Larval Fish

Identification Guide

for the South China Sea and Gulf of Thailand

SCS

SEAFDEC

SOUTHEAST ASIAN FISHERIES DEVELOPMENT CENTER
IN COLLABORATION WITH THE
UNEP/GEF SOUTH CHINA SEA PROJECT

UNEP

GEF

PREFACE

The Indo-west Pacific has long been recognised as the global centre of shallow water marine biological diversity and the South China Sea, which is located at the centre of this marine biological realm, therefore represents an area of globally significant marine biodiversity. The UNEP/GEF South China Sea Project represents the first attempt to develop regionally co-ordinated programmes of action designed to reverse environmental degradation particularly in term of coastal habitat degradation and loss, and fisheries over-exploitation in this area.

The fisheries component of the UNEP/GEF South China Sea Project has focused on the establishment of a regional system of fisheries *refugia* for the South China Sea and Gulf of Thailand. Fisheries *refugia* as defined by the UNEP/GEF Regional Working Group on Fisheries (RWG-F) are "*Spatially and geographically defined, marine or coastal areas in which specific management measures are applied to sustain important species [fisheries resources] during critical stages of their life-cycle, for their sustainable use.*" The overall objective of the fisheries *refugia* initiative of the project is to improve the understanding and hence the management of the links between fish stocks and critical fisheries habitats, including mangroves, coral reefs and seagrass.

A key constraint in the identification of fisheries *refugia* sites is the current lack of information at the regional level regarding specific habitats and locations used by most fish species during critical phases of their life-cycles. This situation results from past fisheries research programmes having focused on determining sustainable yields of fish stocks, with little emphasis being placed on fish life cycle research. SEAFDEC has been working to fill this information gap through the inclusion of sampling for fish eggs and larvae during their regular fisheries resources assessment surveys in the South China Sea. Due to a shortage of technical expertise in the participating countries however, very few larvae fish samples have been processed to date.

In response to this capacity development need a Regional Training Workshop on Larval Fish Identification and Fish Early Life History Science was convened by SEAFDEC from 16th - 31st May 2007. The workshop was aimed at enhancing the scientific basis for the identification of fisheries *refugia* sites by building capacity within national fisheries research stations and institutes for the processing and identification of larval fish samples collected as part of SEAFDEC's regular research cruises. This *Larval Fish Identification Guide for the South China Sea and Gulf of Thailand* is an important output from this regional training event, and it is anticipated that this will serve as a very valuable resource for technical staff in government fisheries departments concerned with the life-cycles of important fish stocks.

This larval fish identification guide was prepared by a team of ichthyologists and fisheries biologists with a wealth of experience in the study of Southeast Asian fish stocks, including Dr. Yoshinobu Konishi, Dr. Chongkolnee Chamchang, Mr. Teerapong Duangdee, and Ms. Penchan Laongmanee. I would like to extend a sincere thank you to all contributors and staff of the SEAFDEC Training Department for their tireless efforts in preparing this guidebook for publication.

Dr. John C. Pernettar
UNEP/GEF South China Sea Project

SORTING

Drain the samples through a hand net (mesh size same as plankton net)

Return preserving liquid to the original sampling jar

Wash the specimens with fresh water

Retain specimens in a container with fresh water

Stir the solution softly with a glass rod

Pour a small number of specimens into a petri-dish

Select fish eggs and larvae from the petri-dish viewed under a dissecting microscope at a magnification of about 10 times (10x ocular, 1x objective)

Place specimens in a labelled petri-dish.
Precaution must be taken to prevent the damage of specimens when selecting.

Count the number of fish eggs and larvae using a counter

Record the total number of fish eggs and larvae removed from the sample on a plankton data sheet

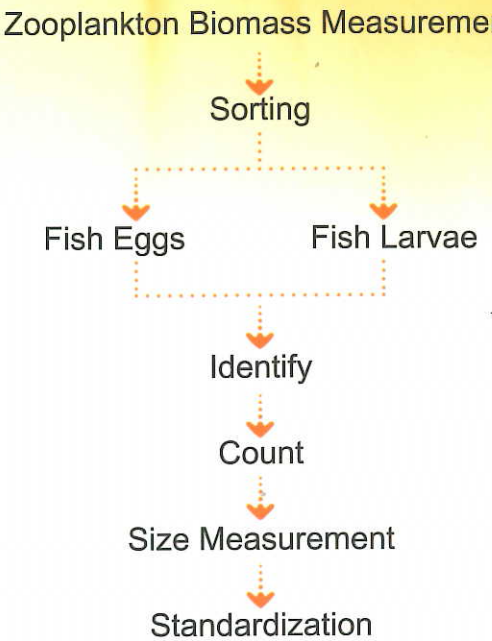
Store fish eggs and larvae in separate labelled vials with 70% ethanol

Place a label in each vial, including information on sampling date, station number, sampling site, sampling method (oblique , horizontal or vertical tow), and plankton net type. Use pencil for labelling.

NOTE : In the case that you cannot finish sorting in one day, place the unsorted plankton into 5% buffer formalin. Then continue sorting the next day.

** After sorting, the remaining plankton should be replaced in the original sampling jar for processing later.

LABORATORY PROCEDURE



ZOOPLANKTON BIOMASS MEASUREMENT (DISPLACEMENT OF SETTLED VOLUME)

Remove non-planktonic organisms such as adult / juvenile fish and large planktonic organisms (individual volume > 5 ml) such as jelly fish and tunicates

Determine total volume

Remove preserving liquid by filtering through 330 µm mesh gauze

Determine volume of removed preserving liquid

Total volume - preserving liquid = Settled volume

Record settled volume on data sheet

Return sample to the original preserving liquid (wait for sorting)

LARVAL FISH IDENTIFICATION USING LITERATURE ACCOUNTS

Identify the Order of the specimen using a table of characteristics

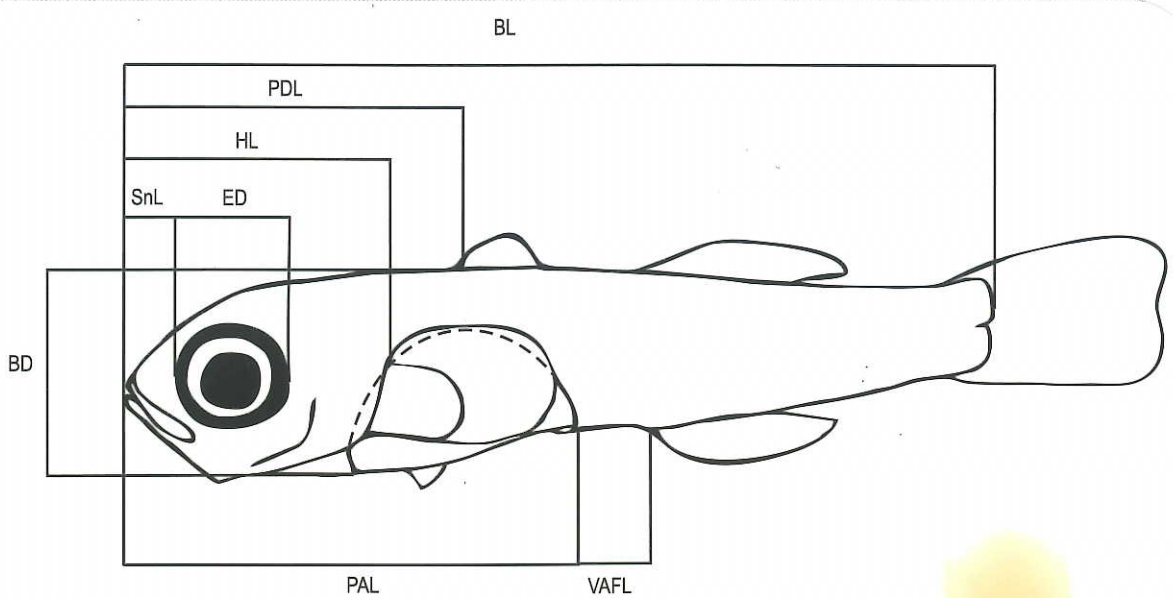
Narrow down the choice using a guide to the identification of morphological groups

Narrow down the choice from the selected morphological group using a picture-based identification key to the families

Compare your specimen with the text descriptions of the family

Compare your specimen with drawings and meristics table

STANDARD MEASUREMENT



BD	body depth
BL	body length
ED	eye diameter
HL	head length
PAL	pre anal length
PDL	pre dorsal-fin length
SnL	snout length
VAFL	vent to anal-fin length

