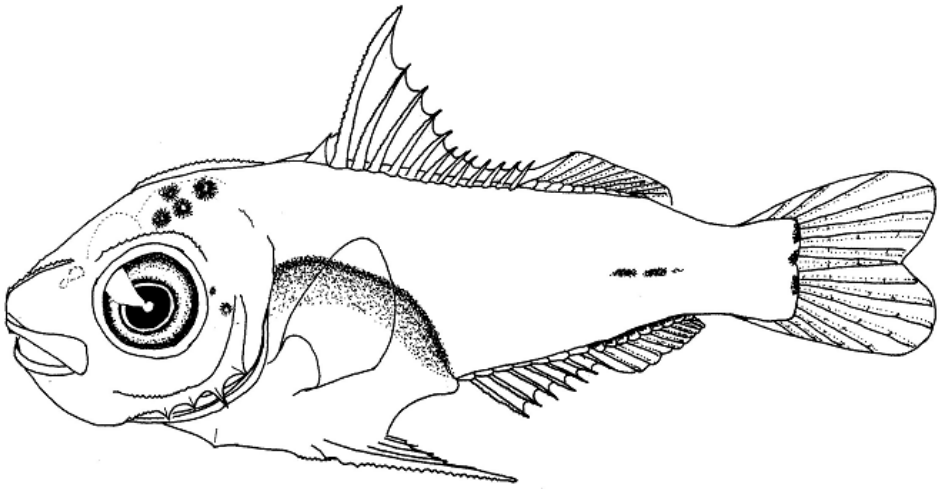
Meristic characters of the Indo-Pacific siganid genus (Leis and Carson-Ewart, 2000)

	D[a]	A	P_1	P_2	C	VERTEBRAE
Siganus	XIII-XIV, 10	VII, 9-10	15-19	I, 3, I	9+8	10+13 = 23

[a] 'procumbent spine' not included in count.



a 5.0 mm SL



b ca 10.4 mm SL

Fig. 86 Larvae of *Siganus* spp. from the South China Sea (a: by Phuttaraksa, K.) and the Andaman Sea (b: by Quang, V. V.)

Order: Perciformes

Family: Acanthuridae (Surgeonfishes, tangs, unicornfishes)

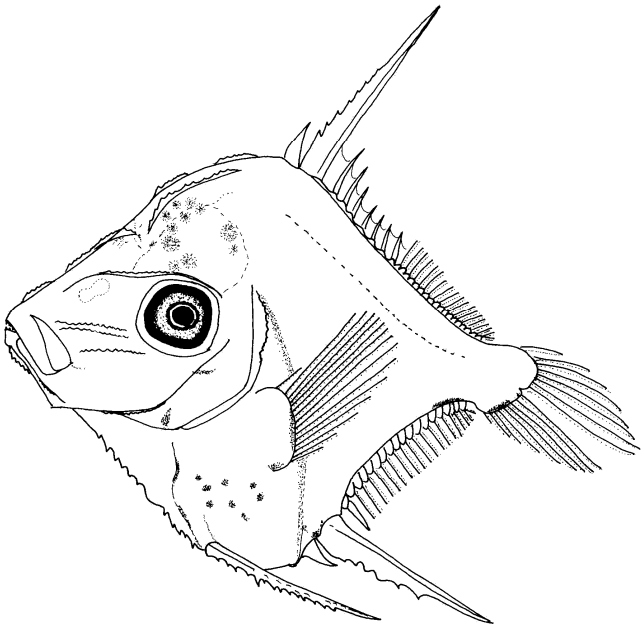
Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Initially moderate, thereafter deep and kite-shaped, and strongly compressed	Deep and kite-shaped, and strongly compressed	Very deep and kite-shaped, and strongly compressed
Gut	Coiled, extends to 44-61% BL. Preanal length becomes relatively smaller with growth due to downward extension of the gut mass	Coiled. Gut mass in ventral profile is pointed (Nasinae) or somewhat round (Acanthurinae)	Coiled, extends to about 40% BL
Gas bladder	Inconspicuous, above the anterior portion of the gut	Inconspicuous, above the anterior portion of the gut	Inconspicuous, above the anterior portion of the gut
Head	Initially moderate, later large, deep and strongly compressed with a vaulted brain case	Large, deep and strongly compressed with a vaulted brain case	Large, deep and strongly compressed with a vaulted brain case
Snout	Long, and concave (Nasinae) or nearly straight (Acanthurinae) in dorsal profile	Long, and deeply concave (Nasinae) or nearly straight (Acanthurinae) in dorsal profile	Long and truncate
Mouth	Small and terminal, never reaches to the anterior edge of the eye	Small and terminal, never reaches to the anterior edge of the eye. Small conical teeth form	Small and terminal, never reaches to the anterior edge of the eye
Eyes	Round and moderate to large, becomes smaller with growth due to enlargement of the snout	Round and moderate to small	Round and moderate to small
Head spination	Serrate supraoccipital crest, and small spines on the preopercle and lower jaw (dentary and angular) and along the throat (on the midventral keel and pelvic girdle) appear	Preopercle spines increase in number. Bony ridges on the supraoccipital crest and lower jaw and along the throat become more serrate	Low, serrate ridge(s) develops on the supracleithral, posttemporal, pterotic, opercle,frontal, supraocular portion, nasal, lachrymal and lateral ethmoid
Fin formation	Initially, second dorsal-fin spine and pelvic-fin spine appear (pelvic spine first forms in *Naso*, dorsal spine first forms in *Acanthurus*) and become long with	Each elongate spine of the dorsal, anal and pelvic fins become longer and more serrated. Other spines and soft rays of the dorsal and anal fins begin to form	Soft rays of the pectoral and pelvic fins form. All fins form completely by about 8 mm

	serration. Thereafter, first spine of the dorsal fin and second spine of the anal fin begin to form (2nd anal-fin spine becomes long with serration)		
Pigment	Moderately pigmented. Melanophores are present on the brain and gut, along the throat, on the lower jaw, and on the dorsal surface of the gas bladder. Some species have large melano-phores posteriorly on the tail	Tail pigment in some species becomes a strong band and is located on the caudal peduncle	Further pigment appears on the head, along the lateral surface of the tail, on the bases of the dorsal and anal fins, and on the membranes of the caudal fin rays and the first two dorsal fin spines
Similar families	Caproidae, Grammicolepidae, Leiognathidae, Luvaridae, Menidae, Siganidae, Zanclidae		

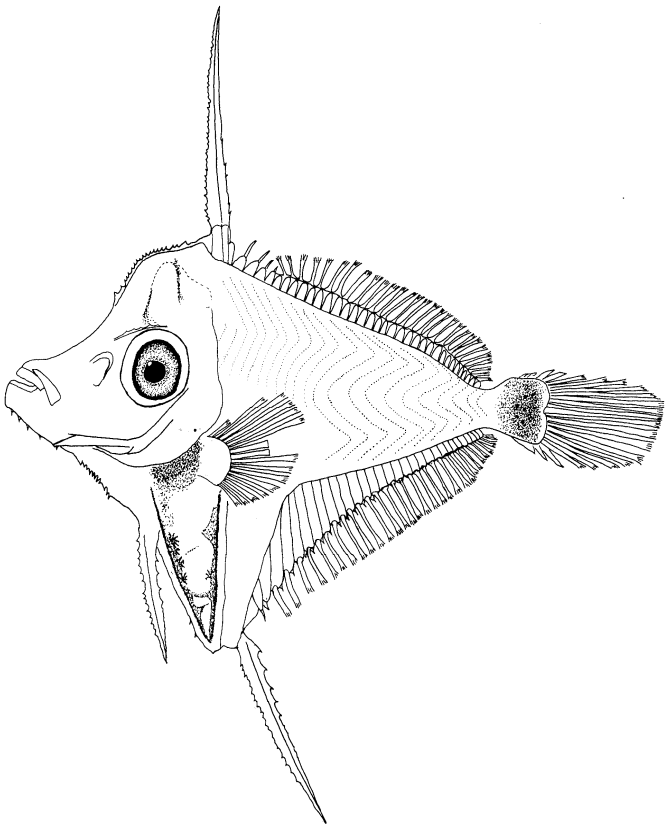
Meristic characters of the Indo-Pacific acanthurid genera (Leis and Carson-Ewart, 2000)

	D	A	P_1	P_2	C	VERTEBRAE
Acanthurinae						
Acanthurus	VI-IX, 22-23	III, 19-29	15-17	I, 5	8+8 = 16	9+13 = 22
Ctenochaetus	VIII, 24-31	III, 21-28	15-17	I, 5	8+8 = 16	9+13 = 22
Paracanthurus	IX, 19-20	III, 18-19	16	I, 3	8+8 = 16	9+13 = 22
Prionurus	VIII-IX, 21-28	III, 20-23	16-18	I, 5	8+8 = 16	9+13 = 22
Zebrasoma	IV-V, 23-33	III, 19-26	14-17	I, 5	8+8 = 16	9+13 = 22
Nasinae						
Naso [a]	IV-VII, 24-31	II, 23-32	15-19	I, 3	8+8 = 16	9+13 = 22

[a] An additional dorsal spine base (but no spine) and a third anal spine are present but not visible extenally in adults.



a ca 6.5 mm SL (*Paracanthurus* sp.?)



b 5.30 mm SL (*Naso* sp.)

Fig. 87 Larvae of Acanthuridae spp. from the Andaman Sea (a: by Nang, M. H.; b: by Polrong, K.)

Order: Perciformes

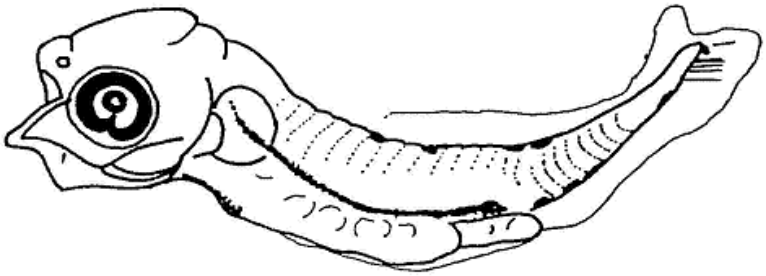
Family: Sphyraenidae (Barracudas)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Elongate and moderately compressed	Elongate and moderately compressed	Elongate, becomes approximately round in cross section
Gut	Straight and long, extends to 60-80% BL	Straight and long, extends to 60-80% BL. Weak striations are present along the gut	Straight and long, extends to 60-80% BL
Gas bladder	Prominent, located above the anterior portion of the gut	Prominent, extends posteriorly with growth	Prominent, becomes enlarged
Head	Moderate, becomes larger with growth	Slightly elongate and large	Elongate and large to very large
Snout	Short and round to pointed, becomes elongate, more pointed and dorsoventrally flattened with growth	More pointed and slightly dorsoventrally flattened	More pointed and dorsoventrally flattened
Mouth	Initially somewhat oblique, thereafter nearly horizontal, not reach to the anterior edge of the eye. Small teeth are present in both jaws	Nearly horizontal, becomes elongate but barely reaches to the anterior edge of the eye	Horizontal and large, not reach to the anterior edge of the eye
Eyes	Round and moderate (large relative to BL), becomes smaller with growth due to enlargement of the snout	Round and small (large relative to BL)	Round and small
Head spination	Not yet appear	One or two small, inconspicuous spines appear ephemerally near the angle of the preopercle	The preopercle spines disappear at about 8 mm in most species
Fin formation	Pectoral fin buds form	Anlagen of the short-based anal and second dorsal fins form nearly oppositely in the tail, thereafter the rays develop	The spines of both dorsal and anal fins begin to form at about 8 mm (the two dorsal fins are well separated). Soft rays of the pectoral fin form. Pelvic fin buds appear posteriorly at the pectoral-fin base near the level of the spiny dorsal fin, later the fin elements form. By 16 mm, a full fin complement is present in all fins. Sequence of fin completion: C-D_2, A-D_1-P_1- P_2
Pigment	Moderately to heavily pig-	Mostly a stripe of pigment	Melanophores increase in

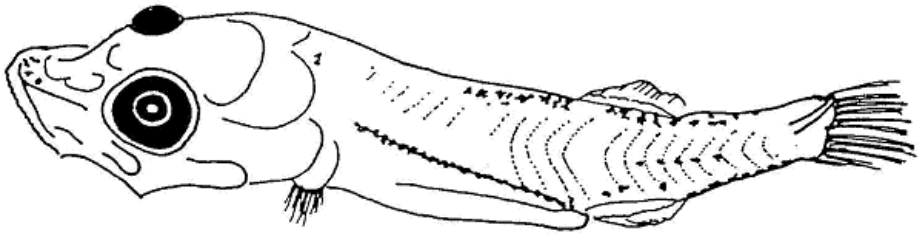
	mented in larval stage. Melanophores appear along the dorsal midline of the trunk and tail. Dorsal surface of the gut and ventral midline of the tail are continuously pigmented. Ventral midline of the gut is pigmented in some taxa	along the lateral midline and scattered melanophores appear on the tail. Some species have pigment dorsally on the head and laterally on the snout	number on the body. Some juveniles develop large pigment spots on the dorsal midline of the trunk and tail, and a wide, longitudinal pigment stripe along the lateral midline of the trunk and tail
Similar families	Belonidae, Cirrhitidae, Echeneidae, Gobiidae, Platycephalidae, Pseudochromidae, Sillaginidae		

Meristic characters of the Indo-Pacific sphyraenid genus (Leis and Carson-Ewart, 2000)

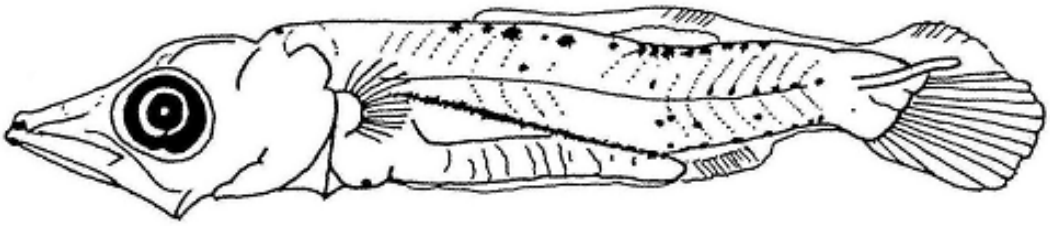
	D	A	P_1	P_2	C	VERTEBRAE
Sphyraena	V+I, 8-10	II, 7-9	12-16	I, 5	9+8	12+12 = 24



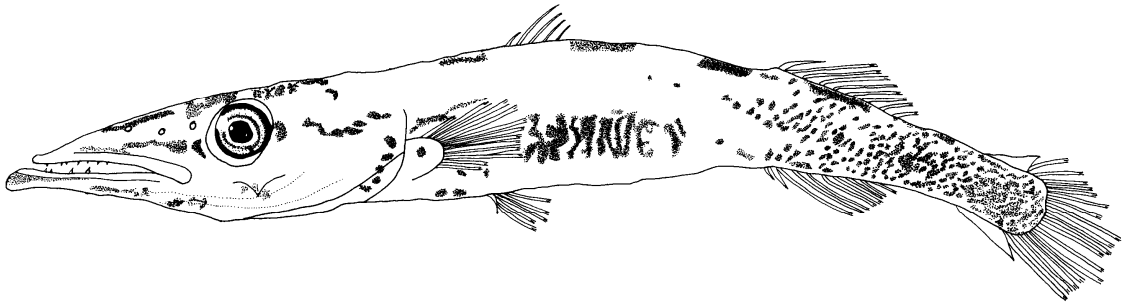
a 2.1 mm TL



b 4.1 mm TL



c 4.9 mm TL



d 18. 8 mm SL

Fig. 88 Larvae of *Sphyraena* spp. from the Gulf of Thailand (a-c: Chayakul 1996; d: by Puntuleng, P.)

Order: Perciformes

Family: Gempylidae (Snake mackerels)

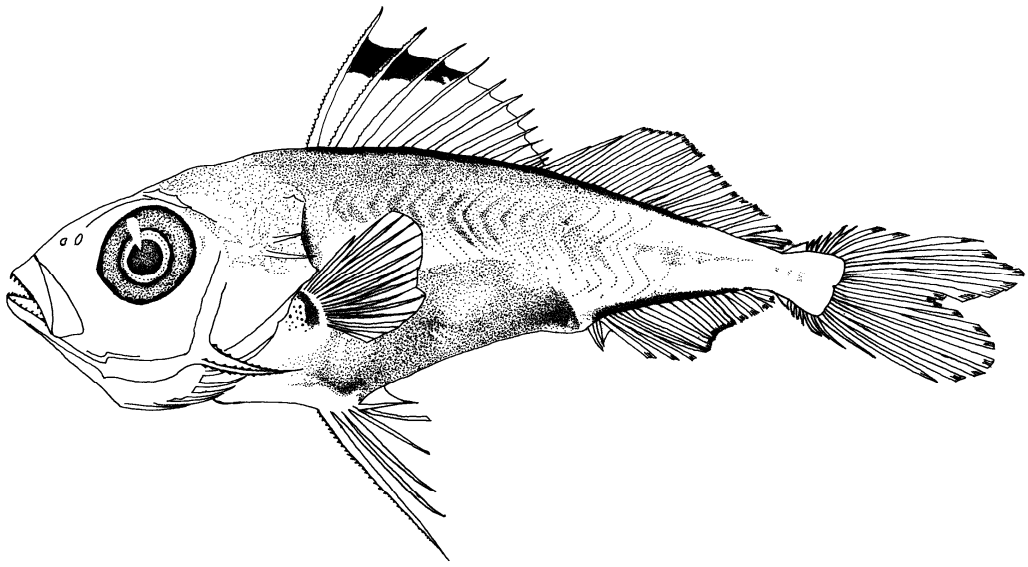
Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Moderate to deep and compressed, tapers to the notochord tip	Moderate to deep and compressed, tapers to the caudal peduncle	Moderate and compressed, mostly becomes more slender at juvenile
Gut	Coiled and triangular, reaches slightly beyond the mid body	Coiled, reaches distinctly beyond the mid body	Coiled, reaches well beyond the mid body
Gas bladder	Small, located over the anterior portion of the gut	Small, located over the anterior portion of the gut	Small, located over the anterior portion of the gut
Head	Large to moderate	Large	Large
Snout	Concave in dorsal profile due to a swell of the premaxilla at the ascending process, and nearly same or longer than eye diameter	Squarish to pointed	Pointed. Anterior tip of the premaxilla slightly extend forward (distinct in *Rexea*, *Nealotus*, *Promethichthys*, *Nesiarchus*)
Mouth	Slightly or distinctly oblique, reaches beyond the anterior edge of the eye except for *Diplospinus* of which the mouth never reaches to the edge through larval stage. Lower jaw mostly protrudes from the upper jaw through larval stage	Slightly oblique, reaches to the mid pupil except for *Diplospinus*	Horizontal (slightly oblique in *Ruvettus* and *Lepidocybium*), reaches to the mid eye except for *Diplospinus* (before the eye) and *Ruvettus* (beyond the mid pupil)
Eyes	Moderate and round	Moderate and round	Small to moderate and round
Head spination	Preopercular spines, posttemporal and opercular spines and small supraoccipital spines (only in *Lepidocybium*) appear	A supraocular ridge and preopercle spine at angle become serrated (*Diplospinus*, *Lepidocybium*, *Neoepinnula*, *Rexea*, *Nealotus*), and pterotic spine (*Lepidocybium*, *Neoepinnula*, *Ruvettus*) forms	Spination becomes reduced, but still remain distinctly
Fin formation	Anterior several spines of the dorsal fin are present and pelvic fin buds appear in the isthmus or on a level with the pectoral-bud base (pelvic-fin position mostly moves posteriorly on the level of the pectoral-fin base with growth)	Spines of the dorsal fin and pelvic-fin spine become long with serration. Pelvic fin element in *Dipolospinus* and *Promethichthys* is only a single spine. Soft rays of other fins form	Sequence of fin completion: mostly D_1, P_2-P_1-C-D_2, A