STANDARDIZATION

$$T = 1000\ t/V$$

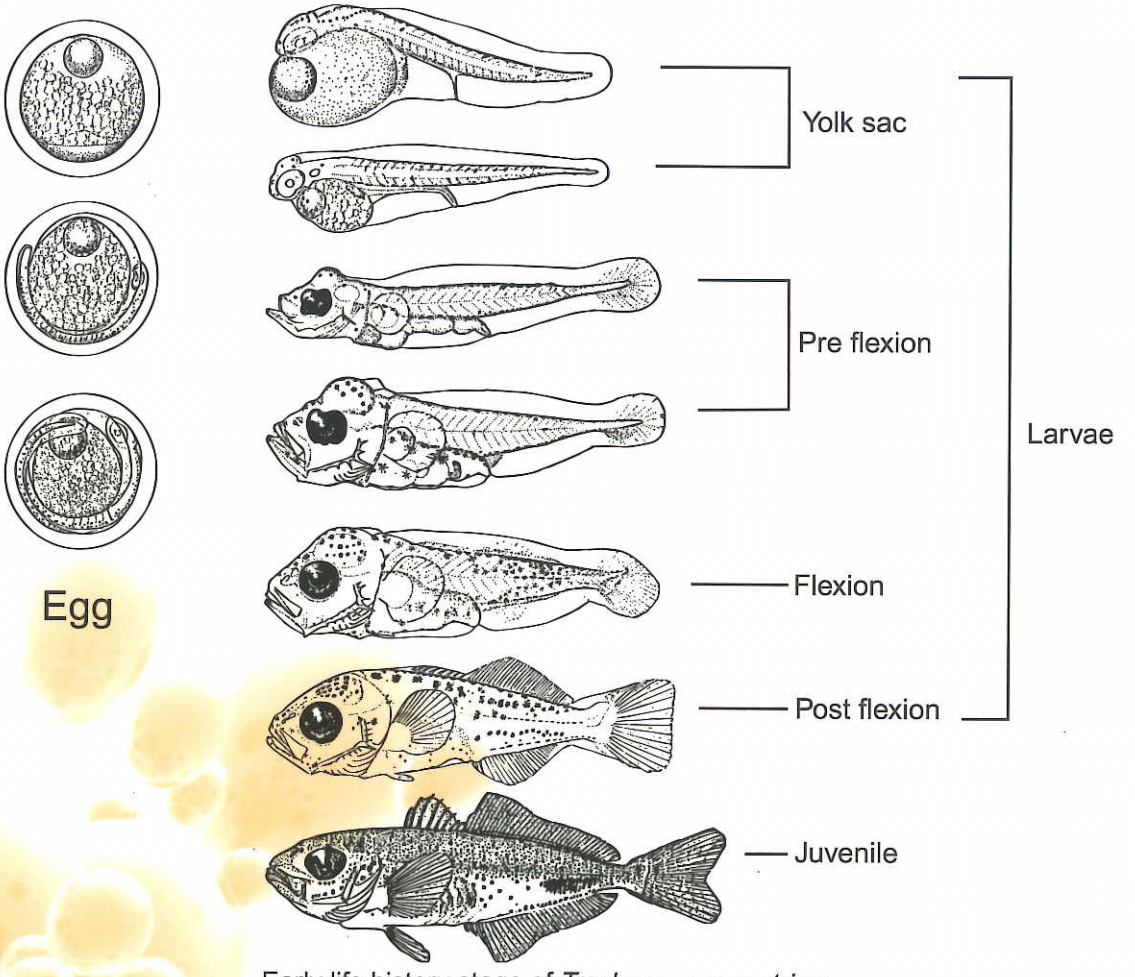
Where
T is the number of larvae or eggs in the sample per 1000 m^3 sea water volume
t is number of fish larvae or eggs in the sample (collected number)
V is sea water volume flow through plankton nets (m^3)

$$V = n \times N_1 \times a \quad \text{or} \quad a \times n/N$$

Where
n is the number of revolutions of the flow meter during the tow
a is the area of the mouth of the net in square metres = πr^2
N is the calibration factor in number of revolutions of the flow meter per 1 metre
N_1 is the calibration factor in metres per revolution for a given flow meter.

Where
N or N_1 is derived from a calibrated flow meter before and after each sampling trip

EARLY LIFE HISTORY STAGES OF FISH

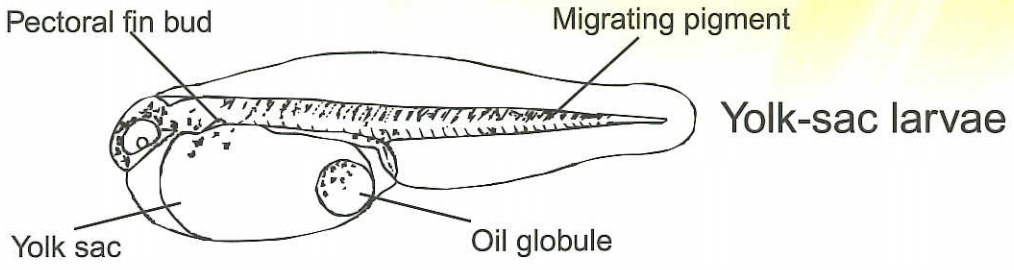


Early life history stage of *Trachurus symmetricus*

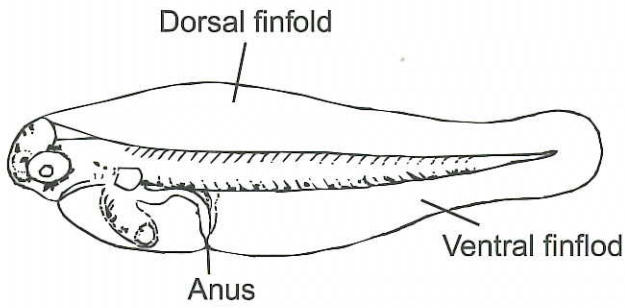
(Ahlstrom, E.H. and O.P.Ball .1954. Description of eggs and larvae of jack mackerel *(Trachurus symmetricus)* and distribution and abundance of larvae *In* Ontogeny and systematics of fishes. Moser, H. G. et al (eds). Amer. Soc. Ich. and Herp. Spec. Pub. No. 1.)

MORPHOLOGICAL CHARACTERS & MORPHOMETRICS OF FISH LARVAE

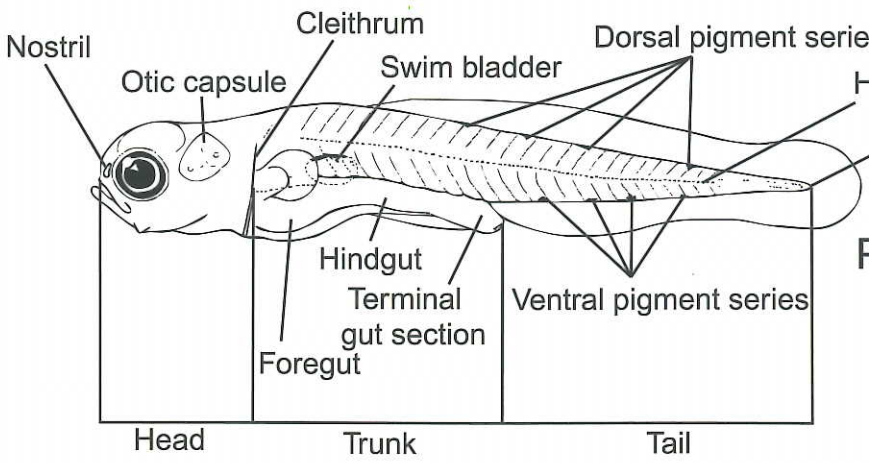
(Moser H.G. 1992. The Early Stages of Fishes in the California Current. CalCOFI. Atlas no.33. p.29)