Pigment	Mostly sparsely pigmented. Melanophores appear over the gas bladder, in the abdomen (dense in *Lepidocybium*). In *Gempylus*, pigment appears on the fore- and mid-brain and snout, and along the dorsal, lateral and ventral midlines near the anus	Spinous dorsal fin (dense in *Neoepinnula* and *Gempylus* at flexion, and in *Ruvettus* at postflexion), branchiostegal membrane (*Diplospinus*), pelvic fin (*Neoepinnula*), and dorsal midline of the trunk and tail are pigmented	Pigment expands in the head, trunk, tail and spinous dorsal fin
Similar families	Istiophoridae, Scombridae (*Scomberomorus*, *Sarda*, *Euthynnus*, *Katsuwonus*, *Thunnus*), Trichiuridae		

Meristic characters of the southeast Asian gempylid genera[a]

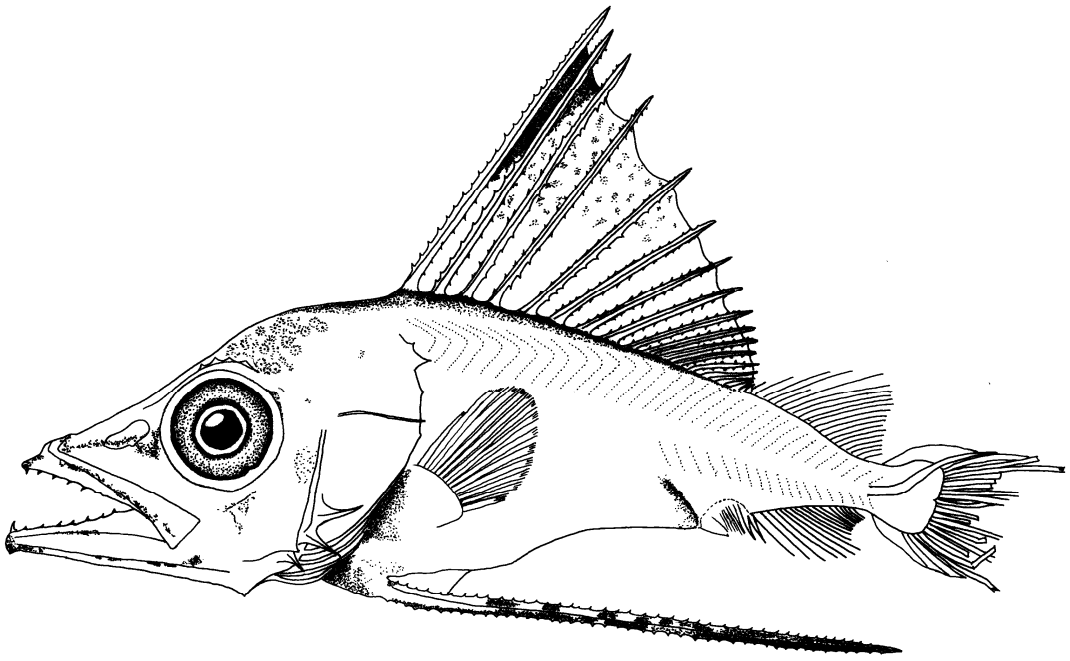
	D	A	P_1	P_2	VERTEBRAE
Diplospinus	XXX-XXXVI+35-42	II, 28-34	11-13	I	32-36+24-28=57-64
Gempylus	XXVIII-XXXII+I, 11-14+5-7	II, 10-13+5-7	13-16	I, 3	24-29+23-26=48-55
Lepidocybium	VIII-X+16-19+4-6	12-15+4-5	15-17	I, 5	16+15=31
Nealotus	XX-XXI+16-19+2	II, 15-19+2	13-14	I, 1	21-22+15-16=36-38
Neoepinnula	XV-XVI+I, 17-20	III, 18-21	13-15	I, 5	-
Nesiarchus	XIX-XXI+I, 19-24	II, 18-21	12-14	I, 5	20-22+14=34-36
Promethichthys	XVII-XIX+I, 18-20+2	II, 15-18+2	14-15	I, 0-1	18-20+14-16=33-35
Rexea	XVIII-XIX+I, 14-18+2	I-II, 11-16+2	12-15	I or 0	18-20+14-15=33-34
Ruvettus	XIII-XV+16-20+2	II, 15-18+2	13-15	I, 5	16+16=32
Thyrsitoides	XVII-XIX+I, 16-18	II, 15-17	I, 13-14	I, 5	20+14=34

[a] *Rexea antefurcata*, *R. solandri*, *Rexichthys johnpaxtoni* and *Tongaichthys robustus* are known from Australia, New Zealand, Fiji and Tonga Islands.



a 12.2 mm SL

Fig. 89 Larva of *Lepidocybium flavobrunneum* from the Andaman Sea (by Polrong, K.)



a 8.2 mm SL

Fig. 90 Larva of *Promethichthys prometheus* from the Andaman Sea (by Polrong, K.)

Order: Perciformes

Family: Trichiuridae (Cutlassfishes, scabbardfishes)

Main characters	Larval stage	
	Phase 1*	**Phase 2***
Body shape	Elongate and compressed with the long, tapering tail	Elongate to very elongate with the long, tapering tail, becomes elongate with growth
Gut	Coiled and compact, initially reaches to 30-40% BL, eventually to about the mid body. Preanal length becomes elongate with growth from 8-9 mm. Initially a large gap between the anus and anal fin origin is distinctly present. Thereafter the gap becomes shorter due to backward movement of the anus, eventually by 11-14 mm the anus is located at the final position	Coiled and elongate, reaches to 50-65% BL
Gas bladder	Conspicuous, located anteriorly over the gut	Conspicuous, located anteriorly over the gut
Head	Initially moderate, thereafter large, becomes larger with growth due to increase of the snout size (*Trichiurus* has a moderate head through Phase 1)	Large to moderate, becomes smaller with growth due to extension of the tail
Snout	Initially short and somewhat round, shortly after elongate, pointed and concave, becomes relatively larger to BL with growth	Pointed and initially large, thereafter moderate, becomes relatively smaller to BL with growth
Mouth	Horizontal, initially reaches beyond the anterior edge of the eye, thereafter does not reach to the edge. Lower jaw protrudes slightly beyond the upper jaw. Small, pointed teeth are present on the both jaws	Horizontal, does not reach to the anterior edge of the eye. Lower jaw protrudes beyond the upper jaw. Large, fang-like teeth appear at the tip of the both jaws
Eyes	Initially large, thereafter moderate to small, become smaller with growth. The eye is slightly elongate but gradually becomes round	Small and round
Head spination	Development of the spination is species-dependent. A few small to moderate preopercular spines are present (a spine at angle is serrated only in *Assurger*). Mostly a serrated or spinous supraocular ridge forms. Some taxa have opercular spine(s), a low, smooth supraoccipital ridge (*Assurger*), serrate frontal ridges (*Eupleurogrammus*) and a supracleithral spine (*Aphanopus*, *Assurger*, *Benthodesmus*, *Lepidopus*)	Preopecular spines become reduced in size. Fimbriation extends laterally on the opercle and subopercle
Fin	Initially the first dorsal-fin spine appears	First dorsal-fin spine becomes shorter. Anal

formation	and becomes elongate (distinctly or considerably longer than the second dorsal spine in *Assurger*, *Benthodesmus* and *Lepidopus*). Thereafter all dorsal spines form and the anterior spines bear serrations. Anlage of the anal fin appears at the onset of the posterior movement of the anus, thereafter the fin elements form. A single large serrate anal spine in the non caudal fin group (*Eupleurogrammus*, *Lepturacanthus*, *Tentoriceps*, *Trichiurus*), or two serrate anal spines in other five genera with the fin (*Aphanopus*, *Assurger*, *Benthodesmus*, *Evoxymetopon*, *Lepidopus*) appear. Pectoral-fin rays begin to form. Small pelvic-fin buds appear except for *Lepturacanthus* and *Trichiurus* which have no pelvic fin through life, later a serrate spine and any rays form (spine size, shape, ornamentation and position vary among taxa)	soft rays of *Lepturacanthus* and *Trichiurus* bear small spinous projections along their ventral margins, these rays subsequently become extremely reduced and laterally fused to form extremely modified spinules. A full complement of all fin rays is attained at latest by 45 mm
Pigment	Lightly to moderately pigmented. Pigment is consistently found along the base of the dorsal fin under ossified fin elements, on the snout, around the orbit of the eye, along the dentary and over the brain. Pigment that varies among taxa is found on the lower jaw tip, on the jugular, preopercular and opercular regions and dorsolaterally on the gut and gas bladder. Pigment patches on the anal and dorsal finfolds (later disappear), on or near the notochord tip and along the ventral midline of the tail vary among taxa	Melanophores increase in number at the head and extend backward at the base of the dorsal fin
Similar families	Carapidae, Gempylidae, Lutjanidae, Paralepididae, Serranidae (Grammistini, Liopropomini)	

* Since notochord flexion does not occur in the four genera without the caudal fin or occurs at a large size in the remaining five genera with it, two phases are used as developmental stages of larvae: Phase 1 is a stage until the anus is located at a position close to the origin of the anal fin; Phase 2 is a stage from the final anus position to about 40 mm BL.

Meristic characters of the Indo-Pacific trichiurid genera[a] (modified from Leis and Carson-Ewart (2000))

	D	A	P_1	P_2	C	VERTEBRAE
Aphanopodinae						
Aphanopus	XXXIX-XLVI, 53-65	II, 43-54	12	I [b]	9+8	(43-51)+(54-65) = 99-115
Benthodesmus	XXXI-XLVI, 68-112	II, 64-102	12	I, 1	9+8	105-163 [c]
Lepidopodinae						
Assurger	XXXIV-XXXV, 84-88	II, 72-86	12	I, 1-2	9+8	(41-43)+(83-86) = 125-129
Eupleurogrammus	III, 115-151	I, 116-140	11-14	I	0 [d]	(30-41)+(125-151) = 157-192
Evoxymetopon	IX-X, 67-86	II, 48-56	12	I, 2	9+8	(32-34)+(60-61) = 91-100
Lepidopus[f]	VIII-IX, 81-100	II, 44-66	12	I, 1-2	9+8	(38-44)+(54-72) = 98-114
Tentoriceps	V, 126-148	I, 75-92	11-12	I	0 [e]	(46-49)+(105-117) = 152-164
Trichiurinae						
Lepturacanthus	III-IV, 110-131	I, 72-84	11-12	0	0 [d]	(32-35)+(124-138) = 159-168
Trichiurus	III-IV, 106-141	I, 79-113	10-14	0	0 [d]	(34-40)+(119-134) = 153-173

[a] Many fin elements are drastically modified or lost in adults.

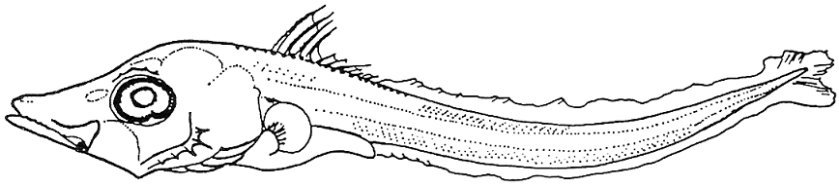
[b] Pelvic fin is almost always absent or extremely reduced in adults, but present as a single spine in larvae and juveniles.

[c] Counts for precaudal and caudal vertebrae are not available.

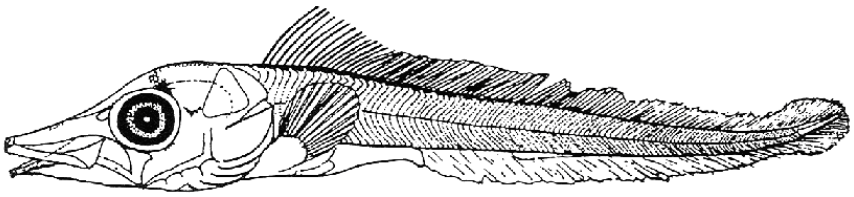
[d] Rudimentary plates and rays are present in larvae, but absent in adults.

[e] Rudimentary plates and rays which barely penetrate the skin are present in adults, but there is no flexion during development.

[f] Known from Australia, New Zealand, Hawaii and southeast Pacific.

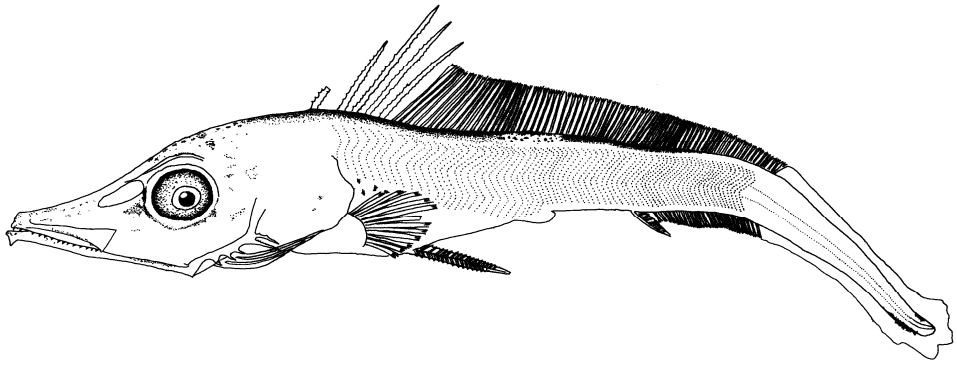


a 6.4 mm TL



b 10.5 mm TL

Fig. 91 Larvae of *Trichiurus leptulus* from the Gulf of Thailand (Chayakul 1996)



a 11.7 mm SL

Fig. 92 Larva of *Tentoriceps cristatus* from the Andaman Sea (by Polrong, K.)

Order: Perciformes

Family: Scombridae (Mackerels, spanish mackerels, tunas, bonitos)

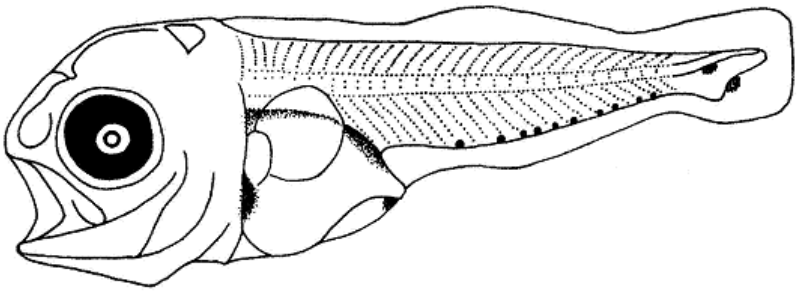
Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Elongate (*Acanthocybium*) to moderate (other taxa), laterally compressed, and the most are abruptly deeper in the head and gut than in the tail through larval stage	Elongate (*Acanthocybium*) to moderate (other taxa) and compressed. Mostly body depth at the pectoral-fin base becomes relatively deepest	Elongate (*Acanthocybium*) to moderate (other taxa) and compressed. Caudal peduncle is short and low
Gut	Coiled and triangular (ovoid in Scombrini), extends beyond the mid body (*Acanthocybium*) or about the mid body (others). Preanal length becomes longer with growth	Coiled and triangular (ovoid in Scombrini), mostly extends beyond the mid body. A gap between the anus and anal fin origin is present	Coiled and triangular (ovoid in Scombrini), extends beyond the mid body. The gap between the anus and anal fin origin is closed in late postflexion stage
Gas bladder	Inconspicuous, located just above the apex of the gut	Inconspicuous, located just above the apex of the gut	Inconspicuous, located just above the apex of the gut
Head	Initially moderate, thereafter large (except Scombrini), becomes longer with growth due to increasing the snout length	Moderate (Scombrini), large (Thunnini) or very large (Sardini, Scomberomorini), and round (Scombrini), triangular (Sardini, Thunnini) or elongate (Scomberomorini)	Large (Scombrini, Thunnini) to very large (Sardini, Scomberomorini), and round (Scombrini), triangular (Sardini, Thunnini) or elongate (Scomberomorini)
Snout	Short and blunt (Scombrini) or slightly pointed (Sardini, Scomberomorini, Thunnini), becomes longer with growth	Great variation ranges from rounded and blunt (Scombrini), pointed (*Grammatorcynus*), triangulate (Sardini, Thunnini), elongate (*Scomberomorus*), greatly elongated (*Acanthocybium*, *Gymnosarda*)	Rounded and blunt (Scombrini), pointed (*Grammatorcynus*), triangulate (Sardini, Thunnini), elongate (*Scomberomorus*), greatly elongated (*Acanthocybium*, *Gymnosarda*)
Mouth	Oblique, reaches to about the anterior edge of the eye in Scombrini, but in other taxa beyond the edge. The jaws are of equal length in most genera. Teeth are present in both jaws, and increase in number and size with growth	Oblique but becomes increasingly horizontal, reaches to about the anterior edge of the eye in Scombrini, beyond the mid pupil or about the posterior edge of the eye in other taxa	Upper jaw projects beyond the lower in most taxa except for Scombrini, and greatly in *Acanthocybium* and *Gymnosarda*
Eyes	Round and large (Scombrini,	Round and large (Scombrini, *Grammatorcynus*) to moderate	Round and large (*Grammatorcynus*) to mod-

	Grammatorcynus) to moderate (other taxa), become smaller with growth	(other taxa)	erate (other taxa)
Head spination	Absent in Scombrini through larval stage, and in *Grammatorcynus* smaller than 3 mm. All other taxa have preopercle spines	Mostly preopercle spines increase in number and size except for Scombrini. A small supraoccipital crest begins to form in *Sarda* and *Scomberomorus*	Supracleithral spines are present except for Scombrini. Some Sardini and Scomberomorini have supraocular and pterotic spines. The supraoccipital spine in *Sarda* and *Scomberomorus* becomes reduced in size
Fin formation	Dorsal and anal fin anlagen are visible	Caudal fin rays develop prior to forming the dorsal and anal fin elements. Second dorsal fin develops first in Scombrini, and the first dorsal fin in other taxa. Pelvic fin buds form	A full complement of all fin rays is attained by about 13 mm. Sequence of fin completion: C-D_2-A- P_2-D_1-P_1 (Scombrini) or C-D_1-D_2-A-P_2-P_1 (other taxa). The dorsal and anal finlets form as part of the main body of the fin and do not separate from it until early juvenile stage
Pigment	Pigment develop dorsally over the gut, over the midbrain except *Rastrelliger* (develop at postflexion stage), at the tip of the snout except Scombrini, and along the ventral midline of the tail except *Gymnosarda*. Melanophores on the isthmus, operculum, lower jaw and tip of the notochord vary in species. Inner pigment at the anterior tip of the forebrain forms in *Sarda orientalis*, *Euthynnus affinis*, *Katsuwonus pelamis* and *Thunnus tonggol*. Red pigment at the tail forms in some *Thunnus* in life	Mostly pigment over the gut and brain becomes spread. A series of pigment forms at the base of the dorsal fin or dorsal midlines of the trunk and/or tail in Scombrini and some Scomberomorini. A pigment stripe develops on the dorsal, ventral and lateral midlines at the posterior portion of the tail in *Auxis*. Elongate snout anterior to the eye in *Acanthocybium* is heavily pigmented	First dorsal fin is pigmented in Sardini, Thunnini, *Acanthocybium* and *Scomberomorus*. Juveniles often have gold and silver chromatophores on the opercles in life
Similar families	Ambassidae, Blenniidae, Gempylidae, Kyphosidae (*Microcanthus*), Mullidae, Myctophidae (*Lampanyctus*, *Nannobrachium*), Nemipteridae, Pinguipedidae, Pomacentridae, Scombrolabracidae, Sparidae, Terapontidae		

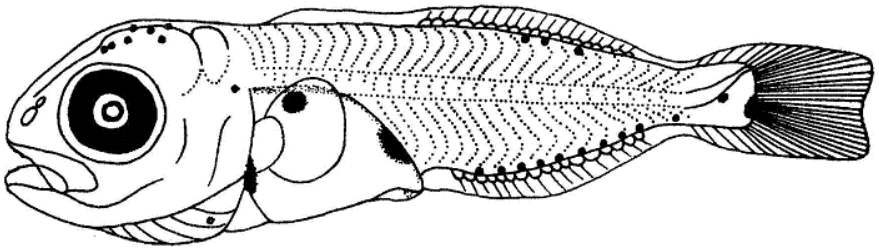
Meristic characters of the Indo-Pacific scombrid genera (Leis and Carson-Ewart, 2000)

	D (finlets)	A (finlets)	P_1	P_2	VERTEBRAE
Sardini					
Cybiosarda	XVI-XVIII, 17-19 (8-10)	15-17 (6-7)	22-24	I, 5	(22-24)+(23-26) = 47-48
Gymnosarda	XIII-XV, 12-14 (6-7)	12-13 (6)	25-28	I, 5	19+19 = 38
Sarda [a]	XVII-IXX, 13-18 (7)	14-17 (6)	23-27	I, 5	(23-24)+(20-22) = 44-46
Scomberomorini					
Acanthocybium [a]	XXIII-XXVII, 12-16 (8-9)	12-14 (9)	22-26	I, 5	(30-32)+(31-33) = 62-64
Grammatorcynus	IX-XIII, 10-12 (6-8)	11-13 (5-7)	21-25	I, 5	(11-12)+(19-20) = 31
Scomberomorus	XIII-XXII, 15-25 (6-11)	16-29 (5-12)	20-26	I, 5	(18-23)+(21-36) = 41-56
Scombrini					
Rastrelliger	VIII-IX, 12 (5)	12 (5)	19-20	I, 5	13+18 = 31
Scomber	IX-XIII, 12 (5)	12 (5)	18-21	I, 5	14+17 = 31
Thunnini					
Auxis	X-XII, 10-12 (8)	11-14 (7)	23-25	I, 5	20+19 = 39
Euthynnus	X-XV, 11-13 (8-10)	13-14 (6-8)	25-29	I, 5	20+19 = 39
Katsuwonus [a]	XIV-XVI, 14-16 (7-9)	14-16 (6-8)	26-27	I, 5	20+21 = 41
Thunnus [a]	XI-XIV, 12-16 (7-10)	11-16 (7-10)	30-36	I, 5	18+21 = 39

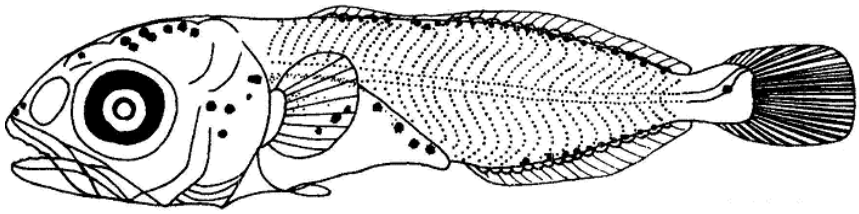
[a] Oceanic, sometimes found near shore.