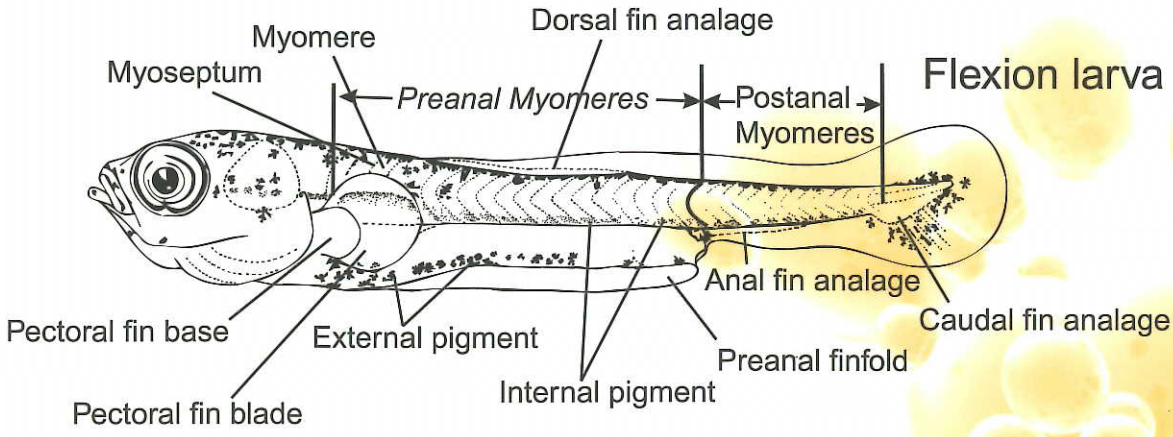
Yolk-sac larvae



Yolk-sac larvae



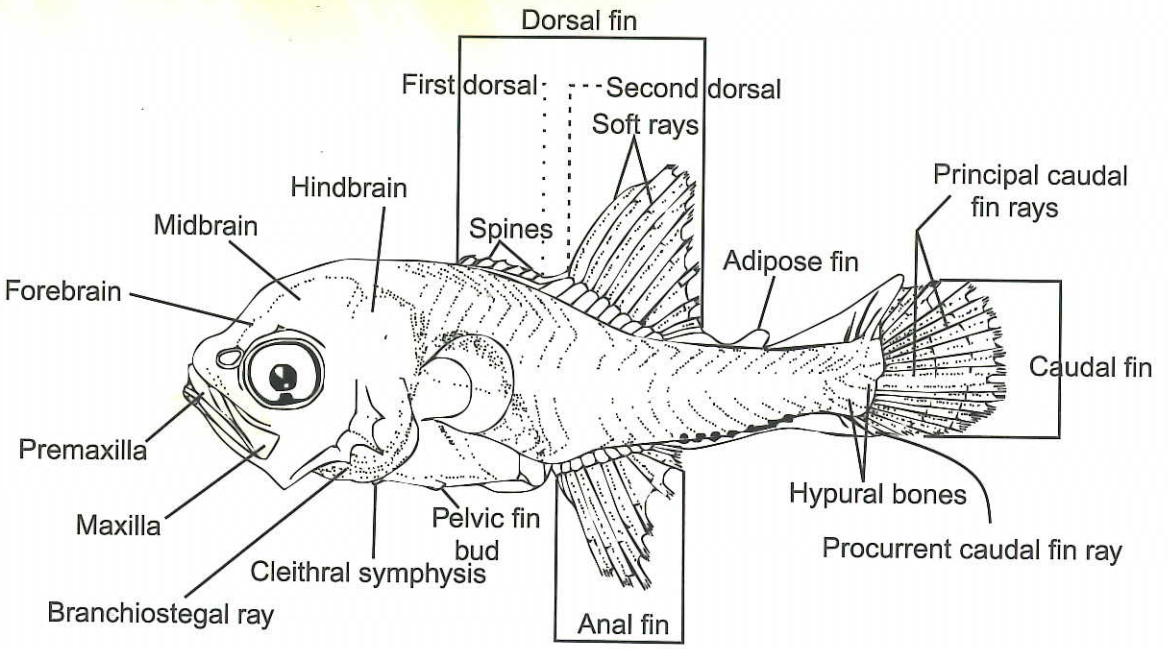
Pre-flexion larva



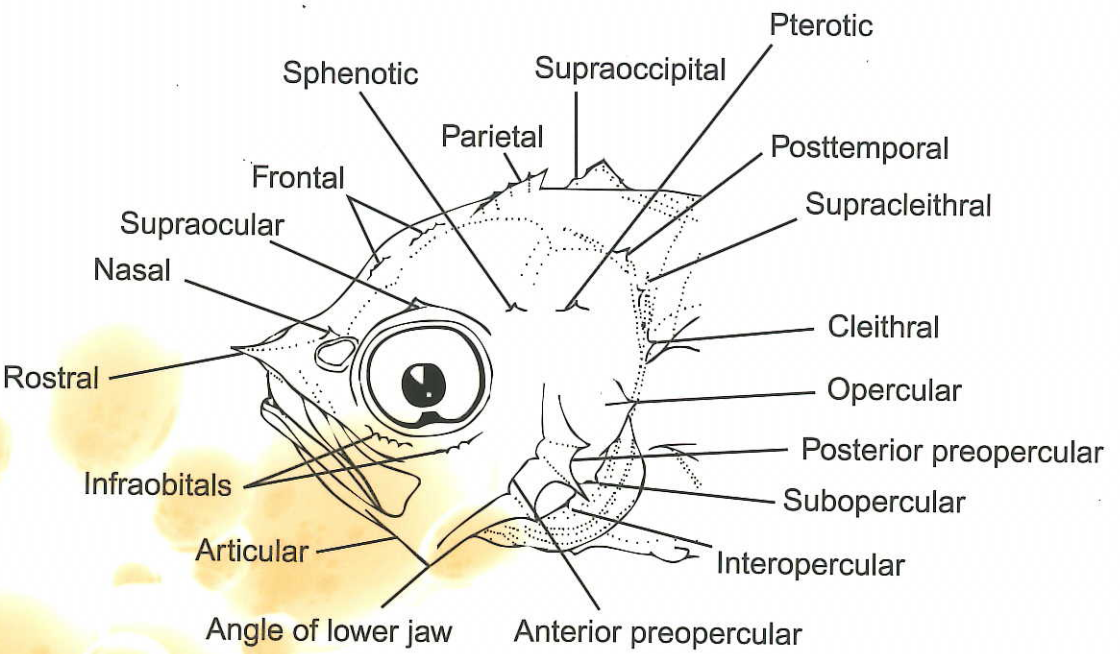
Flexion larva

MORPHOLOGICAL CHARACTERS & MORPHOMETRICS OF FISH LARVAE

(Moser H.G. 1992. The Early Stages of Fishes in the California Current. CalCOFI. Atlas no.33. p.32)



Post-flexion larva

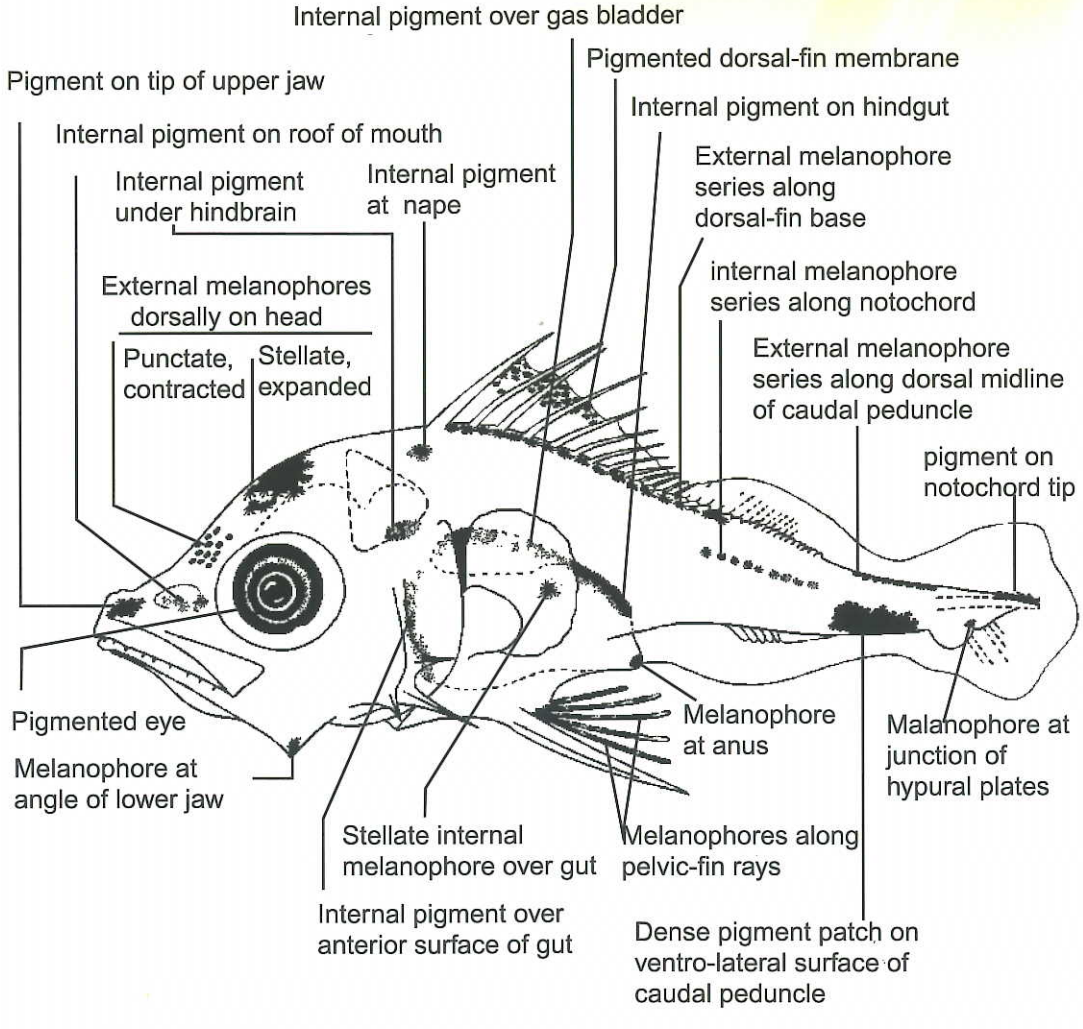


Head spines of fish larva

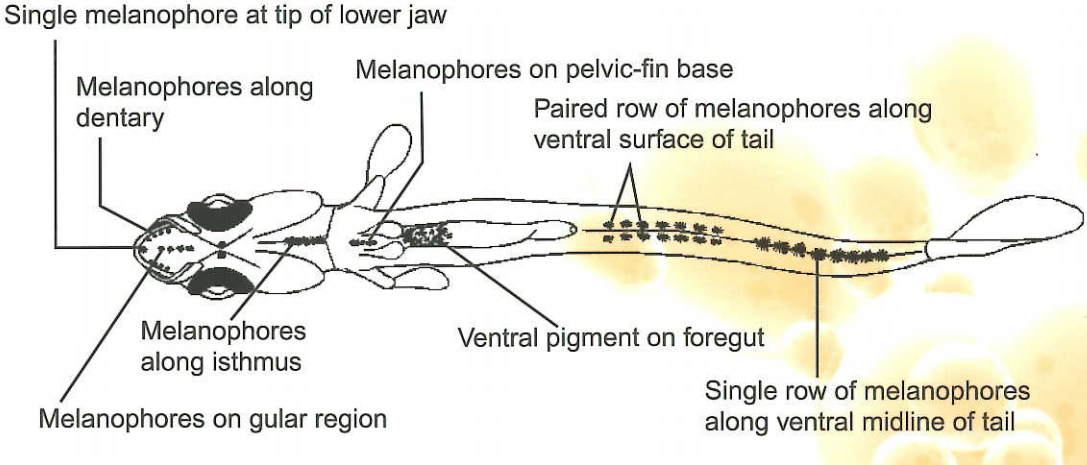
MAJOR PIGMENT CHARACTERS

(Neira, F.J., Miskiewicz, A.G. and Trnski T. 1998.
Larvae of Temperate Australian Fishes. p.18)

A: LATERAL VIEW

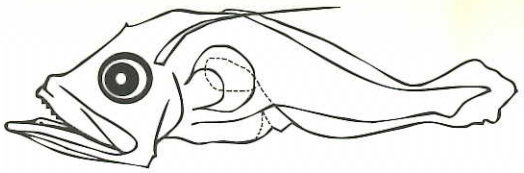


B: VENTRAL VIEW

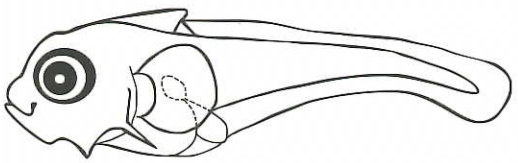


Group 9 (IIIA), continued

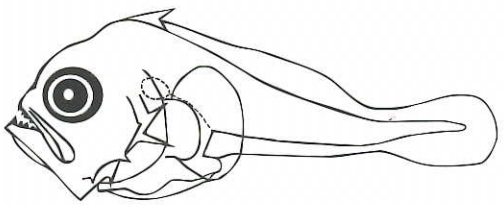
Body depth moderate (BD = 20-40% BL)
Gut coiled and compact early (by 3 mm)