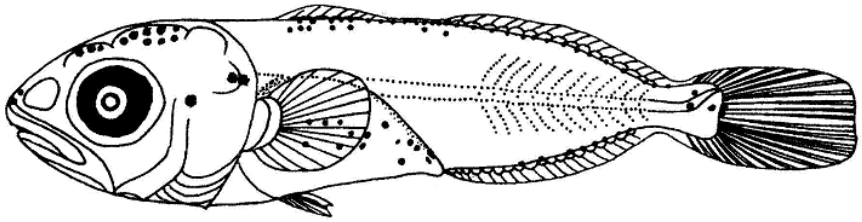
a 4.3 mm SL



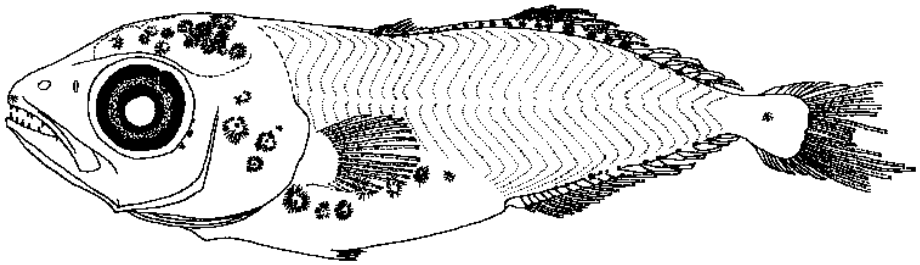
b 6.5 mm SL



c 8.3 mm SL

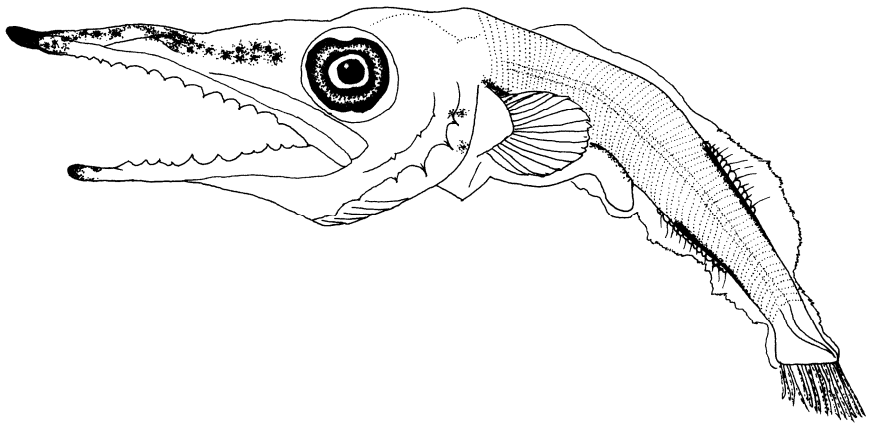


d 9.5 mm SL



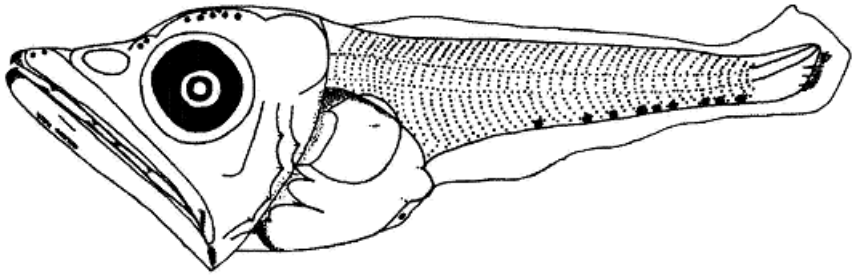
e 10.2 mm SL

Fig. 93 Larvae of *Rastrelliger* spp. from the Andaman Sea (a-d: Puewkhao et al. 2000; e: by Polrong, K.)

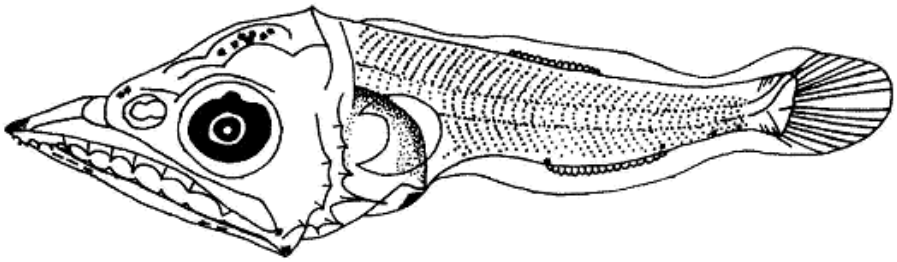


a 7.0 mm SL

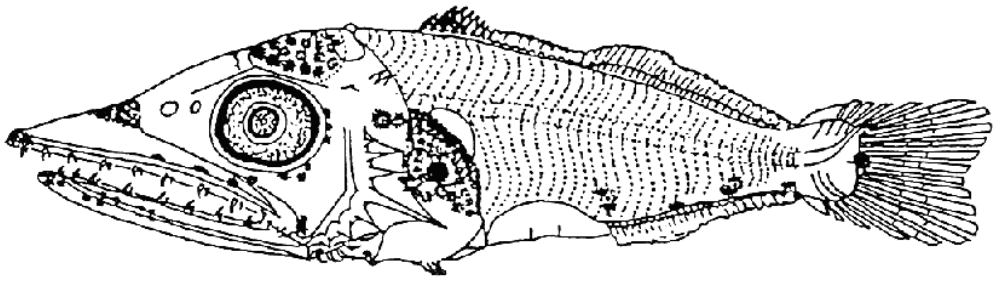
Fig. 94 Larva of *Acanthocybium solandri* from eastern Philippine (by Servidad, R. S.)



a 3.9 mm SL

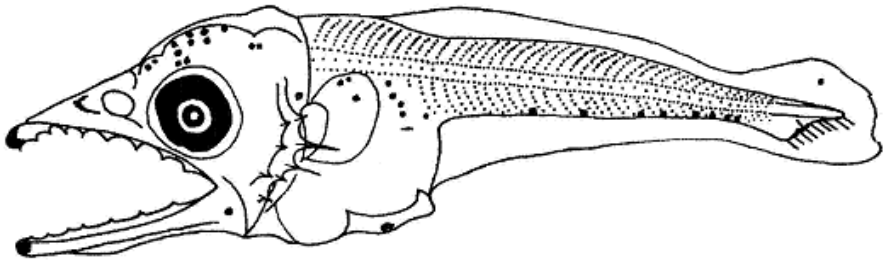


b 6.4 mm SL

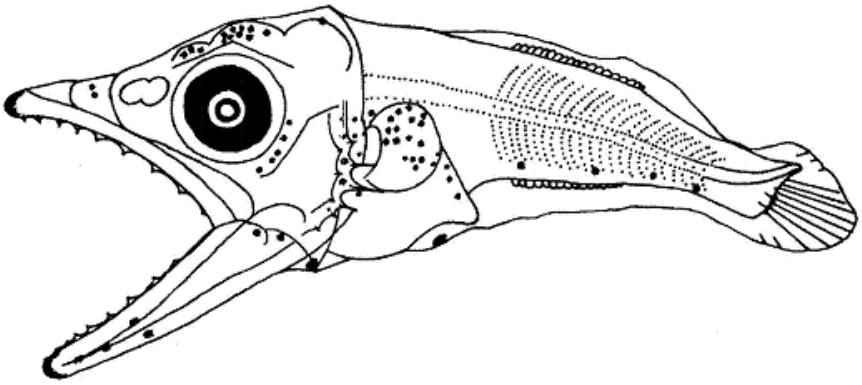


c 10.90 mm TL

Fig. 95 Larvae of *Scomberomorus commerson* from the Andaman Sea (a, b:Puewkhao et al. 2000) and the Gulf of Thailand (c: Chayakul 1996)

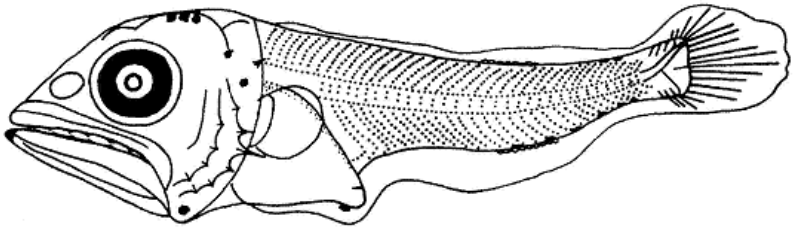


a 5.7 mm SL

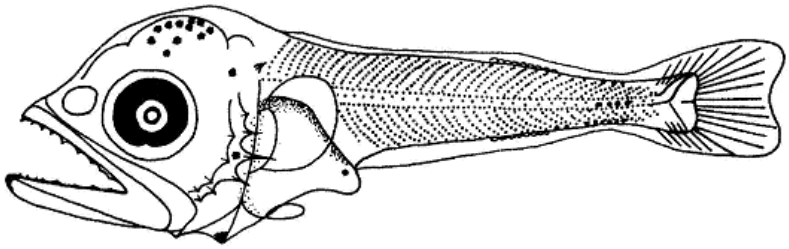


b 5.9 mm SL

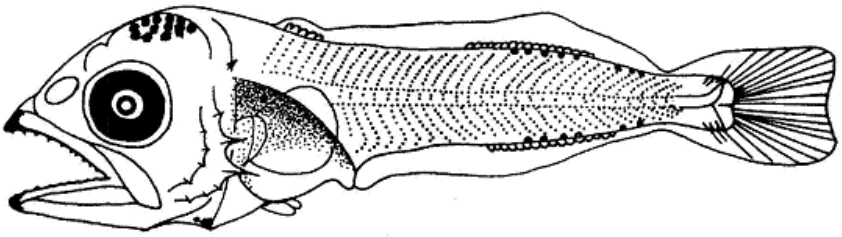
Fig. 96 Larvae of *Scomberomorus guttatus* from the Andaman Sea (Puewkhao et al. 2000)



a 5.2 mm SL

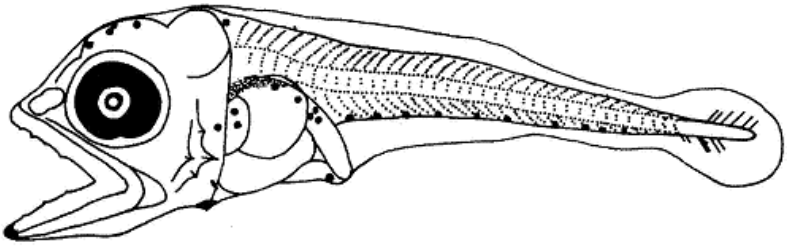


b 5.7 mm SL

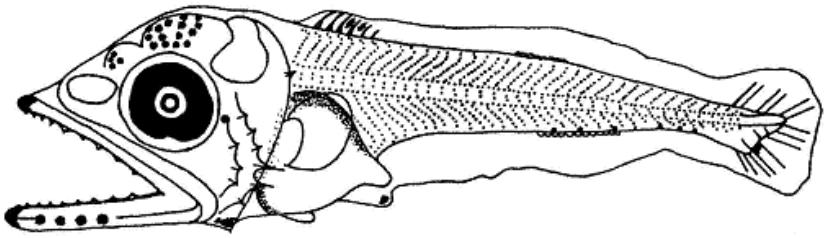


c 6.0 mm SL

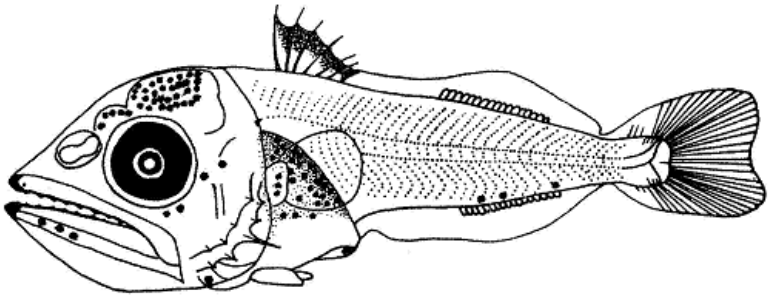
Fig. 97 Larvae of *Auxis thazard* from the Andaman Sea (Puewkhao et al. 2000)



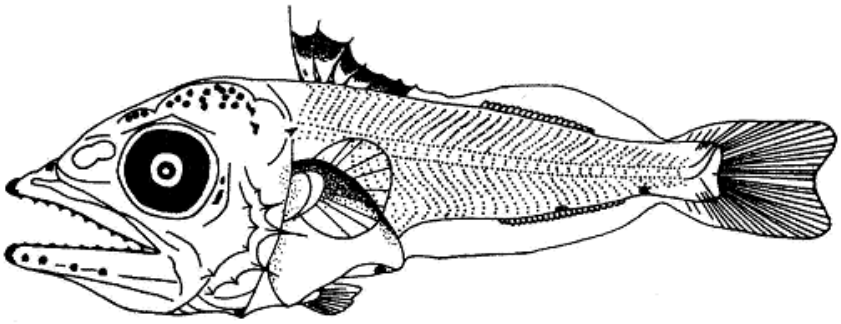
a 3.4 mm SL



b 6.4 mm SL

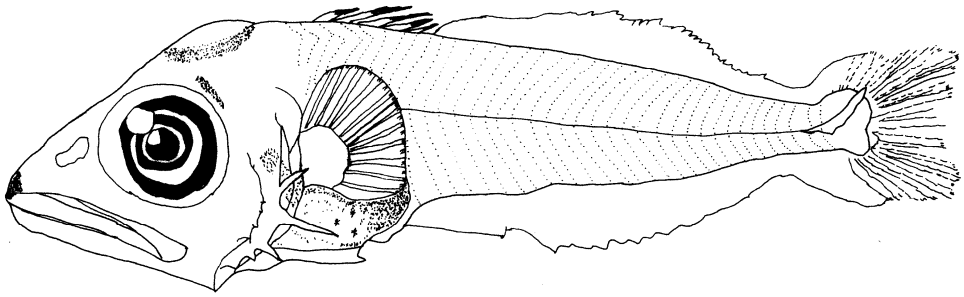


c 7.6 mm SL



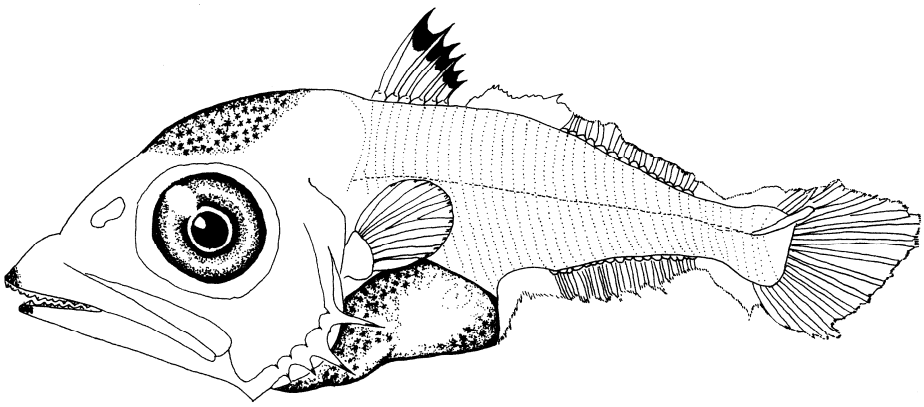
d 7.8 mm SL

Fig. 98 Larvae of *Euthynnus affinis* from the Andaman Sea (Puewkhao et al. 2000)



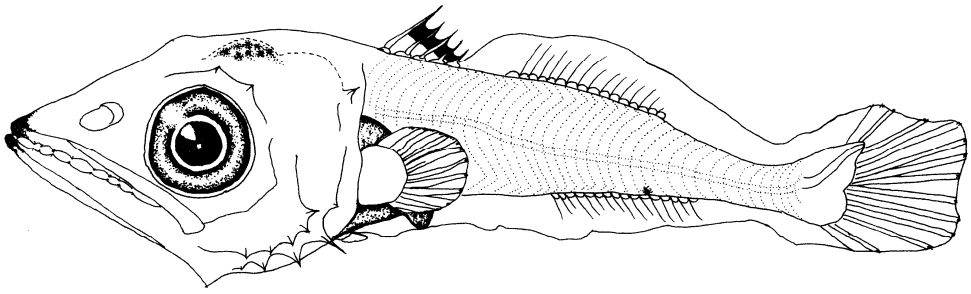
a 8.8 mm SL

Fig. 99 Larva of *Thunnus alalunga* from eastern Philippine (by Servidad, R. S.)



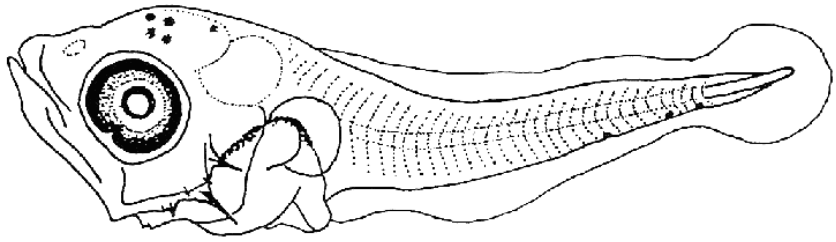
a 5.46 mm SL

Fig. 100 Larva of *Thunnus albacares* from the Andaman Sea (by Servidad, R. S.)