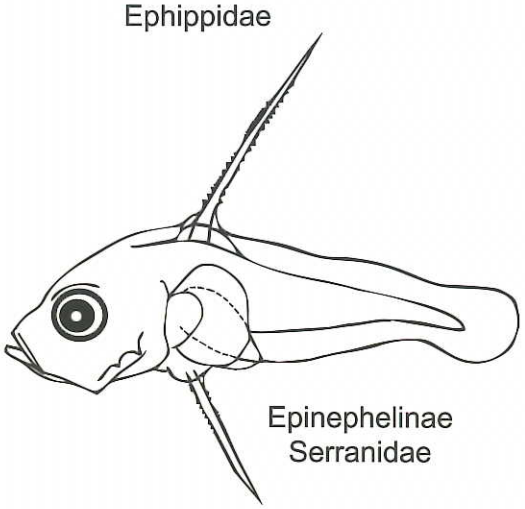
Champsodontidae



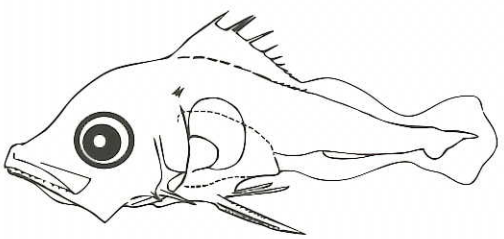
Dactylopteridae



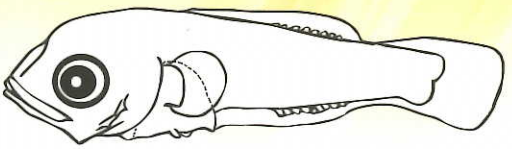
Ephippidae



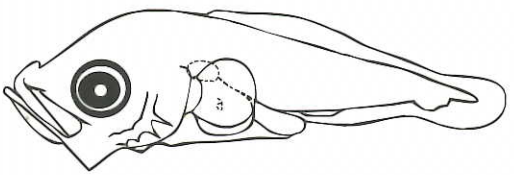
Epinephelinae
Serranidae



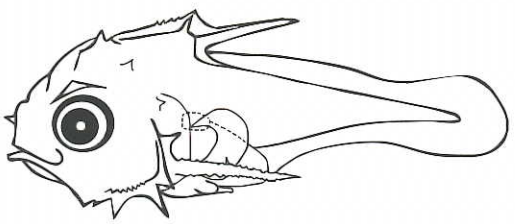
Gempylidae



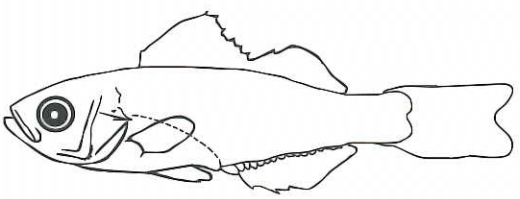
Gerreidae



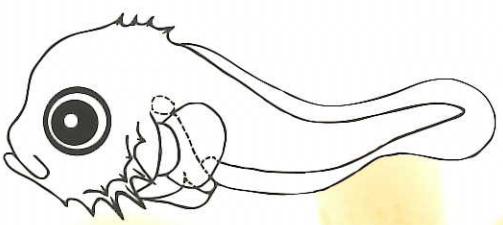
Haemulidae



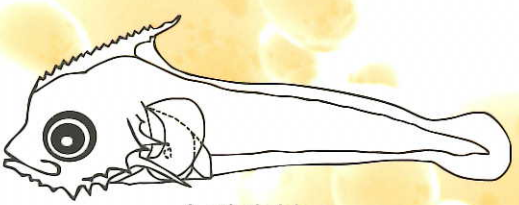
Holocentridae



Kuhliidae



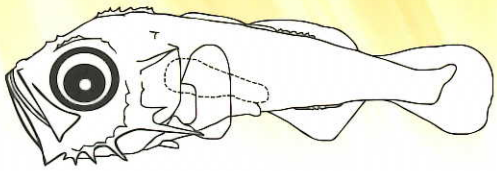
Leiognathidae



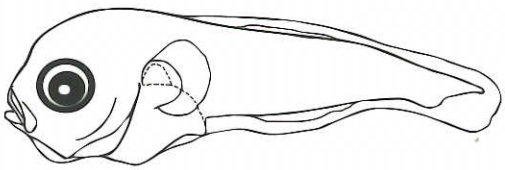
Lethrinidae

Group 9 (IIIA)

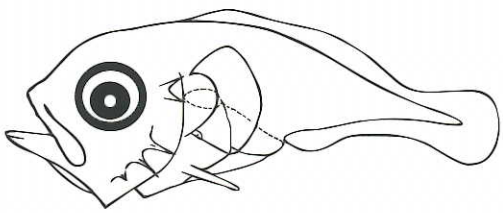
Body depth moderate (BD = 20-40% BL)
Gut coiled and compact early (by 3 mm)



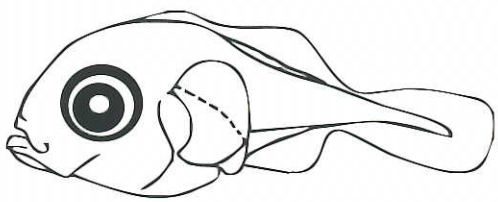
Acropomatidae



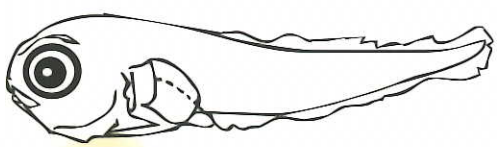
Ambassidae



Anthiinae
Serranidae

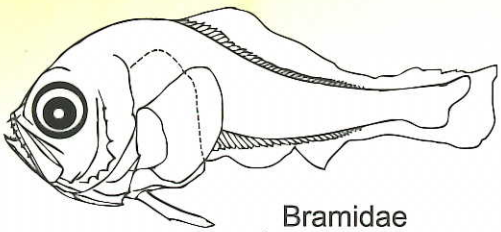


Balistidae

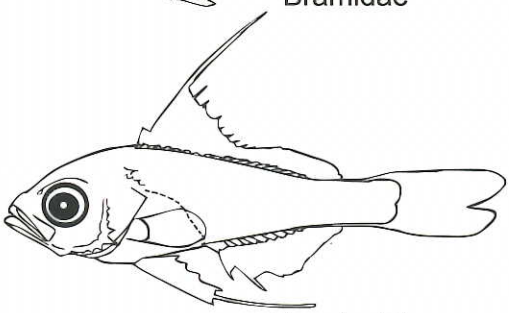


Blenniidae

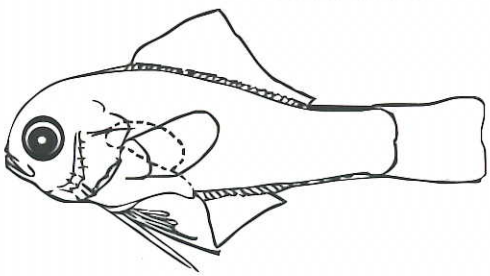
Branchiosteginae
Malacanthidae



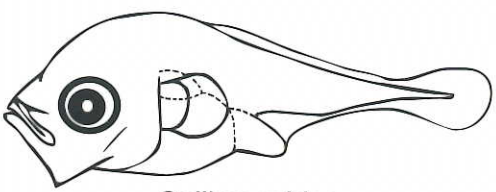
Bramidae



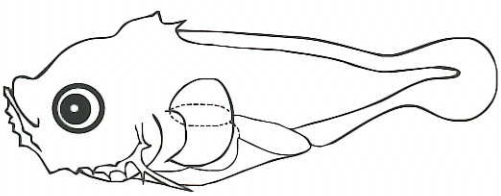
Caesionidae



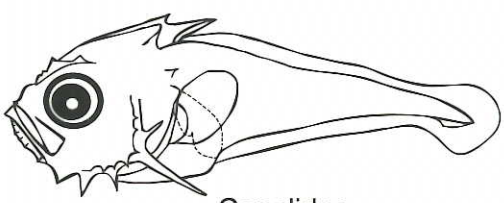
Callanthiidae



Callionymidae



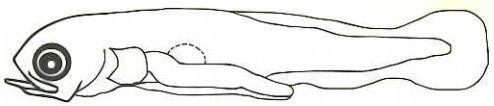
Caproidae



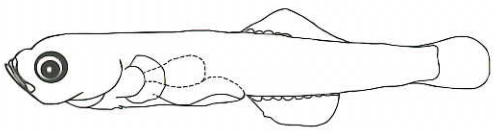
Cepolidae

Group 8 (IIC_3), continued

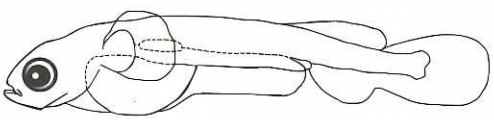
Body elongate (BD = 10-20% BL)
Gut initially uncoiled, remaining uncoiled until hidden by body wall



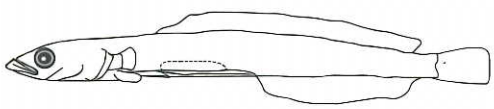
Gobiesocidae



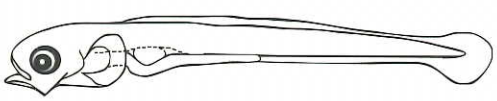
Gobiidae



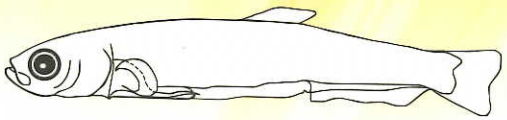
Hemiramphidae



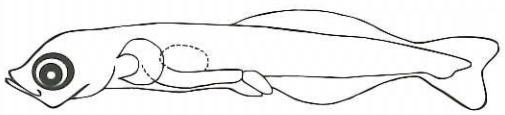
Kraemeriidae



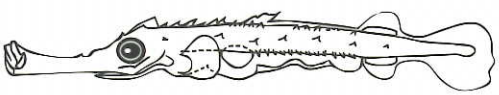
Microdesminae
Microdesmidae



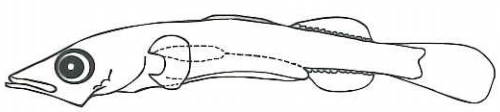
Pristigasteridae



Pereleotrinae
Microdesmidae



Solenostomidae

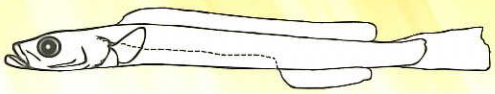


Sphyraenidae

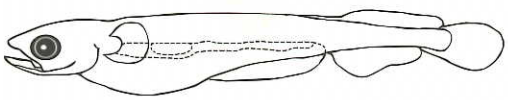
Synodontidae

Group 8 (IIC_3)

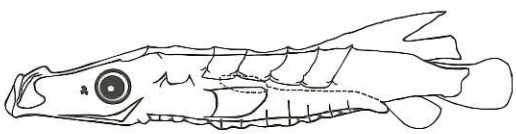
Body elongate (BD = 10-20% BL)
Gut initially uncoiled, remaining uncoiled until hidden by body wall



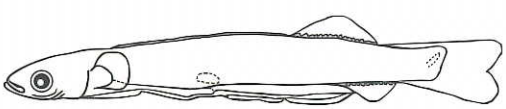
Ammodytidae



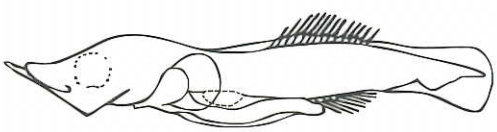
Belonidae



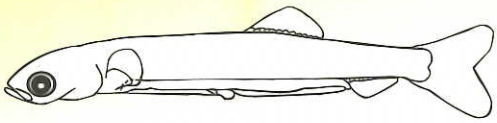
Centriscidae



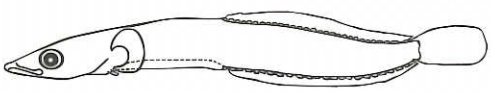
Chanidae



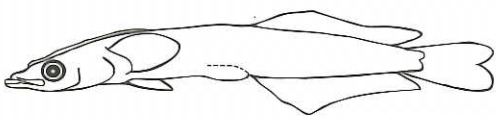
Cirrhitidae



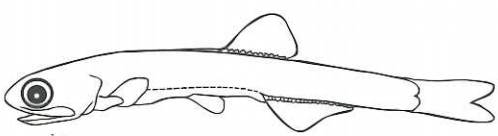
Clupeidae



Creediidae



Echeneidae

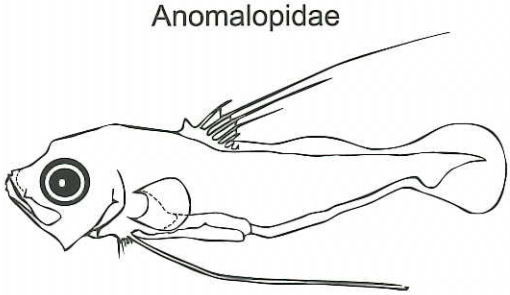


Engraulidae

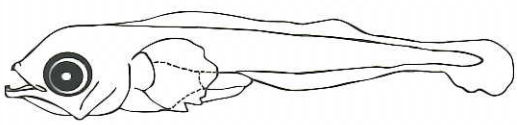
Group 7 (IIC_2)

Body elongate (BD = 10-20% BL)
Gut initially uncoiled, coiling during or after flexion

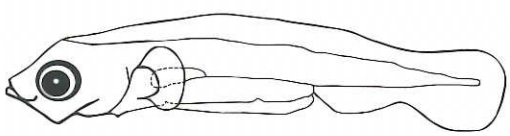
Anomalopidae



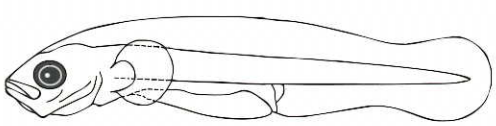
Berycidae



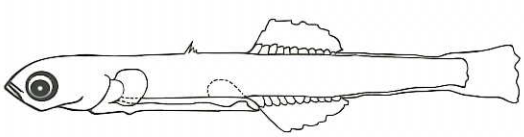
Blenniidae



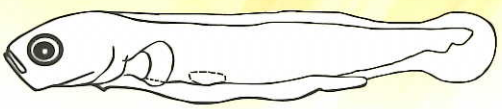
Chaetodontidae



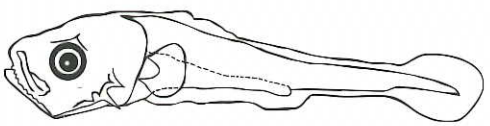
Coryphaenidae



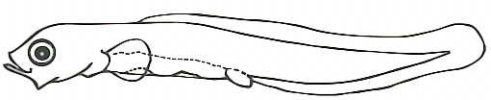
Eleotrididae



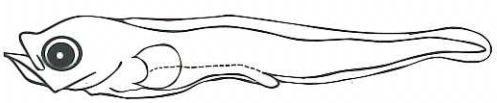
Labridae



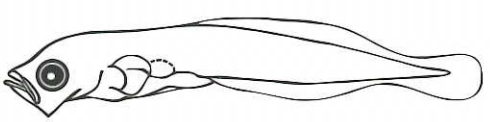
Rachycentridae



Scaridae



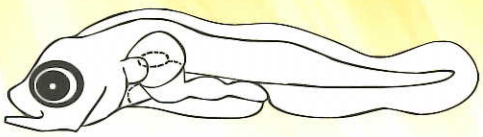
Sillaginidae



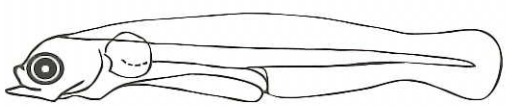
Tripterygiidae

Group 6 (IIC_1)

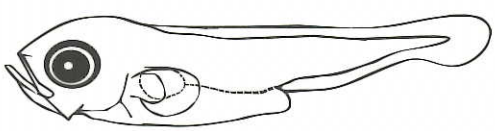
Body elongate (BD = 10-20% BL)
Gut initially uncoiled, coiling before flexion



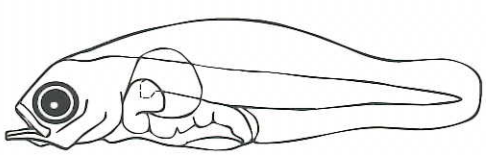
Carangidae



Cheilodactylidae

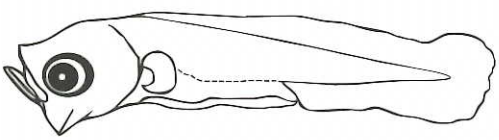


Gobiidae

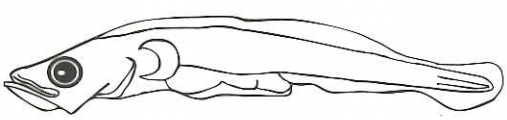


Kyphosidae

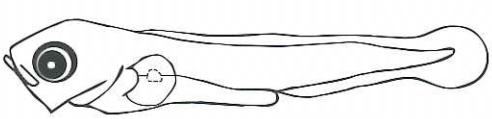
Labridae



Monocentridae



Percophidae



Pseudochromidae

Characters useful for the identification of early stages of fishes, listed by Order (Leis J.M. and Carson-Ewart B. M. 2000. The larvae of Indo-Pacific Coastal Fishes. p.28-30 and Moser H.G. 1996. The Early Stages of Fishes in the California Current. CalCOFI. Atlas No. 33. p.52-56)

	Elopiformes	Anguilliformes	Clupeiformes	Siluriformes	Gonorynchiformes	Aulopiformes	Ophidiiformes
Type of fin elements	Rays	Rays	Rays	Spines and rays	Rays	Rays	Rays
Pectoral fin formation	Late	Late	Late	Late	Late	Often early	Sometimes early
Pelvic fin formation	Late	Absent	Late	Late	Late	Early to late	Late
Pelvic fin position	Abdominal	Absent	Abdominal	Abdominal	Abdominal	Abdominal	Jugular
Pelvic fin formula	10-16	Absent	Usually 7-10	I(0), 5-13	9-12	7-11	0-2
Dorsal fin (s)	1 fin	1 fin	1 fin	1 or 2 fin	1 fin	1 fin	1 fin
Anal fin	1 fin	1 fin	0 spine	0 spine	0 spine	0 spine	0 spine
Adipose fin	No	No	No	Usually present	No	Usually present	No
Principal caudal rays	19 (10+9)	Usually 5-11;absent in some	19	9-10, 17	19	19	0-14
Larvae predominant body shape	Leptocephalus; forked tail	Leptocephalus	Elongate, slender	Slender	Elongate, slender	Various, often elongate	Elongate
Preanal length (%BL)	75-80%	40-95%	48-90%,may decrease ontogenetically	40%	77-90%	c.20-75%	33-55%
Type of gut	Straight	Straight; some with loops; rarely trailing	Straight	Coiled	Straight	Straight, variously shaped	Coiled
Vertebrae	51-82	97-400+ (most 100-250)	39-76	Around 50	40-61	36-121	40-150
Head spination	None	None	None	None	None	Usually none, heavy in 3 genera	Limited to opercular spines
Early forming fin elements	No	No	No	No	No	Occasionally P_1 rays	P_1 rays and vexillum in some

	Gadiformes	Lophiiformes	Gobiesociformes	Atheriniformes	Beloniformes	Mugiliformes	Beryciformes
Type of fin elements	Rays	Spines and rays	Spines and rays, or ray only	Spines and rays,	Rays	Spines and rays	Spines and rays
Pectoral fin formation	Sometimes late	Sometimes early	Late	Late	Late	Late	Not late
Pelvic fin formation	Often early	Often absent, early to late	Late	Late	Late	Late	Often early
Pelvic fin position	Thoracic or jugularl	Thoracic	Thoracic	Abdominal Thoracic	Abdominal	Sub abdominal	Thoracic or abdominal
Pelvic fin formula	Various; 2-8	0 or I, 3-5	I, 4 - I,5	I,5	6	I, 5	0-I, 2-13
Dorsal fin (s)	1-3 fins	2 fins, anterior as illicium on head	1 or 2 fins	2 fins	1 fin	2 fins	1 or 2 fins
Anal fin	0 Spine	0 spine	0-1 spine	0-1 spine	0 spines	2-3 spines	0-4 spines
Adipose fin	No	No	No	No	No	No	No
Principal caudal rays	Various numbers	8-10	8-14	17	15	14-15	18-19
Larvae predominant body shape	Various, elongate to deep-bodiedl	Globular	Moderately to very stubby	Elongate	Elongate	Slender to moderate	Slender to stubby
Preanal length (%BL)	Usually <50%	30-90%	50-85%	20-50%, increases ontogenetically	65-80%	57-78%	c.30-79%
Type of gut	Usually coiled	Deep, coiled	Initially straight, later coiled	Coiled	Straight	Coiled, underslung	Coiled
Vertebrae	40-many	18-31	21-54	21-55	36-97	24-26	24-30
Head spination	Usually none	None	None or one opercular spine	None	None	None	None to markedly heavy
Early forming fin elements	No	Varies, none to P_2 and anterior D	None	None	Caudal formed at hatching	None	Often P_2 and anterior D