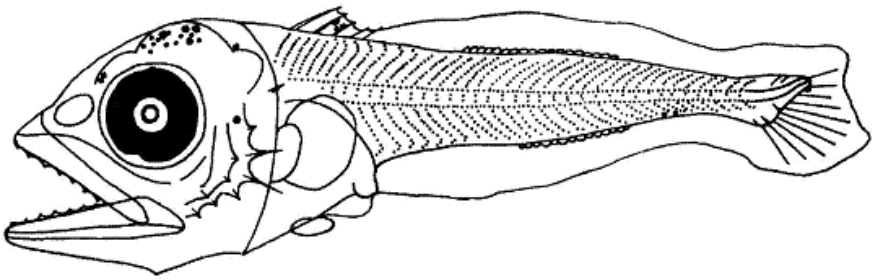


a 5.7 mm SL

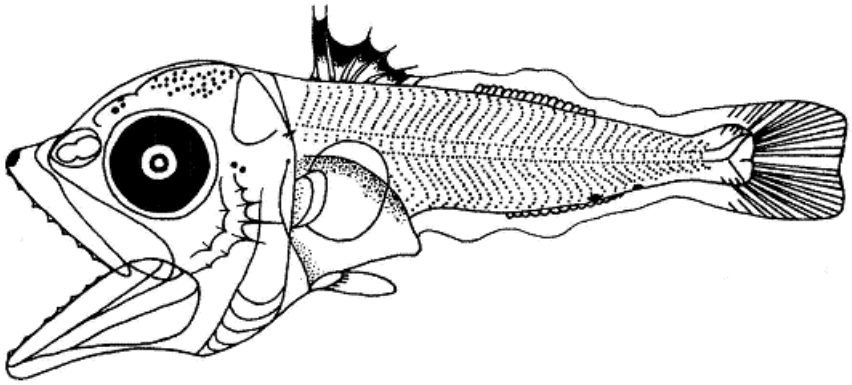
Fig. 101 Larva of *Thunnus obesus* from eastern Philippine (by Servidad, R. S.)



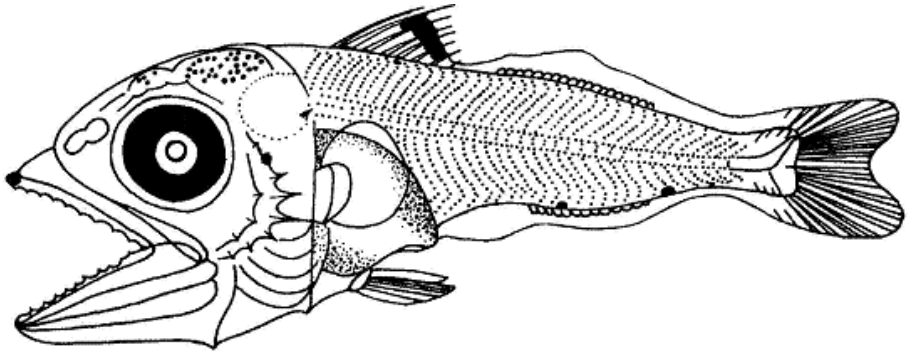
a 4.1 mm TL



b 6.5 mm SL



c 6.8 mm SL



d 7.6 mm SL

Fig. 102 Larvae of *Thunnus tonggol* from the Gulf of Thailand (a: Chayakul 1996) and the Andaman Sea (b-d: Puewkhao et al. 2000)

Order: Perciformes

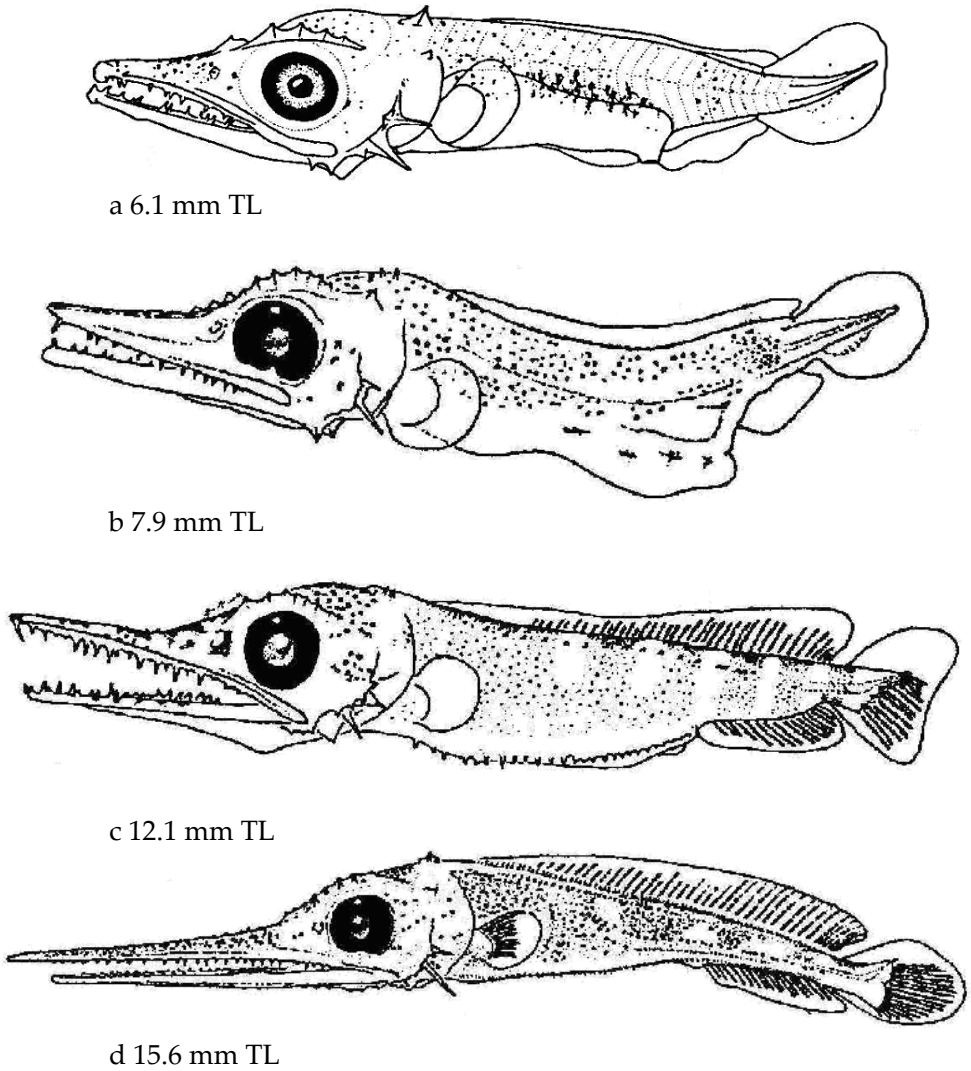
Family: Xiphiidae (Swordfishes)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Moderate to elongate, becomes more elongate with growth	Elongate	Very elongate (BD less than 10% BL)
Gut	Coiled and bulky, reaches to about 75% BL. Anus moves forward with growth	Coiled and bulky, reaches much beyond the mid body	Coiled, reaches much beyond the mid body
Gas bladder	No information available	No information available	No information available
Head	Large and moderately deep, becomes longer with growth due to enlargement of the snout	Very large, becomes shallower	Very large and shallow
Snout	Short, pointed and slightly concave, becomes longer with growth due to protrusion of the both jaws	Elongate like bill	Very elongate like sword
Mouth	Large and slightly oblique, reaches to or beyond the posterior margin of the eye	Very large and horizontal, reaches beyond the posterior margin of the eye (upper jaw protrudes from the lower jaw)	Remarkably large and horizontal, reaches beyond the posterior margin of the eye (upper jaw protrudes from the lower jaw)
Eyes	Large and round, becomes smaller with growth	Large to moderate and round	Moderate to small and round
Head spination	Serrate ridge appears on the frontal and supraocular portion. Spines form on the preopercle and post-temporal. Spinous scales appear on the ventral margins of the gut and tail and on the dorsal margins of the trunk and tail	The frontal and supraocular ridges become more serrated. Small spines appear on the pterotic. Spinous scales extend backward in the dorsal and ventral midlines of the body and begin to form laterally on the body and dorsally on the upper jaw	Spinous scales spread to the caudal fin base and develop in row at the lateral body
Fin formation	Pectoral fin buds form	Dorsal and anal fin anlagen appear, thereafter the fin rays form	All fins have a full complement by about 25 mm. Larvae and juvenile have a single dorsal and anal fin (two in adult). Sequence of fin completion: C-D_2, A-D_1-P_1 (pelvic fin lacking)
Pigment	Melanophores scatter	Pigment becomes dark on the	Dorsal and anal fins are

	heavily on the whole of the head and body except fins	upper half of the body	pigmented, thereafter about nine pigment bands align in the body
Similar families	Chiasmodontidae, Istiophoridae, Scombridae (*Acanthocybium*)		

Meristic characters of the Southeast Asian xiphiid genus

	D	A	P_1	P_2	C	VERTEBRAE
Xiphias	XXXVIII-XLV+4-5	XII-XVI-3-4	17-19	0	9+8	25-27



a 6.1 mm TL

b 7.9 mm TL

c 12.1 mm TL

d 15.6 mm TL

Fig. 103 Larvae of *Xiphias gladius* (a: Collette et al. 1984; b, d: Tåning 1955; c: Arata 1954)

Order: Perciformes

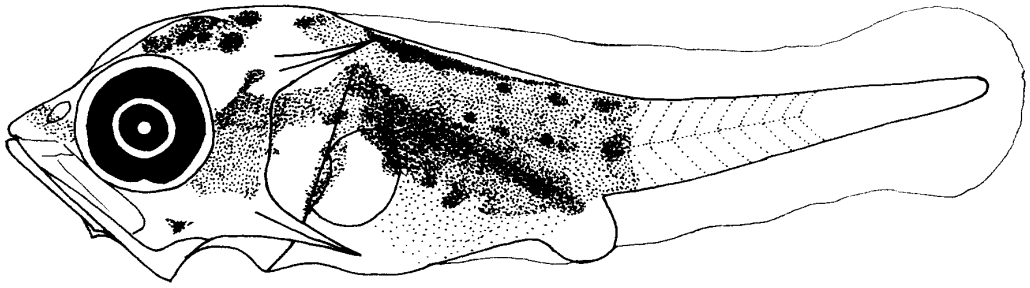
Family: Istiophoridae (Billfishes)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Moderate	Moderate	Moderate (early postflexion) to elongate (late postflexion)
Gut	Coiled, reaches to about 50-60% BL. Preanal length becomes longer with growth	Coiled, reaches to about 60-70% BL	Coiled, reaches to about 70-80% BL
Gas bladder	No information available	No information available	No information available
Head	Moderate to large	Large due to enlargement of the snout	Large due to enlargement of the snout
Snout	Short, pointed and slightly concave. Snout length becomes longer with growth due to protrusion of the both jaws	Triangular or well concave	Elongate like bill
Mouth	Oblique, reaches to the mid eye	Large and oblique, reaches to the posterior edge of the eye	Large, reaches beyond the posterior edge of the eye. Upper jaw protrudes from the lower jaw
Eyes	Large and round, become smaller with growth	Moderate (*Istiophorus*) to large (*Tetrapturus*, *Makaira*) and round	Small (*Istiophorus*) to moderate (*Tetrapturus*, *Makaira*) and round
Head spination	Initially a small spine appears on the pterotic and preopercle, and a bony ridge forms on the supra-ocular portion. Thereafter, the pterotic and preopercle spines possess 3 edges. These edges and the supraocular ridge are serrated	Pterotic spine and preopercle spine at angle become long. Supraocular ridge extends posteriorly and joints with the pterotic spine. Serrated ridge appears on the dentary and articular	Pterotic and preopercle spines become enlarged and direct backward
Fin formation	Pectoral fin buds form	Dorsal and anal fin anlagen appear, thereafter the fin rays form. Pelvic fin buds form	All fins have a full complement at latest by 23 mm. Larvae and juvenile have a single dorsal fin (two in adult)
Pigment	Melanophores scatter on the head and dorsal midline of the trunk, and over the gut	Trunk and head become heavily pigmented	Whole body except the caudal peduncle and fins become black, thereafter the first dorsal fin is well pig-

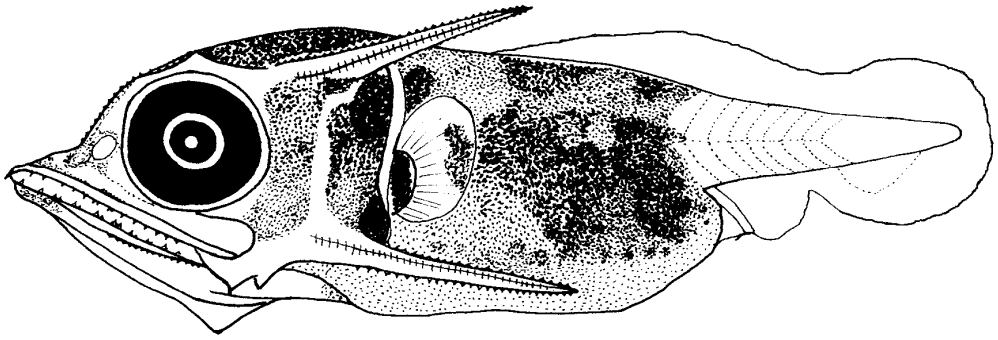
			mented
Similar families	Malacanthidae (*Hoplolatilus*), Holocentridae, Symphysanodontidae		

Meristic characters of the Southeast Asian istiophorid genera

	D	A	P_1	P_2	C	VERTEBRAE
Istiophorus	XXXIX-XLVIII+6-8	XII-XV+5-8	17-20	I, 2	9+8	24
Makaira	XXXVIII-XLIV+6-7	XII-XIV+5-8	19-23	I, 2	9+8	24
Tetrapturus	XXXVII-LII+5-7	XI-XVIII+5-7	18-23	I, 2	9+8	24



a ca 3.3 mm SL



b ca 5.2 mm SL

Fig. 104 Larvae of Istiophoridae sp. from the Andaman Sea (by Termvidchakorn, A.)

Order: Perciformes

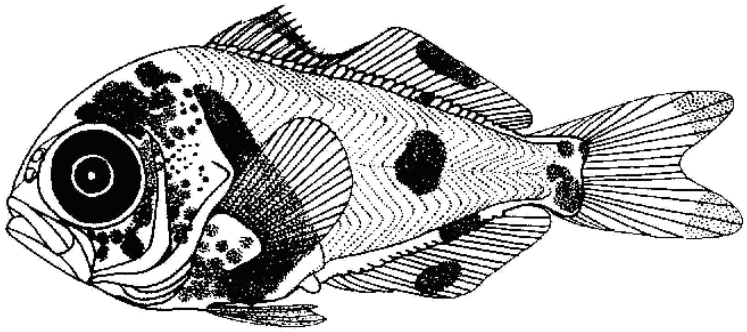
Family: Nomeidae (Driftfishes)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Elongate to moderate and compressed, becomes deeper with growth	Moderate and compressed	Mostly deep and very compressed
Gut	Coiled and triangular, extends to 40 to 50% BL. Gut becomes longer with growth	Coiled and triangular, extends to 50 to 60% BL	Coiled and triangular, extends to 50 to 65% BL
Gas Bladder	No information available	No information available	No information available
Head	Moderate and rounded dorsally, becomes larger with growth	Moderate to large and rounded dorsally	Large to moderate and rounded dorsally
Snout	Short and triangular in profile	Short, steeply sloped and round	Short, steeply sloped and round
Mouth	Oblique, reaches to the anterior margin of the eye	Oblique, reaches to about the mid pupil	Oblique, reaches to about the mid pupil
Eyes	Large and round	Large and round	Large and round
Head spination	Not yet appear	Weak preopercle spines are present	Weak preopercle spines still remain, and eventually disappear at juvenile stage
Fin formation	Pelvic fin precociously forms and becomes fairly elongate in *Nomeus* and *Psenes* (the buds appear at postflexion in *Cubiceps*)	Dorsal and anal anlagen form, thereafter the incipient rays develop	Full completion of all fins is achieved at latest by 8 mm. Sequence of fin completion: C-D_2, A, P_1-D_1, P_2 (*Cubiceps*); P_2-D, A, P, C (*Nomeus*); P_2-D_1-C-D_2, A-P_1 (*Psenes*)
Pigment	A series of pigment spots is present along the ventral edge of the tail (except for *C. pauciradiatus*). Three stripes are present on the dorsal, lateral and ventral midlines at the mid tail region in *C. pauciradiatus*, *P. arafrensis* and *P. pellucidus*. Early-forming pelvic fin is pigmented in *Nomeus* and *Psenes*. Head over the eyes is pigmented (at flexion in *Psenes*). Dorsal surface and ventral margin of the gut	Pigment spot on the head and body increases. Pigment patch in the caudal-fin base develops in *Psenes* and *Nomeus*. Melanophores appear on the caudal fin in *Psenes*	Ventral pigment spot series in the tail disappear. Pigment spot series along the first dorsal fin forms in *Psenes*. A wide, vertically pigment band from the anterior dorsal fin across the gut forms in *Nomeus* (3 to 4 bands on the body at juvenile)

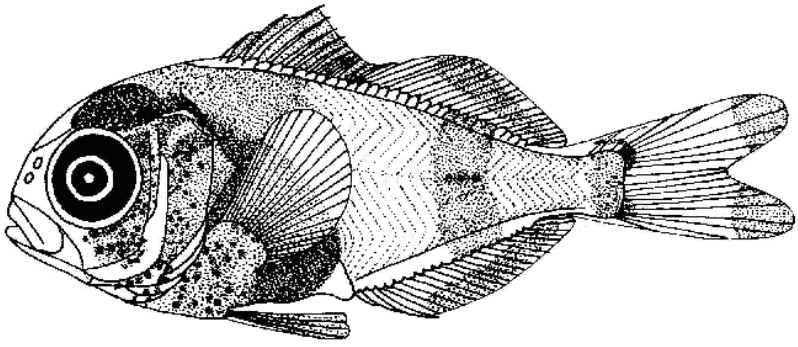
	and tips of the both jaws are pigmented. Inner stripe aligns from the tip of the snout to the upper opercle in *C. baxteri*		
Similar families	Ariomatidae, Centrolophidae, Emmelichthyidae, Pomacentridae, Stromateidae		

Meristic characters of the Southeast Asian nomeid genera

	D	A	P_1	P_2	C	VERTEBRAE
Cubiceps	X-XII+I-II, 15-27	I-III, 14-24	17-23	I, 5	9+8	30-32
Nomeus	IX-XII+I-II, 23-28	I-II, 24-29	19-24	I, 5	9+8	41
Psenes	IX-XII+I-II, 18-32	II-III, 20-35	17-20	I, 5	9+8	31-44



a ca 9.0 mm SL



b ca 13.2 mm SL

Fig. 105 Larvae of *Psenes* sp. from the Andaman Sea (by Termvidchakorn, A.)

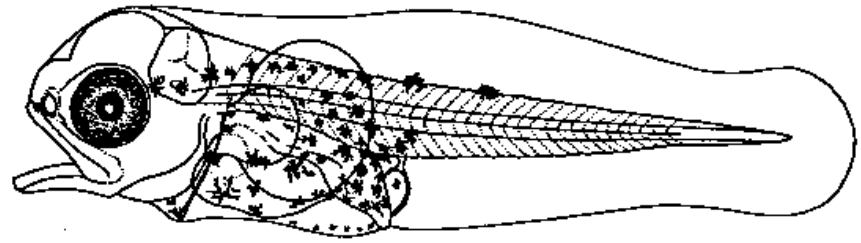
Order: Perciformes

Family: Stromateidae (Butterfishes)

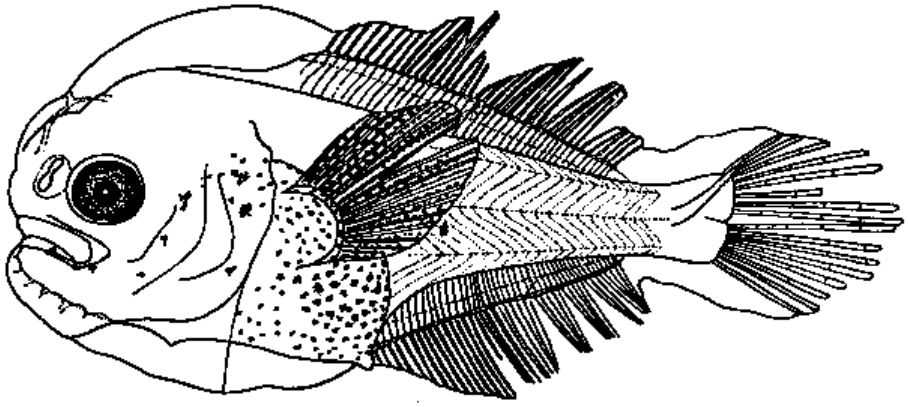
Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Moderate, becomes deeper and compressed with growth	Moderate to deep, oval in shape and strongly compressed	Deep, oval in shape and strongly compressed. The tail is tapered
Gut	Initially straight, thereafter coiled and reaches to the mid body. Preanal length becomes shorter with growth	Coiled and triangular, reaches near the mid body	Coiled and deep, reaches anterior to the mid body
Gas bladder	Absent	Absent	Absent
Head	Moderate and round, becomes larger with growth	Large and round	Large and round
Snout	Short and round, becomes slightly longer with growth	Moderate in size and blunt	Blunt and slightly protrusive
Mouth	Oblique and terminal, reaches to the mid pupil	Nearly horizontal and slightly inferior, reaches to the mid pupil	Nearly horizontal and inferior due to protrusion of the snout, reaches to the mid pupil
Eyes	Initially large, thereafter moderate and round	Moderate and round	Moderate and round
Head spination	None	None	None
Fin formation	Pectoral fin buds form	Long-based anlagen of the dorsal and anal fins form, and the incipient rays of the both and other fins develop (pelvic fin lack for life). Dorsal- and anal-fin pterygiophores are well developed	Spines of the dorsal and anal fins form (the spines are very small or embedded at adult). Caudal and pectoral fins become large. A full complement of all fin rays is attained at latest by 15 mm
Pigment	Stellate melanophores are scattered on the otic region posterior to the eye and laterally on the gut and trunk. Tips of both jaws are pigmented	Pigment on the gut and opercular region increases in number	Opercular region, gut, trunk and anterior tail become heavily pigmented. Pectoral fin is pigmented, later melanophores appear on the origin of the dorsal fin and caudal-fin base in some species
Similar families	Carangidae, Centrolophidae, Nomeidae		

Meristic characters of the Southeast Asian stromateid genus

	D	A	P_1	P_2	C	VERTEBRAE
Pampus	V-XI, 40-50	III-VII, 38-48	24-27?	0	9+8	34-37?

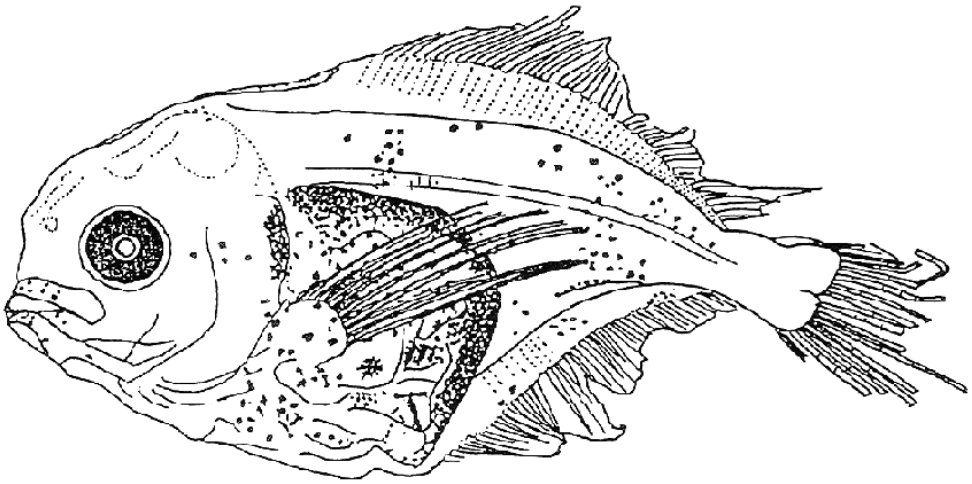


a 4.1 mm SL

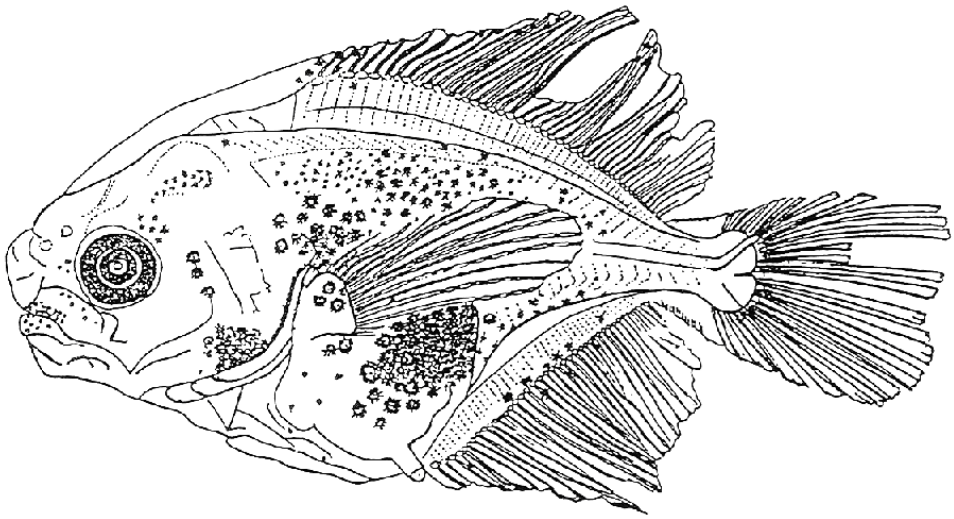


b 6.5 mm SL

Fig. 106 Larvae of *Pampus argenteus* from southern Japan (a: Mito and Senta 1967; b: by Mito, S.)



a 12.1 mm TL



b 15.1 mm TL

Fig. 107 Larvae of *Pampus* sp. from the Gulf of Thailand (Chayakul 1996)

Order: Pleuronectiformes

Family: Psettodidae (Spiny turbots)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Moderate to deep, laterally compressed and bilaterally symmetrical	Deep and strongly laterally compressed	Deep and strongly laterally compressed
Gut	Coiled and moderately thick, reaches to the mid body. End portion of the gut drops steeply downwards toward the anus	Tightly coiled and moderately thick, reaches to the mid body	Tightly coiled and moderately thick, reaches to the mid body
Gas bladder	Small to moderate over the anterior portion of the gut	Small to moderate over the anterior portion of the gut	Small to moderate over the anterior portion of the gut
Head	Moderate to large with a steep dorsal profile	Large with a steep dorsal profile	Large with a gradual dorsal profile
Snout	Moderate and concave	Moderate and concave	Moderate and broadly convex
Mouth	Large and oblique, reaches to the anterior margin of the eye. Lower jaw protrudes from the upper jaw through larval stage. Recurved canine teeth form on both jaws	Very large and oblique, reaches beyond the posterior margin of the eye	Very large and oblique, reaches beyond the posterior margin of the eye. Canine teeth become large
Eyes	Moderate and round, become relatively smaller with growth	Moderate and round. Dextral or sinistral eye starts to migrate at about 8.0 mm	Moderate to small and round. The moving eye reaches the dorsal midline of the head by about 10 mm
Head spination	Small spines form posteriorly on the preopercle	Preopercular spines increase in number	Spination on the preopercle disappeas at latest by about 15 mm
Fin formation	Anterior dorsal fin with 9-10 elongate, spine-like rays forms at the nape. Pelvic-fin buds form at the thorax	All rays of the long-based dorsal and anal fins form. Incipient pectoral-fin rays begin to form	Pelvic- and pectoral-fin rays form completely. Dorsal-fin origin is still located posterior to the eye. Full completion of all fins is achieved by about 10 mm. Sequence of fin completion: D, A-P_2-P_1
Pigment	Four large, well-spaced pigment spots form on the dorsal midline from the nape to the posterior of the tail (the posteriormost spot opposes another pigment spot on the ventral midline,	Pigment spreads laterally from the head to the tail except the caudal peduncle	Entire body except the caudal peduncle and the caudal fin is covered by large, stellate melanophores with heavily pigmented areas at the posterior portions of the tail and gut, and in the snout

	and the both persist until metamorphosis). Ventral midlines of the lower jaw, gut and tail are pigmented. Small melanophores scatter on the pectoral fin and brain		
Similar families	Bothidae (S**), Citharidae (D* or S**), Paralichthyidae (S**), Poecilopsettidae (D*), Samaridae (D*), Soleidae (D*)		

* D: eyes dextral

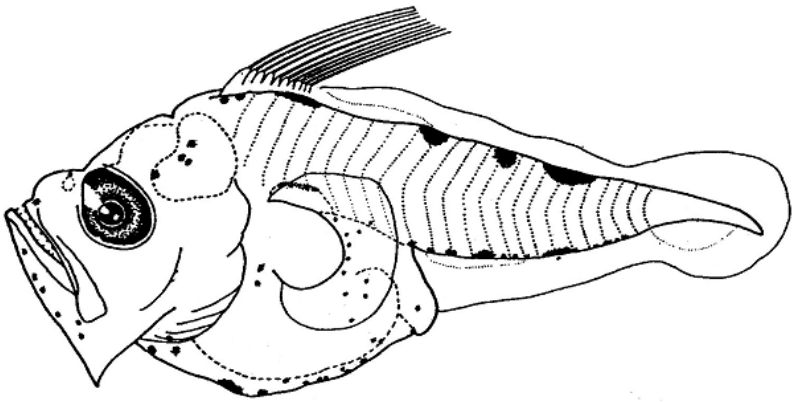
** S: eyes sinistral (in paralichthyid *Tephrinectes sinensis* some dextral individuals occur)

Meristic characters of the Indo-Pacific psettodid genus (Leis and Carson-Ewart, 2000)

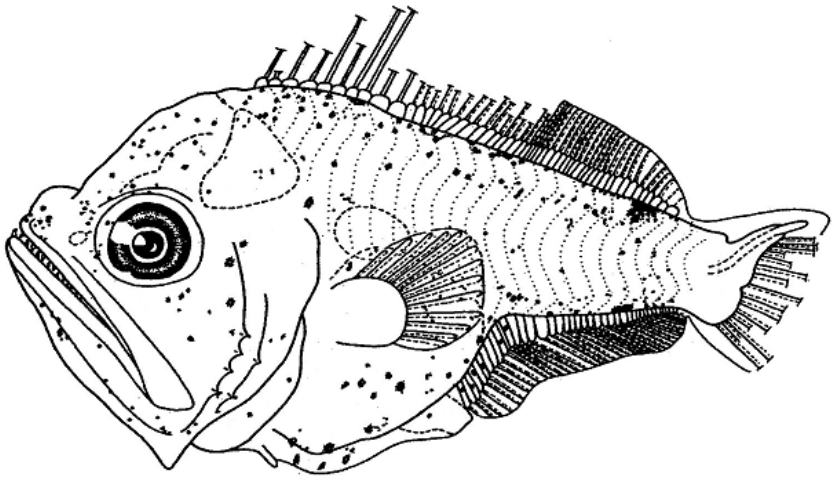
	D[a]	A[b]	P_1	P_2	C	VERTEBRAE
Psettodes	50-56	34-43	14-16	I, 5	9+8	10+14 = 24

a First 10 or so rays unsegmented and spine-like.

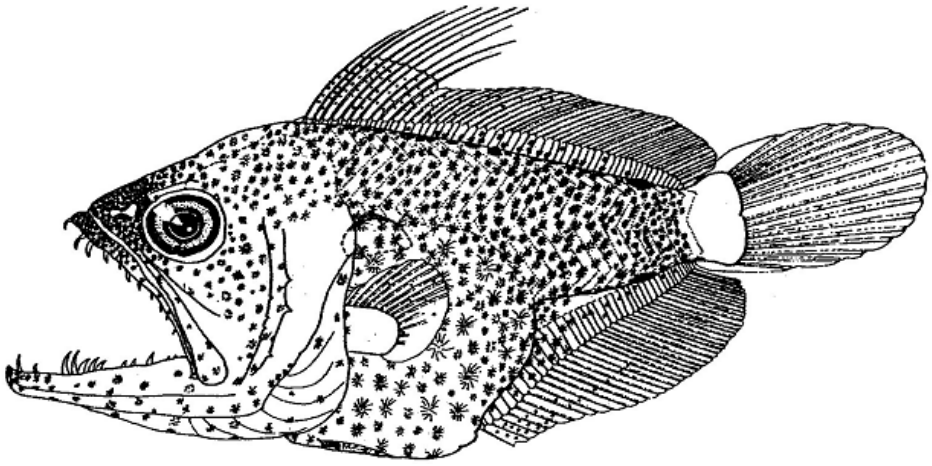
b First ray unsegmented and spine-like.



a 4.3 mm SL



b 5.3 mm SL



c 8.7 mm SL

Fig. 108 Larvae of *Psettodes erumei* from the Great Barrier Reef (Brunton et al. 2000)

Order: Pleuronectiformes

Family: Paralichthyidae (Bastard halibuts, shortfin flounders)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Moderate in depth at the head and trunk, elongate at the tail and cylindrical in cross-section, and bilaterally symmetrical	Moderate in depth and laterally compressed	Deep and oval, and laterally compressed
Gut	Initially straight, and later coiled and downward inflated, reaches to about the mid body. Preanal length becomes shorter with growth	Tightly coiled and still inflated, reaches anterior to the mid body	Tightly coiled, reaches to about 30% BL
Gas bladder	Absent	Absent	Absent
Head	Moderate with a steep dorsal profile, becomes slightly larger with growth	Moderate with a steep dorsal profile	Moderate and concave in conjunction with eye migration
Snout	Short and angular	Short and angular	Short and round
Mouth	Moderate and oblique, reaches to the mid eye	Moderate to large and oblique, reaches to the mid eye	Large and oblique, reaches to the mid point of the left eye
Eyes	Small and round	Moderate and round. Right eye begins to move to the left side of the body	Moderate and round. Right-side eye migrates to the dorsal midline of the head (some *Tephrinectes sinensis* have dextral eyes)
Head spination	Mostly minute spines form on the preopercle. Otic region of the head has tiny spines in some species	Minute spines develop on the opercle, interopercle, subopercle and supracleithral in some species	Head spination reduces in size
Fin formation	First 4-13 rays of the dorsal fin early form at the nape and are elongate through larval stage	Long anlagen of the anal fin and the remaining dorsal fin appear, thereafter their incipient rays form. Pelvic-fin buds form (just before flexion in some species) at the thorax	Dorsal-fin origin moves to the snout after completion of eye migration. Pectoral-fin rays form after settlement. Full completion of all fins except the pectoral fin is achieved by about 9 mm. Sequence of fin completion: C-D-A-P_2-P_1
Pigment	Melanophores are generally present dorsally and ventrally on the gut, ventrally on the head and along the	Melanophores are present on the anterior, elongate dorsal fin, pelvic fin-buds and fin-folds in some species	Pigmentation becomes intense on the body in the eye-side. Sometimes pigment blotches on the dorsal and

	dorsal and ventral midlines of the trunk and tail. Some taxa develop melanophores on the brain and operculum and a diffuse pigment band at the posterior tail		anal fins, and pigment spots along the myosepta in the trunk and tail form
Similar families	Bothidae (S**), Citharidae (D* or S**), Cynoglossidae (S**), Poecilopsettidae (D*), Psettodidae (D* or S**), Samaridae (D*), Soleidae (D*)		

* D: eyes dextral

** S: eyes sinistral

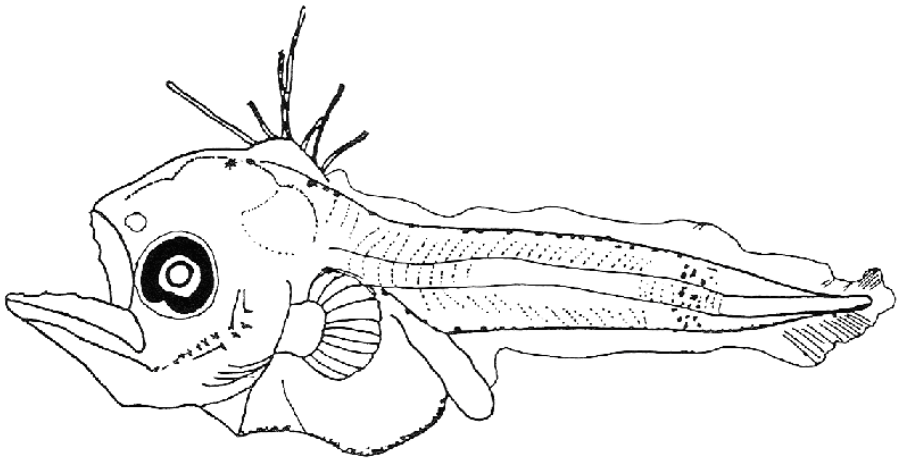
Meristic characters of the Indo-Pacific paralichthyid genera (modified from Leis and Carson-Ewart (2000))

	D	A	P_1[a]	P_2	C	VERTEBRAE
Cephalopsetta	65-68	47-50	12	6	17	32-33
Paralichthys	66-84	49-63	10-13	6	18	10+(27-29) = 37-39
Pseudorhombus	61-89	49-67	9-13	6	17-18	10+(23-29) = 33-39
Tarphops [b]	59-70	47-56	10-11	6	17	10+(23-26) = 33-36
Tephrinectes [c]	46-49	34-39	11-13	6	17	10+17 = 27

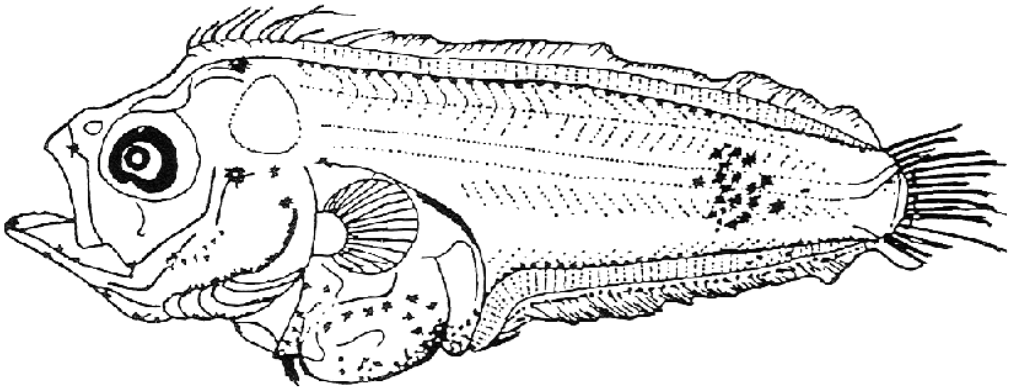
[a] Left (ocular) side.

[b] Known from Japan, South Korea and Taiwan.