	Zeiformes	Gasterosteiformes	Scorpaeniformes	Perciformes	Pleuronectiformes	Tetraodontiformes
Type of fin elements	Spines and rays	Spines and rays	Spines and rays	Spines and rays	Rays, except P2 spine in some	Spines and rays or rays only
Pectoral fin formation	Late	Late	Various	Various	Late	Sometimes early
Pelvic fin formation	Various, early to late	Often absent, late	Intermediate	Sometimes early	Sometimes early	Often absent, late
Pelvic fin position	Abdominal to thoracic	Abdominal	Thoracic	Various,usually thoracic	Thoracic to jugular	Thoracic
Pelvic fin formula	0-I, 3-10	0-6	I,5 or fewer	I,5 or fewer	I,5 or 0,2-6	0-I,5
Dorsal fin (s)	1 fin	1 or 2 fins	1 or 2 fins	1 fin or 2 fins	1 fin	1 or 2 fins
Anal fin	0-3 spines	0-1 spine	0-3 spines	Usually 1-3 spines	0 spine	0 spine
Adipose fin	No	No	No	No	No	No
Principal caudal rays	9-13	0-15	Variable, <18	Usually 17	Variable	9-12
Larvae predominant body shape	Deep, compressed	Various, often elongate	Various, usually stubby	Various, usually stubby	Various, markedly compressed	Various, usually Moderate
Preanal length (%BL)	50-70%	Various, 45-90%	c.35-60%	Various,20-80%	Usually <40%	40-90%
Type of gut	Deep, coiled	Usually straight	Coiled	Various,usually coiled	Coiled	Coiled
Vertebrae	21-46	19-87	c.25-65	c.20-100+, often 24-28	25-65	16-30
Head spination	None to markedly heavy	None to heavy, often associated with body plates	Usually present, heavy in some	None to markedly heavy	None to heavy	Various
Early forming fin elements	Various, none to P2	None to heavy, often associated with body plates	P1 can be large	Sometimes: D spine, P2 spine and rays	Often, 1-12 anterior D rays. Sometimes 2-3 P2 rays	P1 rays sometimes

GUIDE TO IDENTIFYING MORPHOLOGICAL GROUP

(Modified Leis J.M. & Carson-Ewart B. M. 2000.
The Larvae of Indo-Pacific Coastal Fishes. p.31)

I Body very elongate (BD <10% BL)

A – Gut very long (PAL >70% BL)	Group 1
B – Gut of moderate length (PAL = 50-70% BL)	Group 2
C – Gut short (PAL < 50% BL)	Group 3

II Body elongate (BD 10-20% BL)

A – Gut coiled and compact early (by 3 mm)	Group 4
B – Gut coiled early but not compact	Group 5
C – Gut initially uncoiled	
1 – Gut coiled before flexion	Group 6
2 – Gut coiled during or after flexion	Group 7
3 – Gut remains uncoiled until hidden by body wall	Group 8

III Body depth moderate (BD 20-40% BL)

A – Gut coiled and compact early (by 3 mm)	Group 9
B – Gut coiled early but not compact	Group 10
C – Gut initially uncoiled	
1 – Gut coiled before flexion	Group 11
2 – Gut coiled during or after flexion	Group 12
3 – Gut remains uncoiled	Group 13

IV Body deep to very deep (BD > 40% BL)

A – Head and trunk very broad	Group 14
B – Head and trunk strongly compressed	Group 15
C – Head and trunk neither broad nor strongly compressed	
1 – Gut coiled and compact early (by 3 mm)	Group 16
2 – Gut coiled early but not compact	Group 17
3 – Gut initially uncoiled	Group 18

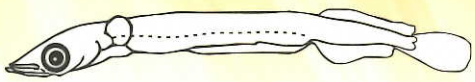
V Body (not just head) dorso-ventrally flattened Group 19

VI Leptocephalus larva

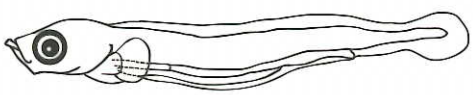
A – Elopiformes Leptocephali (with forked caudal fin)	Group 20
B – Anguilliformes Leptocephali (without forked caudal fin)	Group 21

Group 1 (IA)

Body very elongate (BD <10% BL)
Gut very long (PAL>70% BL)

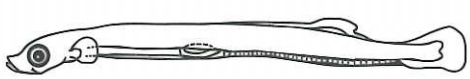


Belonidae

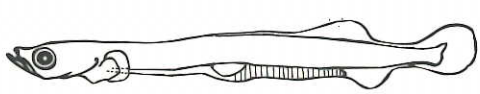


Chanidae

Chirocentridae

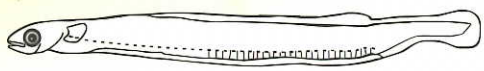


Clupeidae

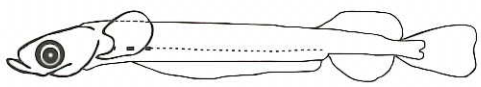


Engraulidae

Fistulariidae

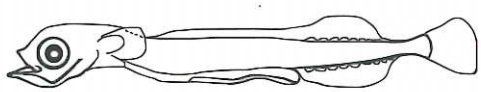


Gonorynchidae

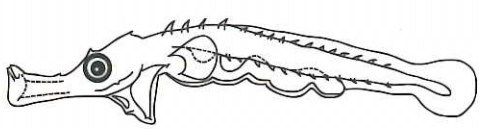


Hemiramphidae

Pristigasteridae



Schindleriidae



Solenostomidae

Synodontidae

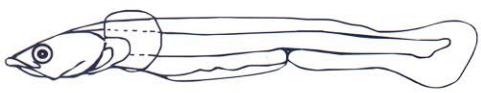
Group 2 (IB)

Body very elongate (BD <10% BL)
Gut of moderate length (PAL=50-70% BL)

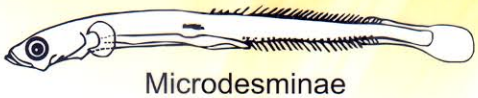
Ammodytidae

Aulostomidae

Creediidae

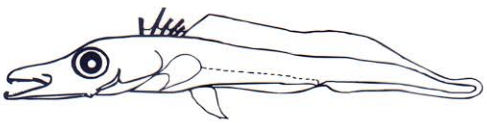


Echeneidae



Microdesminae
Microdesmidae

Schindleriidae

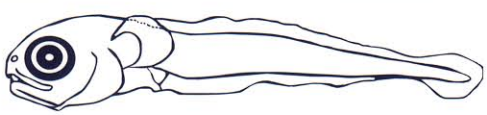


Trichiuridae

Trichonotidae

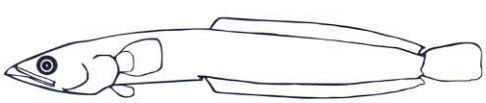
Group 3 (IC)

Body very elongate (BD <10% BL)
Gut short (PAL< 50% BL)

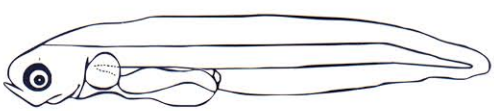


Blenniidae

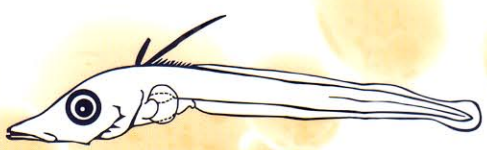
Carapidae



Creediidae



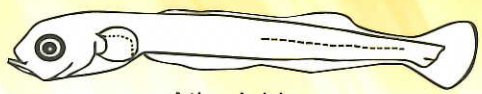
Ophidiidae



Trichiuridae

Group 4 (IIA)

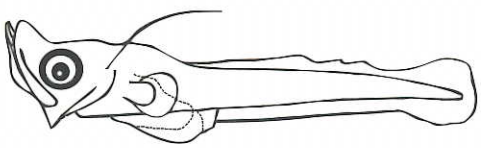
Body elongate (BD 10-20% BL)
Gut coiled and compact early (by 3 mm)



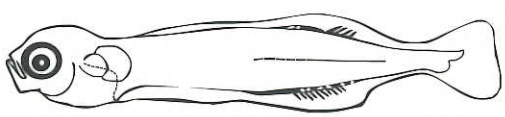
Atherinidae

Blenniidae

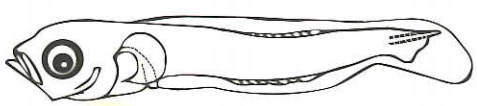
Carapidae



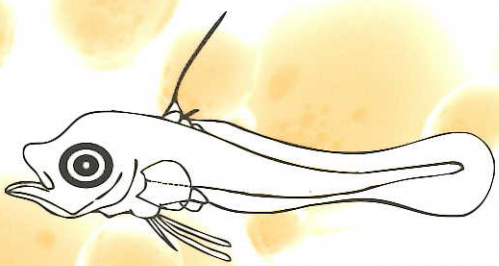
Champsodontidae



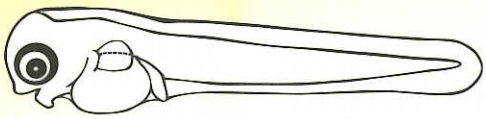
Isonidae



Kuhliidae

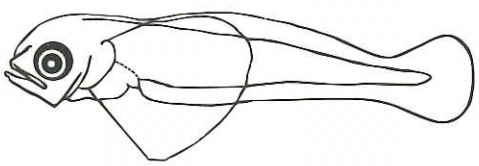


Lutjanidae



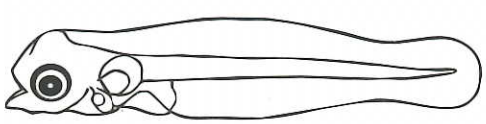
Monacanthidae

Mullidae

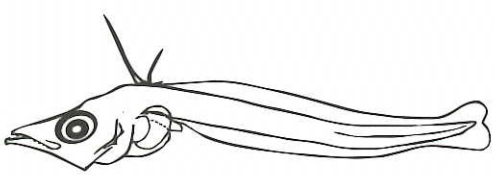


Ophidiidae

Pomacentridae



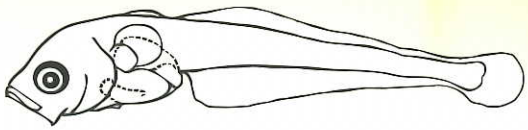
Scombridae



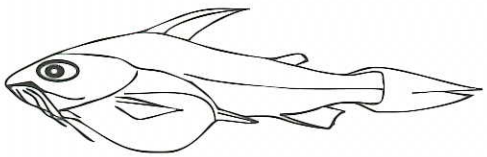
Trichiuridae

Group 5 (IIB)

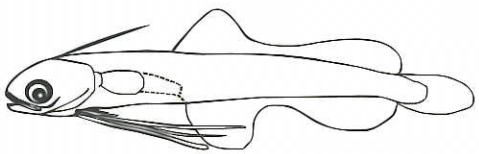
Body elongate (BD = 10-20% BL)
Gut coiled early but not compact