[c] Only *T. sinensis* is reported from China and Taiwan.



a 3.6 mm TL



b 7.1 mm TL

Fig. 109 Larvae of *Pseudorhombus* sp. from the Gulf of Thailand (Chayakul 1996)

Order: Pleuronectiformes

Family: Bothidae (Lefteye flounders)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Moderate in depth, extremely laterally compressed and bilaterally symmetrical. Mostly anterior half of the body is squarish and the tail is tapering	Moderate to deep and strongly laterally compressed	Moderate (e.g., *Arnoglossus*, *Chascanopsetta*, *Laeops*), deep (e.g., *Asterorhombus*, *Engyprosopon*), very deep (e.g., *Bothus*, *Grammatobothus*, *Taeniopsetta*) and strongly laterally compressed
Gut	Coiled, reaches to about 50% BL. Preanal length becomes shorter with growth	Coiled, reaches to 33-50% BL. Mostly the gut protrudes downward	Coiled, reaches to 15-33% BL in the late stage. *Laeops* and *Chascanopsetta* have a trailing gut
Gas bladder	Small to moderate, usually inflated at night	Small to moderate, usually inflated at night	Initially inconspicuous, and disappears before the right eye begins to migrate
Head	Moderate and squarish, becomes relatively smaller and more rounded with growth	Moderate, becomes deep due to enlargement of the urohyal bone	Small to moderate and round
Snout	Steep and concave. Anterior projection of the dorsal-fin base develops like a rostrum in *Arnoglossus*, *Chascanopsetta*, *Laeops* and *Parabothus*	Steep and concave	Steep to slightly round. Anterior projection of the dorsal-fin base becomes slightly reduced
Mouth	Small and oblique, mostly does not reaches to the anterior margin of the eye	Small and oblique, mostly does not reaches to the anterior margin of the eye	Small and oblique, mostly does not reaches to the anterior margin of the eye
Eyes	Moderate and round to elliptical with lunate choroid tissues, becomes relatively smaller with growth	Moderate to small and round	Small to moderate and round. Right eye migrates to the left side of the body through a hole between the dorsal-fin base and the cranium or a narrow slit in the dorsal profile at 13-125 mm. Choroid tissues disappear during eye migration
Head spination	Small spines develop on the head and thoracic portion through larval stage in some genera: on the urohyal and posterior pel-	Spines which form at preflexion stage in some genera increase in number	Posterior pelvic process has spines in *Crossorhombus* and some *Grammatobothus*. Head and thoracic spination is lost before settlement

	vic process (*Asterorhombus*, *Engyprosopon*, some *Psettina*, *Taeniopsetta*), on the cleithral (*Asterorhombus*, some *Engyprosopon*, *Taeniopsetta*) and on the epiotic (*Asterorhombus*, *Taeniopsetta*). Other genera (*Arnoglossus*, *Bothus*, *Chascanopsetta*, *Laeops*, some *Psettina*, *Tosarhombus*) have no spination through larval stage		
Fin formation	Initially an elongate dorsal-fin ray (usually the 2nd ray, but 3-4 elongate rays in *Grammatobothus*, and 9-10 in *Parabothus*) forms over the head, later anlagen of the other dorsal and anal fins develop and their incipient rays begin to form. Pelvic-fin buds form at the thoracic region between the urohyal and posterior pelvic process in some species (others at flexion)	Dorsal- and anal-fin rays develop. The anterior, elongate dorsal-fin ray(s) shorten in most taxa	Dorsal-fin origin moves anteriorly onto the snout. Dorsal, anal and asymmetrical pelvic fins form completely by 5-9 mm. Dorsal- and anal-fin pterygiophores are well developed and opaque at the proximal portion unlike Poecilopsettidae and Samaridae. Pectoral-fin rays develop after settlement. Sequence of fin completion: D, A-C-P_2-P_1
Pigment	Generally sparse to absent through larval stage. Ventral midlines of the head and gut, the dorsal surface of the gas bladder and the posterior tail are pigmented in some species	Sparse to absent	Pigment develops on the dorsal and ventral margins of the body, on the head and dorsal, anal and pelvic fins, on the fleshy membranes of the elongate dorsal-fin rays, and as spots or blotches laterally on the body in some species. Orange-colored pigment is present along the dorsal- and anal-fin bases and myosepta in the tail in some species (this pigment is lost after preservation)
Similar families	Citharidae (D* or S**), Cynoglossidae (S**), Paralichthyidae (S**), Poecilopsettidae (D*), Psettodidae (D* or S**), Samaridae (D*), Soleidae (D*)		

* D: eyes dextral

** S: eyes sinistral (in paralichthyid *Tephrinectes sinensis* some dextral individuals occur)

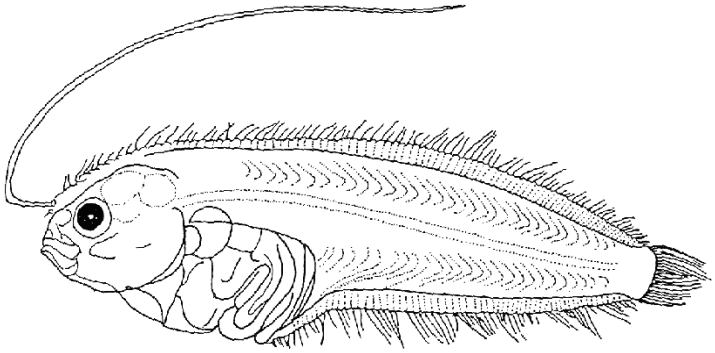
Meristic characters of the Indo-Pacific bothid genera (modified from Leis and Carson-Ewart (2000))

	D	A	P_1[a]	P_2	C	VERTEBRAE
Bothinae						
Arnoglossus	79-121	61-101	8-16	6	16-18	(10-12)+(27-38) = 37-48
Asterorhombus	77-89	55-69	9-12	6	17	10+(25-27) = 35-37
Bothus	84-104	61-81	8-13	6	16-17	10+(25-32) = 35-42
Chascanopsetta	106-133	71-98	13-17	6	17	(15-18)+(34-44) = 50-61
Crossorhombus	79-93	59-74	9-13	6	17	10+(24-27) = 34-37
Engyprosopon	70-96	53-74	9-13	6	17	10+(23-28) = 33-38
Grammatobothus	75-93	61-77	13-17	6	17	10+(27-30) = 37-40
Japonolaeops	109-125	90-101	12-16	6	17	(10-11)+(41-44) = 51-53
Kamoharaia	109-112	84-86	15-16	6	17	(13-14)+(37-39) = 50-53
Laeops	85-116	67-96	11-16	6	17	(10-12)+(35-42) = 46-53
Lophonectes [b]	87-93	71-77	11-12	6	17	10+(32-33) = 42-43
Neolaeops	106-110	83-87	14-15	6	17	13+38 = 51
Parabothus	83-121	63-99	11-15	6	17	10+(30-37) = 40-47
Psettina	78-103	60-80	8-13	6	17	10+(26-30) = 36-40
Tosarhombus [c]	96-109	76-85	12-14	6	17	10+(28-32) = 38-42
Taeniopsettinae						
Taeniopsetta	83-97	67-81	12-16	6	16-18	10+(30-32) = 40-42

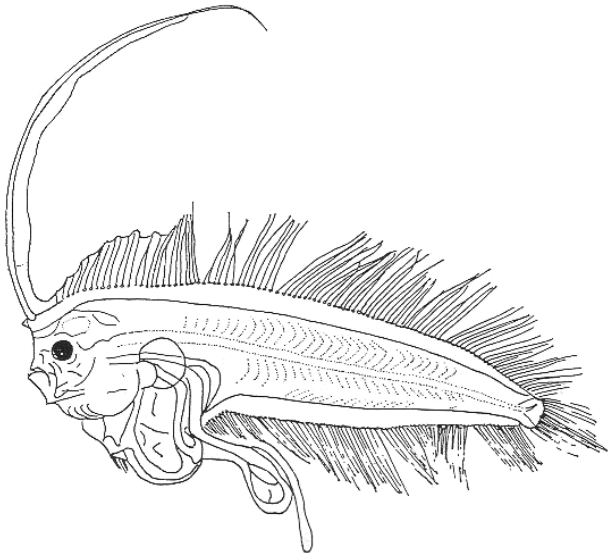
[a] Left (ocular) side

[b] Known from southern Australia and New Zealand.

[c] Known from New Caledonia.

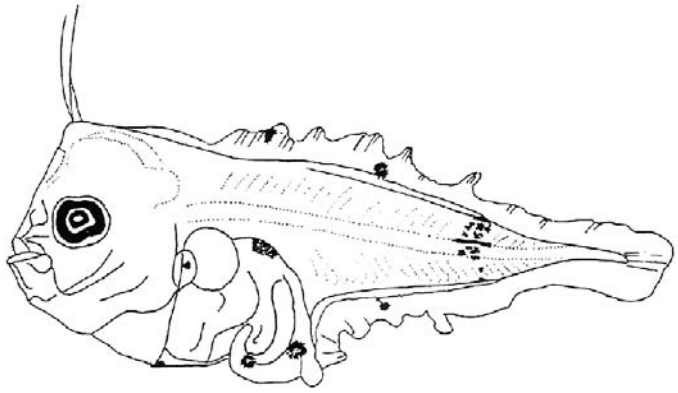


a 12.7 mm TL

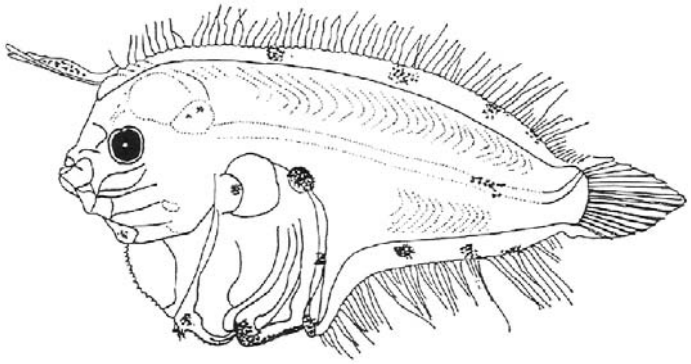


b 17.6 mm TL

Fig. 110 Larvae of *Arnoglossus* sp. from the Gulf of Thailand (Chayakul 1996)

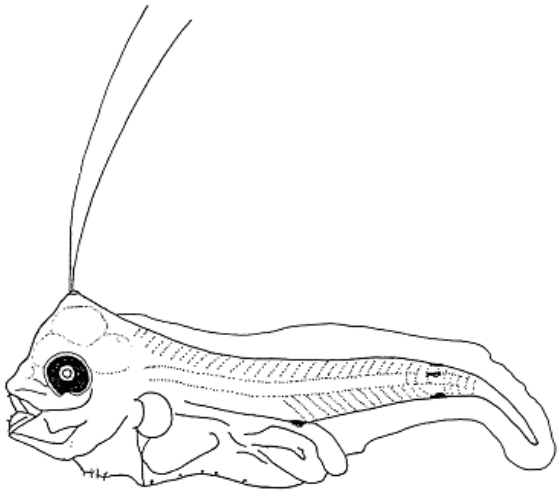


a 4.0 mm TL

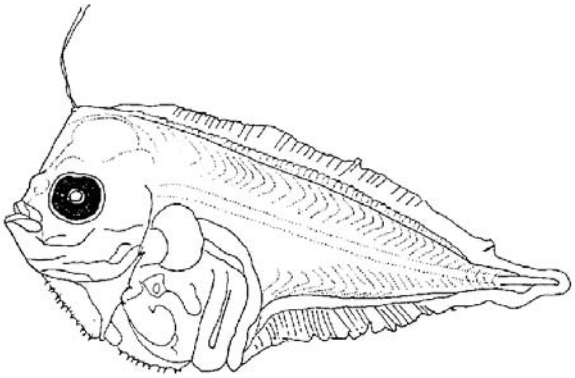


b 6.9 mm TL

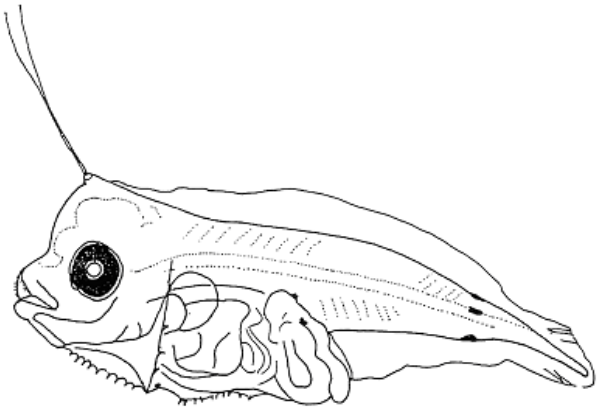
Fig. 111 Larvae of *Asterorhombus* sp. from the Gulf of Thailand (Chayakul 1996)



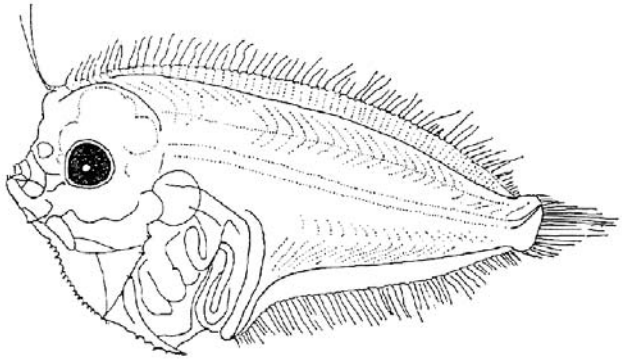
a 2.9 mm TL



c 4.5 mm TL

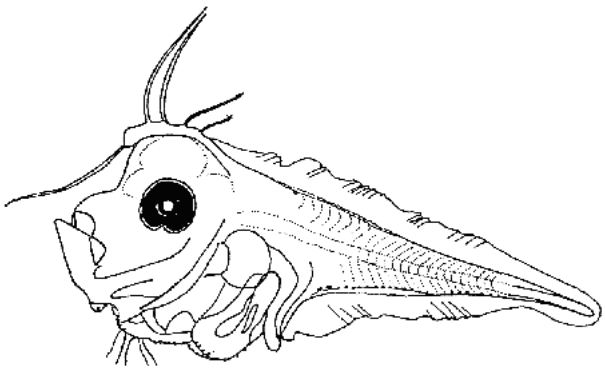


b 3.5 mm TL

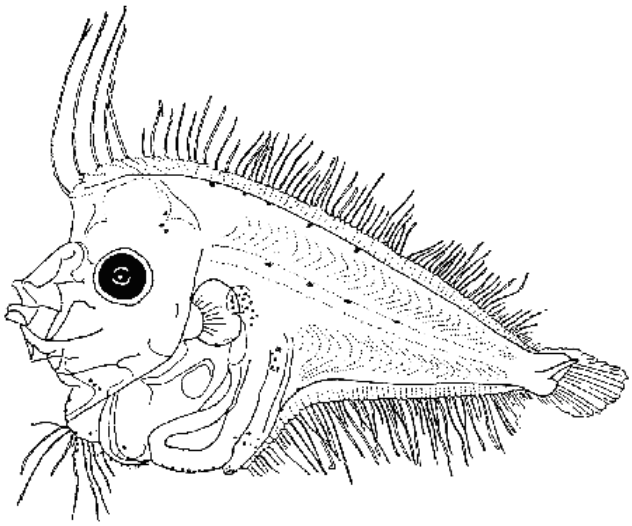


d 6.8 mm TL

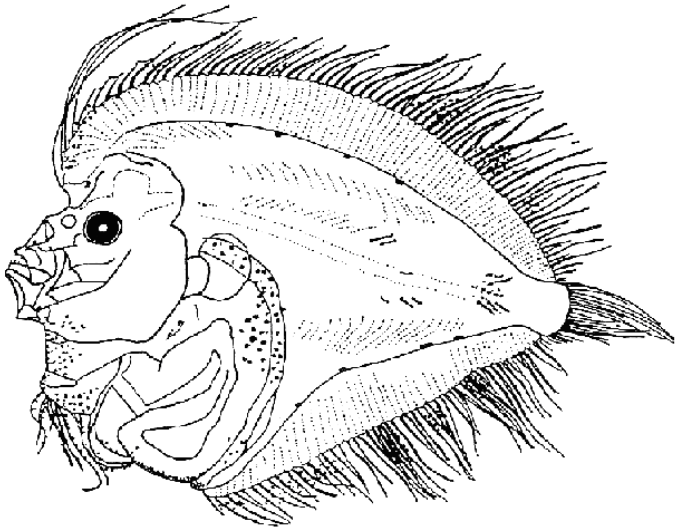
Fig. 112 Larvae of *Engyprosopon* sp. from the Gulf of Thailand (Chayakul 1996)



a 4.0 mm TL

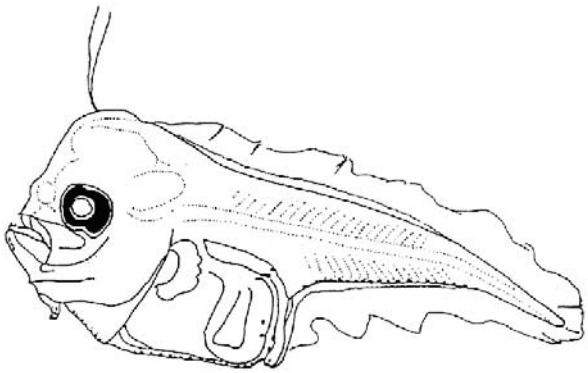


b 7.1 mm TL

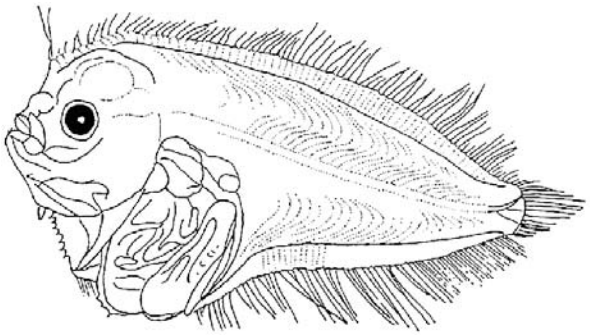


c 14.2 mm TL

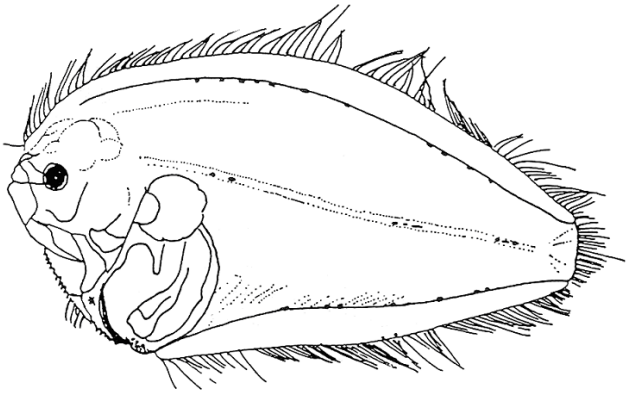
Fig. 113 Larvae of *Grammatobothus polyophthalmus* from the Gulf of Thailand (Chayakul 1996)



a 3.6 mm TL



b 8.2 mm TL



c 15.2 mm TL

Fig. 114 Larvae of *Psettina* sp. from the Gulf of Thailand (Chayakul 1996)

Order: Pleuronectiformes

Family: Cynoglossidae (Tonguefishes)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Slightly deep at the head and trunk, elongate (Cynoglossinae) to tapering (Symphurinae) at the tail, laterally compressed and bilaterally symmetrical	Tail becomes deeper, but remains less deep than the head and trunk	Moderate in depth, elliptical in shape and extremely laterally compressed
Gut	Thick and coiled with a large loop, protrudes markedly from the ventral body margin through larval stage. Anus is slightly trailing and located in 30-40% BL	Thick and coiled with a large loop, protrudes markedly from the ventral body margin, and reaches to 30-40% BL	Coiled, retracts within the body margin in transforming larvae and then reaches to 23-30% BL
Gas bladder	Small (inflated at night) over the posterior portion of the gut	Small (inflated at night) over the posterior portion of the gut	Small (inflated at night), but disappears during transformation
Head	Small, round and deep. Bases of the anterior, elongate dorsal rays are slightly enlarged	Small, round and deep. Enlarged bases of the elongate dorsal rays grow, incipiently become a rostral hook and begin to move onto the snout	Small and deep. Incipient rostral hook moves downward over the snout and then a gap develops between the rostral hook and the snout. The gap closes due to fusion of the hook and snout just after completion of the right-eye migration
Snout	Short and steep to round	Short and convex	Convex to round, becomes relatively longer due to growth of the rostral hook
Mouth	Oblique and terminal, reaches to the posterior margin of the pupil	Oblique to horizontal and terminal, reaches to the posterior margin of the pupil or beyond it	Initially horizontal and terminal, during or after transformation slightly inferior (Cynoglossinae) or nearly terminal (Symphurinae), reaches to the posterior margin of the pupil or beyond it. Villiform teeth are visible during transformation
Eyes	Round, initially large, later moderate with a posterior projection, become smaller with growth	Round and moderate with a posterior projection. Right eye migration begins at late flexion to late postflexion	Small to moderate and round. Right eye moves to left body through a temporary opening formed during the downward

			movement of the rostral hook
Head spination	Absent	Absent	Generally absent. Some species have spination on the subopercle and interopercle
Fin formation	0 - 6 elongate, anterior dorsal rays form first. Anlagen of the dorsal and anal fins form posteriorly, and later the incipient rays develop. Large, paddle-shaped pectoral fins are present but the rays never develop. A single, medial pelvic-fin bud forms from the pelvic bone of the right side	Incipient rays of the pelvic fin develop. Dorsal- and anal-fin pterygiophores do not become particularly elongate	Dorsal and anal fins are confluent with the caudal fin. The elongate, anterior dorsal rays and membranous pectoral fin degenerate during transformation. Sequence of fin completion: D, A, C-P_2
Pigment	Generally clusters and longitudinal series of melanophores are present sparsely along the dorsal and ventral body margins. Pigment occurs on the elongate dorsal rays and ventrally on the head and trunk in some species. Heavy pigment with some stripes on the lateral body appear through larval stage in some *Cynoglossus*	Additional pigment develops laterally on the tail in some species. Melanophores increase in number at the head, thorax, abdomen and gut	A few species become heavily and relatively uniformly pigmented during metamorphosis
Similar families	Bothidae (S**), Citharidae (D* or S**), Paralichthyidae (S**), Poecilopsettidae (D*), Psettodidae (D* or S**), Samaridae (D*), Soleidae (D*)		

* D: eyes dextral

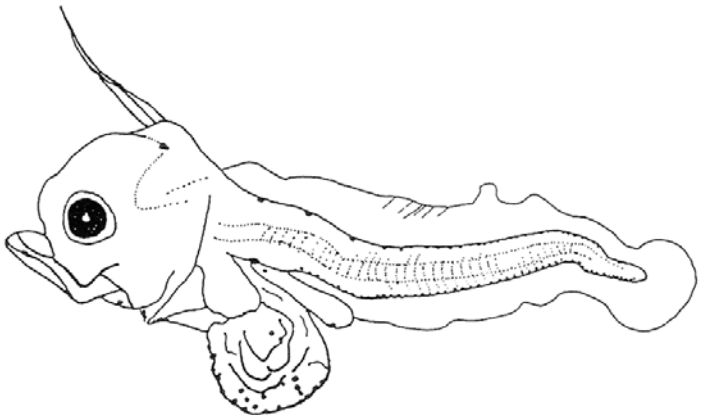
** S: eyes sinistral (in paralichthyid *Tephrinectes sinensis* some dextral individuals occur)

Meristic characters of the Indo-Pacific cynoglossid genera[a] (Leis and Carson-Ewart, 2000)

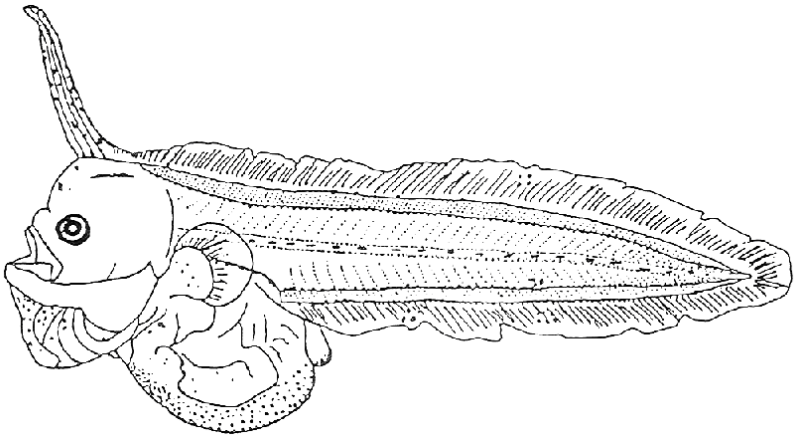
	D	A	P_2[b]	C	VERTEBRAE
Cynoglossinae					
Cynoglossus	89-141	67-114	4	7-12	(9-11)+(33-57) = 42-66
Paraplagusia	97-143	74-112	4	7-8	9+(36-55) = 45-64
Symphurinae					
Symphurus	84-121	70-106	4	10-14	(8-10)+(38-53) = 42-63

[a] Pectoral fins are absent or vestigial in adults.

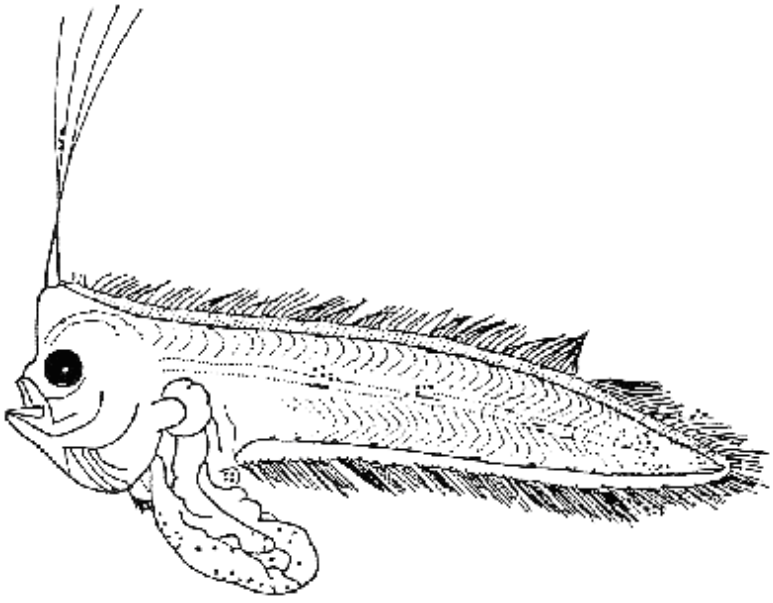
[b] Single pelvic fin derived from right side.



a 2.8 mm TL

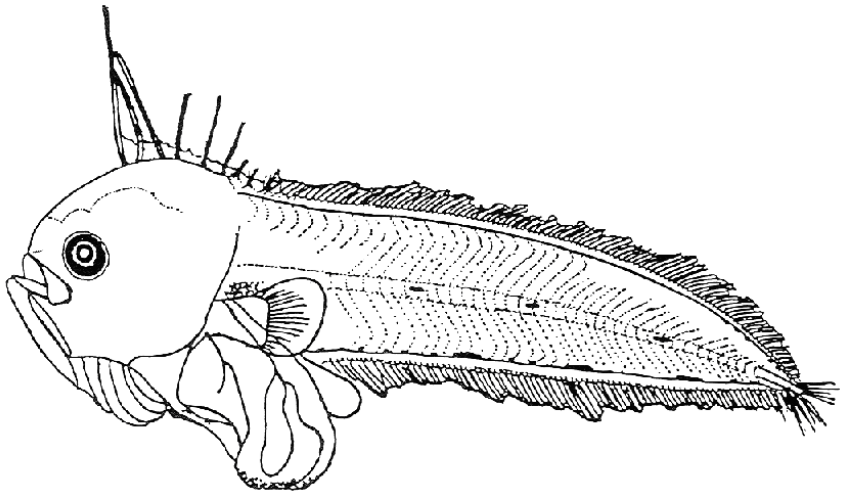


b 6.7 mm TL



c 10.0 mm TL

Fig. 115 Larvae of *Cynoglossus* sp. from the Gulf of Thailand (Chayakul 1996)



a 5.9 mm TL

Fig. 116 Larvae of *Symphurus* sp. from the Gulf of Thailand (Chayakul 1996)

Order: Pleuronectiformes

Family: Soleidae (Soles)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Moderate to deep, extremely laterally compressed and bilaterally symmetrical, becomes relatively reduced in depth with growth	Moderate to deep and extremely laterally compressed	Moderate to deep and extremely laterally compressed
Gut	Coiled and massive, protrudes below the ventral profile and reaches to about the mid body. Preanal length becomes shorter with growth due to anterior migration of the anus. Anus is slightly trailing	Coiled, deep and massive, protrudes below the ventral profile and reaches to about the mid body. Anus is slightly trailing	Coiled, reaches anterior to the mid body. Gut protrusion becomes indistinct
Gas bladder	Small over the gut in some species	Small over the gut in some species	Small over the gut in some species
Head	Moderate and increasingly steep in dorsal profile	Moderate and increasingly steep in dorsal profile	Moderate and round. During eye migration the anterior head over the eyes becomes like a rostrum or is widely concave in dorsal profile
Snout	Short and round	Short and round	Round. Snout length increases during eye migration in some species
Mouth	Terminal and oblique, reaches to the mid pupil	Terminal and oblique to horizontal, reaches to the mid eye or is short of the eye	Mostly horizontal, slightly inferior due to protrusion of the snout. Small villiform teeth become visible on the blind side
Eyes	Round, initially large, thereafter moderate	Small and round. Left eye begins to migrate in some species (in others at postflexion)	Small and round. Left eye migrates to the right body over the dorsal midline of the head anterior to the dorsal fin or through the head ventral to the dorsal-fin base
Head spination	Absent	Absent. Small spines develop on scales at the lateral midline of the posterior tail in *Aseraggodes*, but disappear until settlement	Absent, but dermal papillae develop on the branchiostegal membrane in transforming larvae of some species
Fin formation	Anlagen of the dorsal and anal fins form. Pectoral-fin	Incipient rays of the dorsal and anal fins develop and full	Dorsal and anal fins are free from the caudal fin in some

	buds are present (the rays develop after settlement), and become smaller with growth (in some genera the fins are lost until settlement)	fin complements are attained in late flexion to early post-flexion stage. Dorsal fin has no elongate rays. Pelvic-fin buds form at latest by early postflexion stage	genera or united with the fin in others. Dorsal and anal pterygiophores become elongate, but no translucent region develops at the proximal pterygiophores, or if present, it is narrow. Full completion of all fins except the pectoral fin is achieved by 5.0-12.5 mm. Sequence of fin completion: C-D, A-P_2-P_1
Pigment	Intensity of pigmentation varies among species. Fine melanophores scatter sparsely on the tail, gut and finfolds or the entire body in some species. Melanophores heavily cover the entire body throughout development in some species (e.g. *Aseraggodes*, *Zebrias*)	Some small, faint patches of melanophores are present along the dorsal- and anal-fin bases and the body midline in some species	Mostly pigment increases in size and number and becomes more distinct
Similar families	Bothidae (S**), Citharidae (D* or S**), Cynoglossidae (S**), Paralichthyidae (S**), Poecilopsettidae (D*), Psettodidae (D* or S**), Samaridae (D*)		

* D: eyes dextral

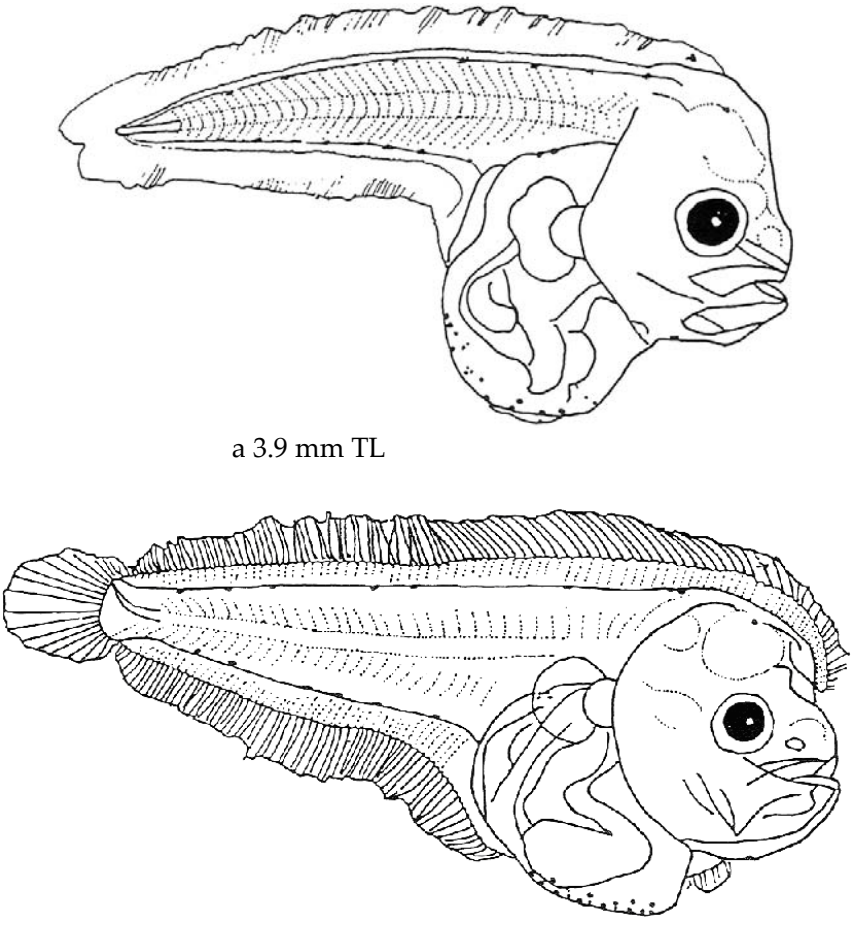
** S: eyes sinistral (in paralichthyid *Tephrinectes sinensis* some dextral individuals occur)

Meristic characters of the Indo-Pacific soleid genera (modified from Leis and Carson-Ewart (2000))

	D	A	P_1[a]	P_2[a]	C(branched)	VERTEBRAE
Aesopia	66-79	51-68	11-15	3-4	10-17	46-48
Aseraggodes	57-82	39-61	0	5	17-19	32-40
Austroglossus [c]	90-110	80-95	P[b]	P	8+7	50-58
Barbourichthys [d]	83	62	4	4	20	-
Bathysolea [e]	75-81	59-64	3-4	5	18	43-44
Brachirus	52-86	40-66	3-9 / 4-7	4-5	14-18	33-43
Dexillichthys	61-71	47-57	0	4-5	13-15	40-41
Heteromycteris	69-109	47-77	0-5	5	18-20	36-41
Liachirus	59-76	42-56	0	5-6	18	33-34
Microchirus [e]	65	52	7	5	18	37
Paradicula [f]	70	57	5	3	14	-
Pardachirus	62-82	45-61	0	5	17-18	35-41
Phyllichthys [g]	69-84	61-71	0-7	4	13-15	46-49
Pseudaesopia [h]	65-81	54-67	6-11	4-5	16-19	41-45
Rendahlia [f]	86-92	61-64	0	5 / 4-5	17-18	-
Rhinosolea [i]	75?	64	P	3	8	-
Solea	57-81	41-69	7-8 / 4-5	4-5 / 5-6	15(20)	32-43

Soleichthys	77-103	65-87	7-12 / 4-11	4-5 / 5-6	18	44-52
Strabozebrias [j]	71-81	64-70	P	P	-	49
Synaptura	68-81	52-68	5-9 / 4-8	2-5 / 4	12-18	42-47
Typhlachirus	74	61	P	P	15	-
Zebrias	58-97	50-85	5-12 / 6-12	4-5	15-18(14-16)	40-54

[a] Asymmettry in paired fin counts shown: eyed side/blind side.
[b] P = present but count unknown.
[c] Known from South Africa.
[d] Only *B. zanzibaricus* is reported from the Arabian Sea.
[e] Known from the western Indian Ocean.
[f] Known from the western Central Pacific.
[g] Known from the western Central Pacific and northwestern Australia.
[h] Known from Japan, Korea and China.
[i] Only *R. microlepidota* is reported from southernJapan.
[j] Known from nortwestern Australia.



a 3.9 mm TL

b 5.6 mm TL

Fig. 117 Larvae of Soleidae sp. from the Gulf of Thailand (Chayakul 1996)

Order: Tetraodontiformes

Family: Balistidae (Triggerfishes)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	Initially elongate and slightly compressed, and later moderate to deep and rotund in the trunk	Deep, ovate and laterally compressed with a slender tail. Head and gut are covered by spinule-like scales	Deep, ovate and laterally compressed. Spinule-like scales extend on the whole body
Gut	Coiled, reaches to 40-55% BL. Preanal length becomes longer with growth	Deep and coiled, reaches to 55-65% BL	Deep and coiled, reaches to 65-70% BL
Gas bladder	Small and inconspicuous above the anterior portion of the gut	Small and inconspicuous above the anterior portion of the gut	Inconspicuous
Head	Moderate to large and round, becomes relatively larger with growth	Large and round	Large and round
Snout	Short and round	Short and round to steep	Moderate and steep, sometimes concave
Mouth	Small and terminal, reaches to the eye. Incisiform teeth form just before flexion	Small and terminal, reaches to the eye	Small and terminal, does not reach to the eye
Eyes	Round and large, become smaller with growth	Round and large	Round and large (moderate at juvenile)
Head spination	A batch of spinules is present on the preopercle	Spinules on the preopercle are lost in conjunction with development of spinule-like scales	Absent
Fin formation	Anlagen of the dorsal and anal fins and first two spines of the dorsal fin early form (the spines elongate and first spine is strongly barbed). Pelvic-fin bud forms	Incipient rays of the dorsal and anal fins and 3rd dorsal spine form. Pectoral-fin rays begin to form	Pelvic fin is degenerated and a barbed spine is present at the symphysis of the pelvic bones. Full completion of all fins is attained by 6 mm. Sequence of fin completion: D_1-D_2, A, P_1-C
Pigment	Heavy pigment is present on top of the head and nape and over the gut and operculum. Melanophores develop on the ventral midline of the tail and around the notochord tip	Pigment on top of the head and the gut becomes heavier. Membrane of the spiny dorsal fin is pigmented. Additional melanophores develop laterally on the body in some species	Pigment spreads widely on the body. Entire body is heavily pigmented at juvenile in some species
Similar families	Dactylopteridae, Monacanthidae, Priacanthidae, Triacanthidae, Triacanthodidae		

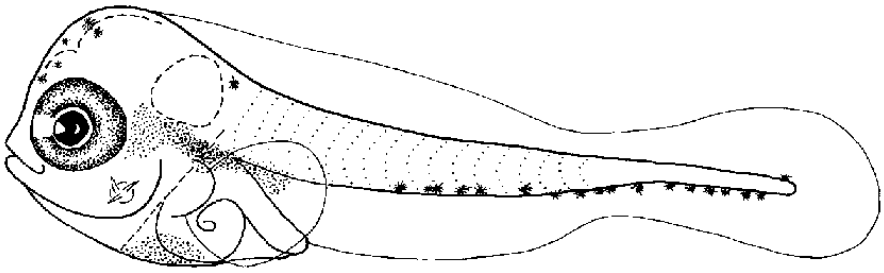
Meristic characters of the Indo-Pacific balistid genera[a] (modified from Leis and Carson-Ewart (2000))

	D	A	P_1[b]	C	VERTEBRAE
Abalistes	III+25-27	24-25	14-15	12	7+11 = 18
Balistapus	III+25-27	20-24	12-14	12	7+11 = 18
Balistes	III+26-32	24-30	13-15	12	7+11 = 18
Balistoides	III+25-26	22-24	14	12	7+11 = 18
Canthidermis	III+23-26	20-23	14-16	12	7+11 = 18
Melichthys	III+30-35	27-31	13-16	12	7+11 = 18
Odonus	III+33-35	28-31	14-15	12	7+11 = 18
Pseudobalistes	III+24-27	19-24	14-15	12	7+11 = 18
Rhinecanthus	III+22-27	20-24	12-14	12	7+11 = 18
Sufflamen	III+26-30	23-27	12-14	12	7+11 = 18
Xanthichthys	III+26-32	23-29	12-14	12	7+11 = 18
Xenobalistes [c]	III+27	25	13-14	12	7+11 = 18

[a] Pelvic fins are absent.

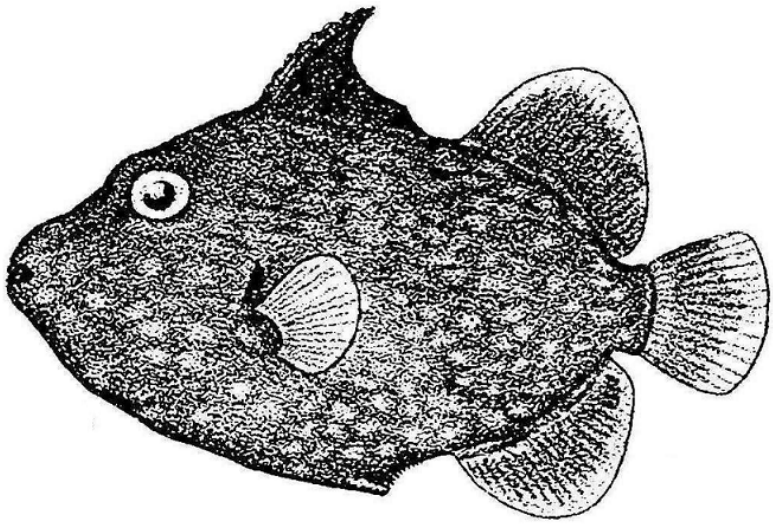
[b] Rudimentary, dorsal-most ray excluded.