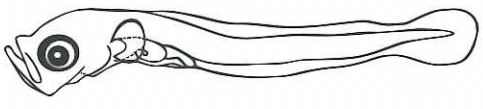
Amblyopinae
Gobiidae



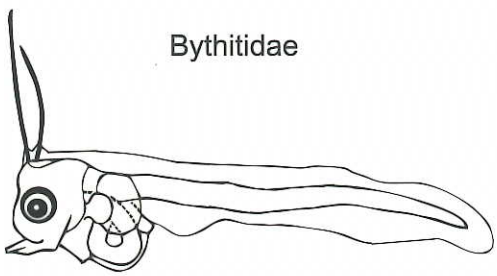
Ariidae



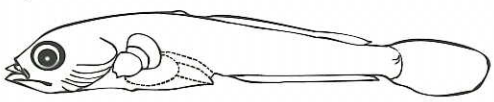
Bregmacerotidae



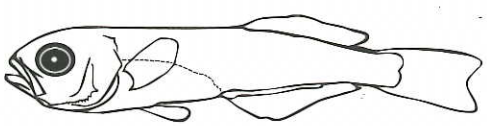
Bythitidae



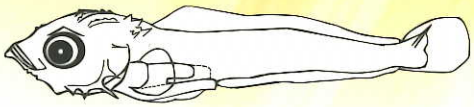
Cynoglossidae



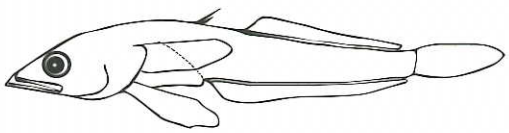
Draconettidae



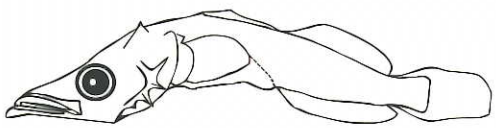
Leptobramidae



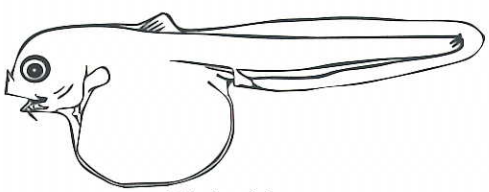
Malacanthinae
Malacanthidae



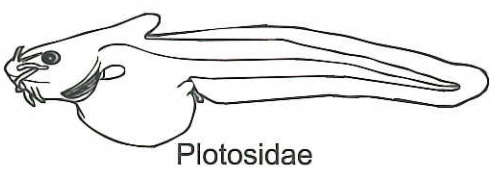
Percophidae



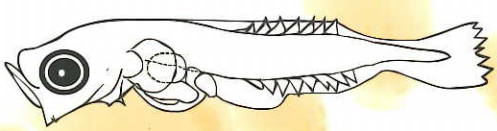
Platycephalidae



Plotosidae



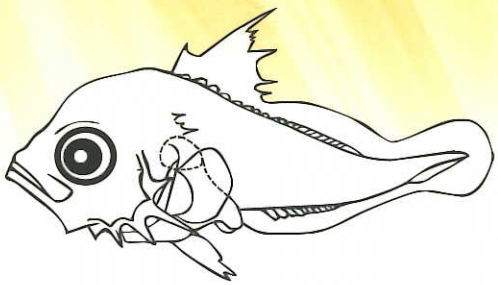
Plotosidae



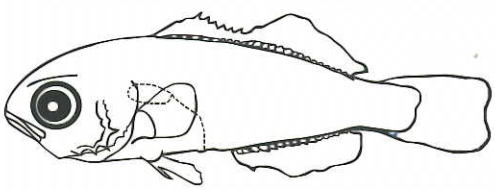
Xenisthmidae

Group 9 (IIIA), continued

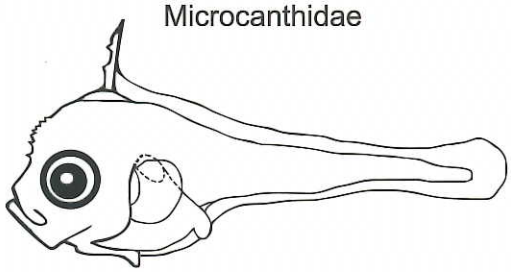
Body depth moderate (BD = 20-40% BL)
Gut coiled and compact early (by 3 mm)



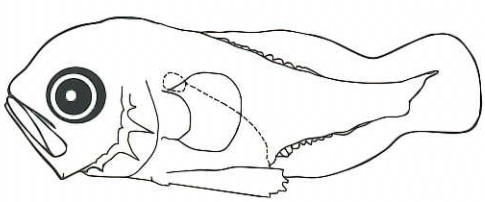
Lutjanidae



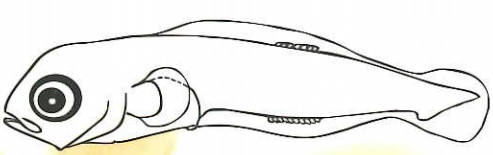
Microcanthidae



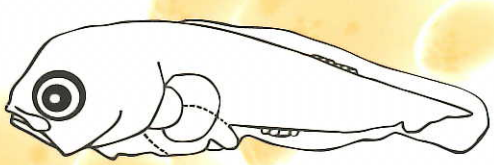
Monacanthidae



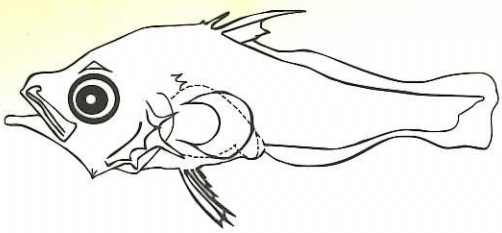
Monodactylidae



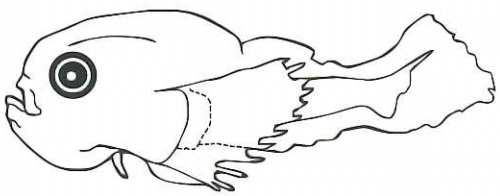
Mullidae



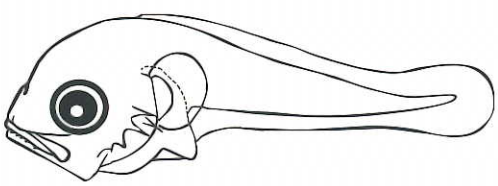
Nemipteridae



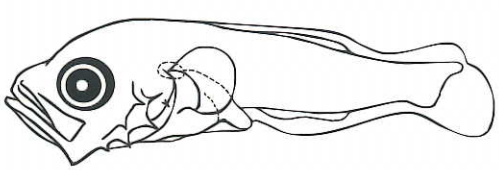
Niphonini
Serranidae



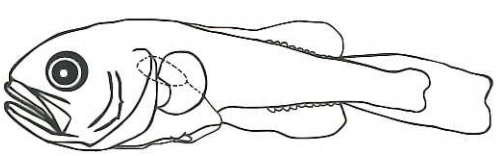
Ogcocephalidae



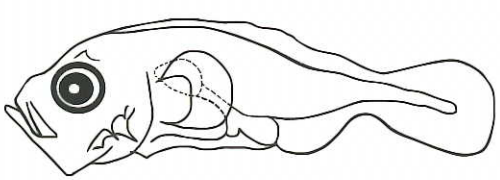
Pinguipedidae



Plesiopidae



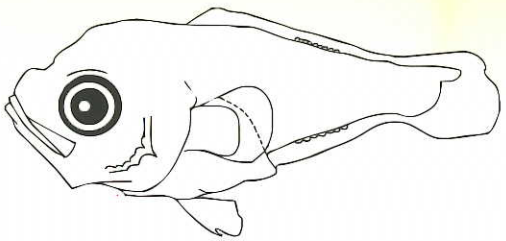
Polynemidae



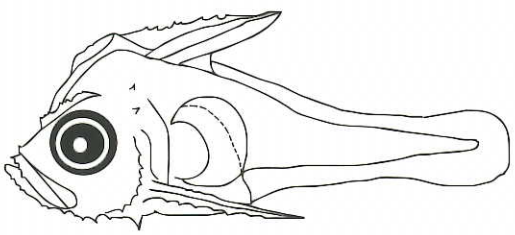
Pomacanthidae

Group 9 (IIIA), continued

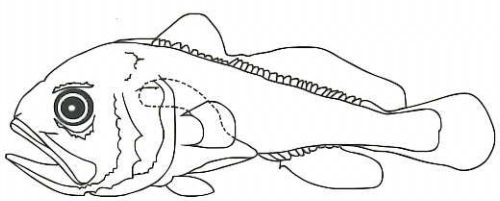
Body depth moderate (BD = 20-40% BL)
Gut coiled and compact early (by 3 mm)