[c] Only *X. tumididipectoris* is reported from the western Central Pacific.



a 1.5 mm SL (rearing, 2.5 days after hatching)

Fig. 118 Larva of *Sufflamen chrysopterum* from Australia (Leis and Rennis 2000b)



a 32 mm SL

Fig. 119 Larva of *Canthidermis maculatus* (Berry and Baldwin 1966)

Order: Tetraodontiformes

Family: Monacanthidae (Filefishes)

Main characters	Larval stage		
	Preflexion	**Flexion**	**Postflexion**
Body shape	[Morph A]: elongate to deep and slightly laterally compressed. Some species (e.g., *Stephanolepis*, *Thamnaconus*) become angular with growth. [Morph B]: moderate to deep, initially rotund, later laterally compressed, becomes deeper with growth, but remains rounded. Small spinules form at the interobit in Morph A and B	[Morph A]: elongate to deep and laterally compressed. Small papillae cover the body. [Morph B]: deep, round and laterally compressed. Small papillae extend on the body	[Morph A]: elongate to deep and strongly laterally compressed (notochord tip is long and still remains). [Morph B]: deep, round and laterally compressed. Small papillae on the body become spinule-like scales in Morph A and B
Gut	Deep and coiled, reaches anterior to the mid body. Preanal length becomes longer with growth	Deep and coiled, reaches to about the mid body	Deep and coiled, reaches beyond the mid body
Gas bladder	Small above the anterior portion of the gut	Small above the anterior portion of the gut	Small and inconspicuous above the anterior portion of the gut
Head	Moderate and round to triangular, becomes larger with growth	Moderate to large and round to triangular	Moderate to large and round to triangular
Snout	Initially short, mostly becomes longer with growth	Moderate and steep to round in dorsal profile	Moderate and steep to round in dorsal profile
Mouth	Small and terminal, reaches to the anterior margin of the eye	Small and terminal, does not reach to the eye due to elongation of the snout	Small and terminal, does not reach to the eye
Eyes	Round and considerably large, become smaller with growth	Round and large to moderate	Round and large to moderate
Head spination	A batch of spinules is present on the preopercle only in Morph A, but lost by flexion	Absent	Absent
Fin formation	[Morph A]: 1st dorsal spine forms on the nape, thereafter anlagen of the remaining dorsal and anal fins and their incipient rays	A barbed, prominent pelvic spine (not true pelvic fin) appears at the symphysis of the pelvic bones in some Morph A (the bud of the spine	Pectoral-fin rays form in Morph A at 7-15 mm and in Morph B at about 4 mm. Notochord tip is still long and persists in Morph A. Full

	develop oppositely in the tail. The spine mostly migrates from the nape over the eye and is smooth or armed with hooks and barbs. Some species develop a small, smooth 2nd dorsal spine (some at flexion) [Morph B]: anlagen of the dorsal and anal fins form oppositely in the tail prior to 1st dorsal spine which develops at postflexion and is unarmed to at least 6 mm	appears at preflexion), but it is not externally visible in other Morph A and Morph B	completion of all fins is achieved at latest by 15 mm. Sequence of fin completion: D_1 (pelvic spine) -D_2, A-C-P_1- in Morph A; D_2, A-C-D_1-P_1 in Morph B
Pigment	Moderately to heavily pigmented through larval stage. Generally, the head, operculum and gut are pigmented. In Morph A, a series or clusters of pigment is present at the tail (at flexion to postflexion in Morph B) and melanophores develop on the elongate dorsal spine	Pigment becomes heavier with growth	Mostly, pigment covers entirely on the body. Pigment blotches are present on the tail and caudal fin in some species
Similar families	Balistidae, Dactylopteridae, Pomacentridae, Priacanthidae, Tetoraodontidae, Triacanthidae		

Morph A: at least *Aluterus*, *Amanses*, *Cantherhines*, *Monacanthus*, *Oxymonacanthus*, *Pseudalutarius*, *Stephanolepis*, *Thamnaconus*

Morph B: at least *Brachaluteres*, *Paraluteres* (?), *Rudarius*

Meristic characters of the Indo-Pacific monacanthid genera[a] (modified from Leis and Carson-Ewart (2000))

	D	A	P_1	C	VERTEBRAE
Acreichthys	II+26-30	25-29	10-12	12	7+13 = 20
Aluterus	II+43-51	46-54	13-15	12	7+(14-16) = 21-23
Amanses	II+26-29	22-25	13	12	7+12 = 19
Anacanthus	I+47-52	56-62	8-10	12	7+(22-24) = 29-31
Brachaluteres	II+23-30	20-27	10-12	12	7+13 = 20
Cantherhines	II+32-39	28-35	11-15	12	7+12 = 19
Cantheschenia [b]	II+34-41	32-36	10-14	12	7+12 = 19
Chaetodermis	II+25-27	23-25	11-13	12	7+13 = 20
Colurodontis [c]	II+27-32	26-31	10-12	12	7+12 = 19
Eubalichthys [d]	II+32-39	33-37	12-14	12	7+12 = 19
Lalmohania [e]	II+25-27	25-28	10-11	12	7+12 = 19
Monacanthus	II+28-34	27-34	11-14	12	7+12 = 19
Nelusetta [f]	II+30-36	30-34	12-14	-	-
Oxymonacanthus	II+26-35	23-32	10-12	12	8+(17-18) = 25-26
Paraluteres	II+25-28	24	11-12	12	7+(13-14) = 20-21
Paramonacanthus	II+24-33	24-34	10-13	12	(6-7)+(12-13) = 19
Pervagor	II+29-39	25-36	10-14	12	7+12 = 19
Pseudalutarius	II+43-50	41-46	10-12	12	8+(18-21) = 26-29
Pseudomonacanthus	II+28-35	27-34	10-13	12	7+12 = 19
Rudarius	II+22-28	20-28	10-12	12	7+(12-13) = 19-20
Scobinichthys [d]	-	-	-	-	-
Stephanolepis	II+28-35	29-34	10-14	12	7+12 = 19
Thamnaconus	II+31-39	30-37	12-16	12	7+12 = 19

[a] Pelvic fins are absent.

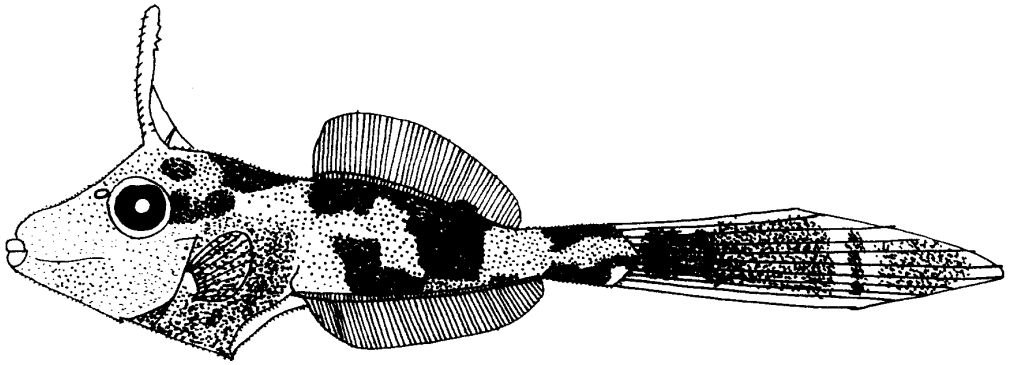
[b] Known from eastern Australia.

[c] Only *C. paxmani* is reported from northwestern Australia.

[d] Known from southern half of Australia.

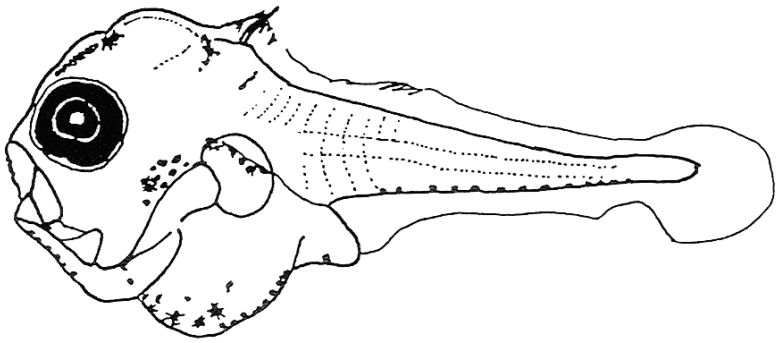
[e] Only *L. velutina* is reported from the western Indian Ocean.

[f] Only *N. ayraud* is reported from southern Austrtalia and New Zealand.

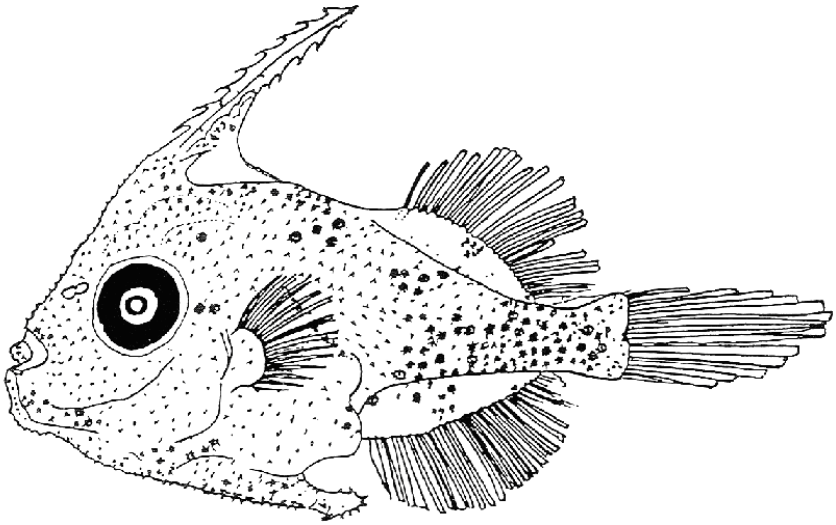


a ca 15.7 mm SL

Fig. 120 Larva of *Aluterus* sp. from the Andaman Sea (by Termvidchakorn, A.)



a 1.75 mm TL



b 9.1 mm TL

Fig. 121 Larvae of Monacanthidae sp. from the Gulf of Thailand (Chayakul 1996)

Key to the families of leptocephali (more than about 20 mm BL) for the Elopiformes (ELOP), Albuliformes (ALBU), Anguilliformes (ANGU) and Saccopharyngiformes (SACC) in the Southeast Asian region

(modified from Miller and Tsukamoto 2004)

1a. Tail forked and like a typical caudal fin of most fishes ……..…….. 2
1b. Tail not forked, but either pointed or rounded ……...…….…. 4
2a. Dorsal fin small and located far forward of anal and caudal fins ……...… Albulidae (ALBU)
2b. Dorsal fin larger and located close to anal and caudal fins …… 3
3a. Dorsal fin overlapping with anal fin ……...…… Megalopidae (ELOP)
3b. Dorsal fin not overlapping with anal fin ……...…… Elopidae (ELOP)
4a. Gut long and straight with only one swelling anteriorly [1] …… Muraenesocidae (ANGU)
4b. Gut either with no swellings, one swelling at end of gut, or more than one swelling ……... 5
5a. Gut with swellings or curvatures …… 6
5b. Gut simple, straight ……. 11
6a. Gut with one swelling at end of gut ……... 7
6b. Gut with more than one swelling ……... 8
7a. Jaws at angle and mouth opening large, body relatively deep ……. Eurypharyngidae, Saccopharyngidae (SACC)
7b. Jaws normal, body relatively slender, and melanophores large and stellate in most species …… Moringuidae (ANGU)
8a. Gut with two swellings, lateral pigment and body shapes varied ……...……. Nettastomatidae (ANGU)
8b. Gut with more than two swellings ……. 9
9a. Telescopic eyes ……. Synaphobranchid Ilyophinae (ANGU)
9b. No telescopic eyes ……... 10
10a. Body elongated …… Ophichthidae (ANGU)
10b. Body not elongated ……. Cyematidae (SACC)
11a. Gut less than 50% BL, lateral body pigmented ……...…… Chlopsidae (ANGU)
11b. Gut typically greater than 50% BL …… 12
12a. Telescopic eyes ……. Notacanthids [2] (ALBU, body long and thin with small pigment on gut) and Synaphobranchid Synaphobranchinae (ANGU)
12b. No telescopic eyes ……... 13
13a. No pigment anywhere on body (except on caudal fin of specimens < 10 mm) ……... Anguillidae (ANGU)
13b. Pigment on body, gut, or notochord …… 14
14a. Pigment prominent on gut or myosepta, lateral pigment patterns varied (1 to 3 rows) …….. 15
14b. Pigment not prominent on gut (except the dorsal surface) or no aligned, small melanophores on myosepta …….. 16
15a. Gut prominently pigmented and long ……... Congrid Congrinae (ANGU)

15b. Myosepta pigmented with aligned, small melanophores and gut long [3] …….. Congrid Bathymyrinae (ANGU)

15c. Gut short ……...……... Congrid Heterocongrinae (ANGU)

16a. Body long and slender, pigment on dorsal surfaces of notochord and gut, and on lateral body, tail pointed ……. Nemichthyidae (ANGU)

16b. Body not long and slender, no pigment on dorsal surface of notochord ……... 17

17a. No pigment on lateral body, ventral midline of notochord pigmented, tail rounded …… Muraenidae (ANGU)

17b. Some pigment on lateral body, tail pointed …… 18

18a. Last vertical blood vessel [4] at about myomere 59-80 …… Derichthyidae (ANGU)

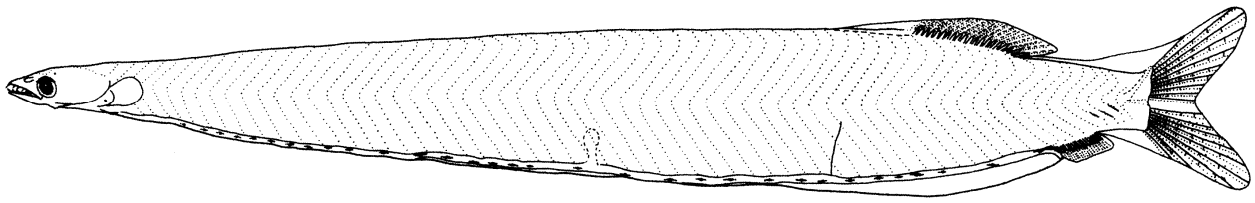
18b. Last vertical blood vessel at about 30-37 …….. Serrivomeridae (ANGU)

[1] Some muraenid leptocephali will appear to have just one swelling along the gut anteriorly like in the muraenesocids, but the muraenids don't have a row of lateral pigment and sometimes will have pigment on the underside of the notochord.

[2] Some taxa of notacanthids have a normal eye.

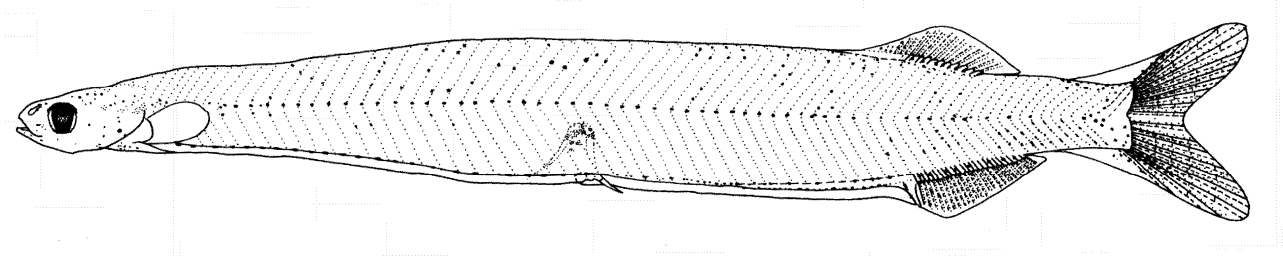
[3] Some bathymyrin *Ariosoma* have the exteriorly elongate (exterillium) gut.

[4] One or more of the vertically oriented blood vessels connecting the aorta with the gut or kidney in leptocephali.



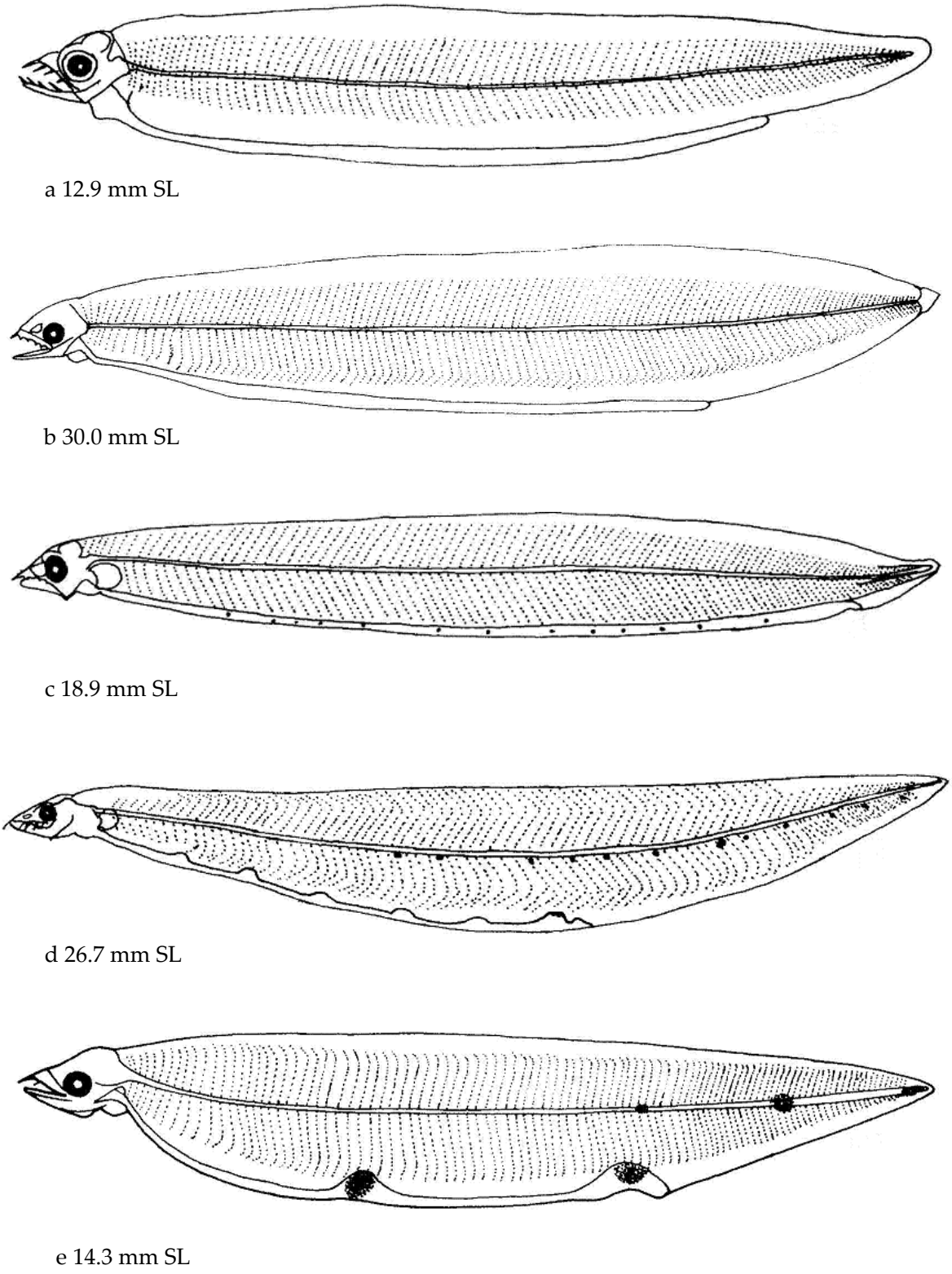
a 29.6 mm SL

Fig. 122 Larva of the elopid *Elops* sp. from the Andaman Sea (by Duangdee, T.)



a 21.2 mm SL

Fig. 123 Larva of the megalopid *Megalops cyprinoides* from the Andaman Sea (by Duangdee, T.)



a 12.9 mm SL

b 30.0 mm SL

c 18.9 mm SL

d 26.7 mm SL

e 14.3 mm SL

Fig. 124 Larvae of Anguilliformes spp. from the Andaman Sea (by Termvidchakorn, A.)

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Southeast Asian Fisheries Development Center
Training Department (TD)
P.O.Box 97, Phrasamutchedi,
Samut-Prakarn, 10290, THAILAND
Tel: (66 2) 425 6100
Fax: (66 2) 425 6110-1

http://www.seafdec.or.th