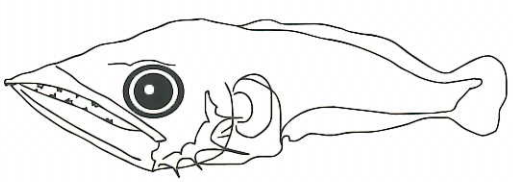
Pomacentridae



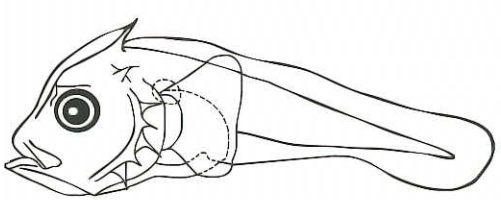
Priacanthidae



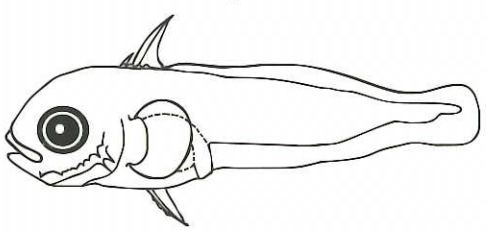
Sciaenidae



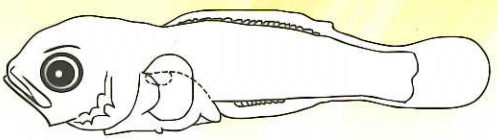
Scombridae



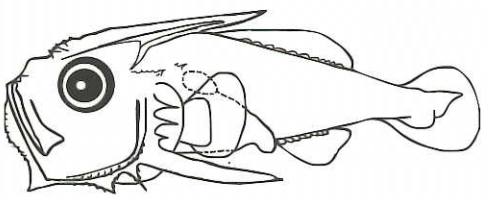
Scorpaenidae



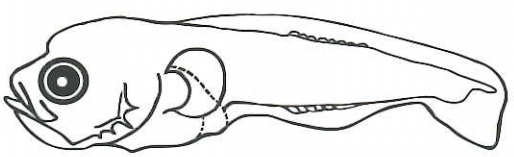
Siganidae



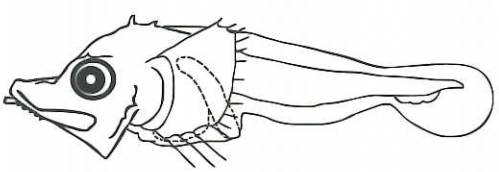
Sparidae



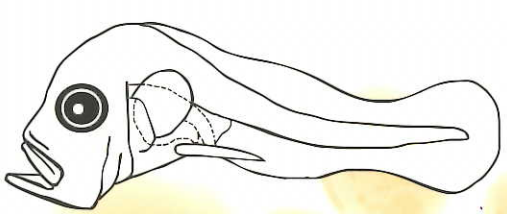
Symphysanodontidae



Terapontidae



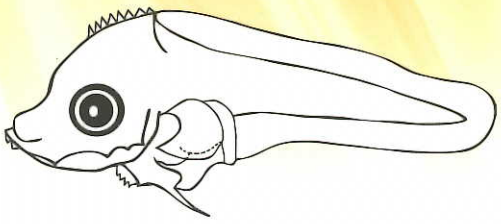
Triglidae



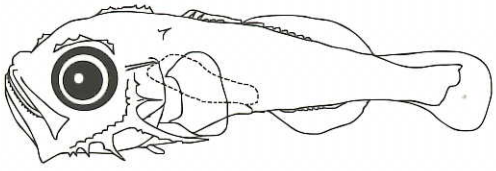
Zeidae

Group 10 (IIIB)

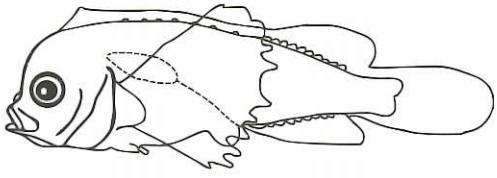
Body depth moderate (BD = 20-40% BL)
Gut coiled early, but not compact



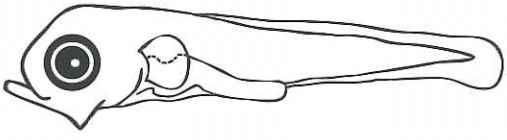
Acanthuridae



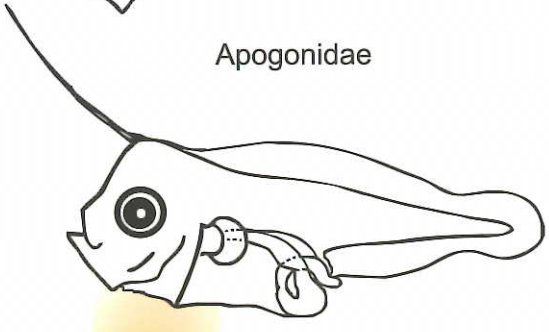
Acropomatidae



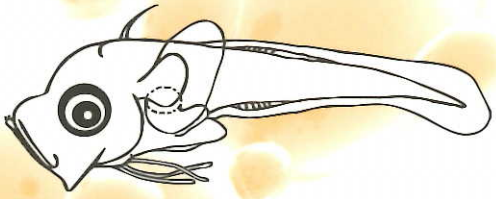
Aploactinidae



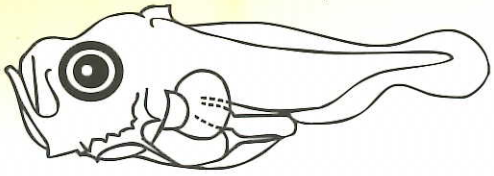
Apogonidae



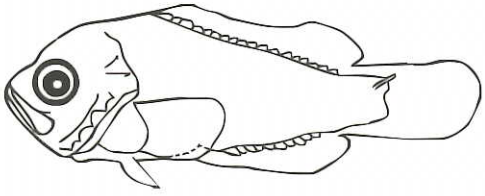
Bothidae



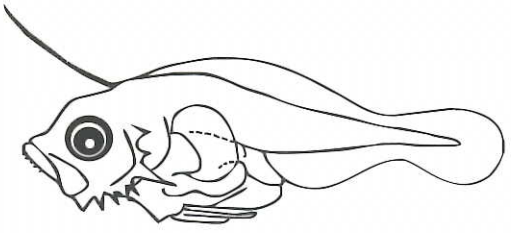
Bregmacerotidae



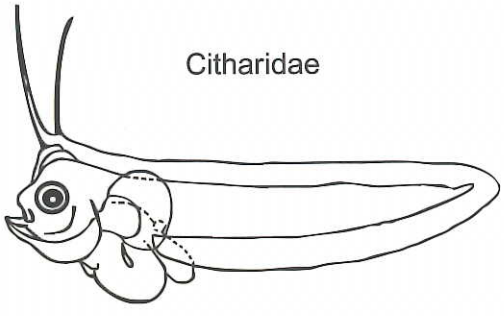
Carangidae



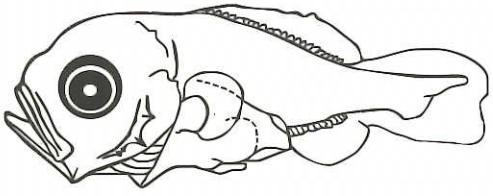
Centrogeniidae



Citharidae



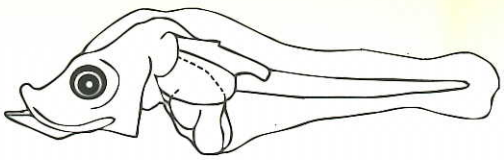
Cynoglossidae



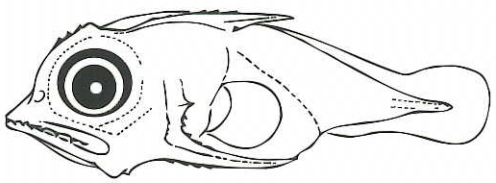
Glaucosomatidae

Group 10 (IIIB), continued

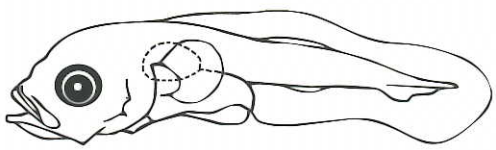
Body depth moderate (BD = 20-40% BL)
Gut coiled early, but not compact



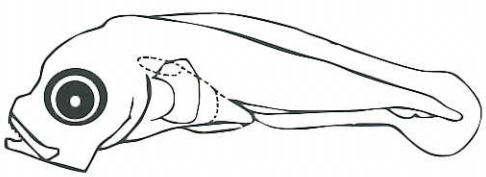
Hoplichthyidae



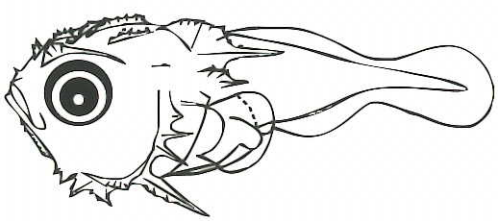
Istiophoridae



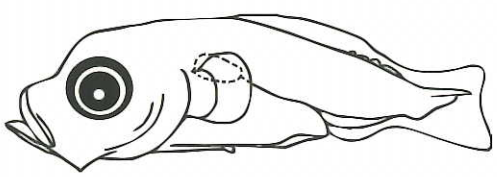
Latidae



Leptobramidae

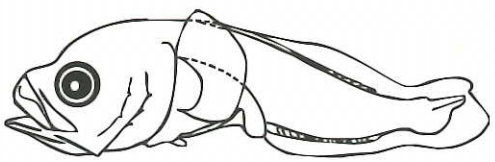


Malacanthinae
Malacanthidae

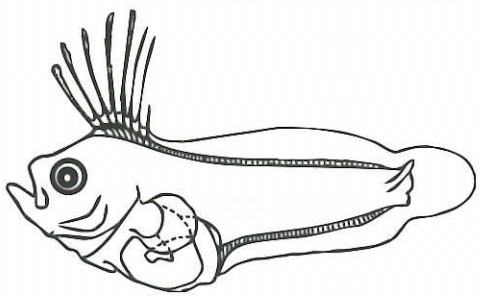


Mugilidae

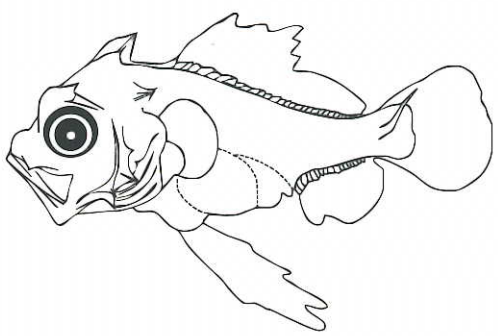
Nomeidae



Opistognathidae

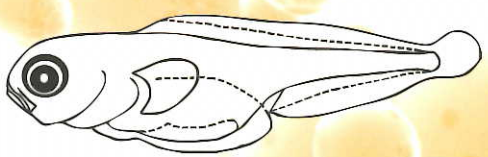


Paralichthyidae



Pentacerotidae

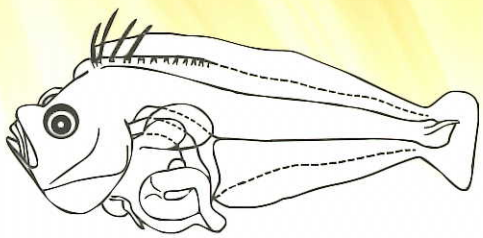
Percophidae



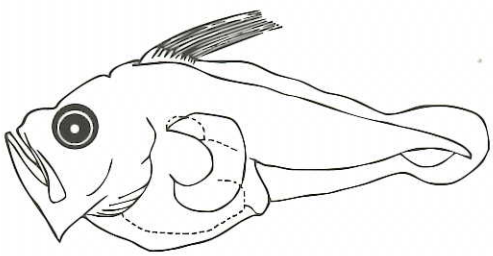
Pholidichthyidae

Group 10 (IIIB), continued

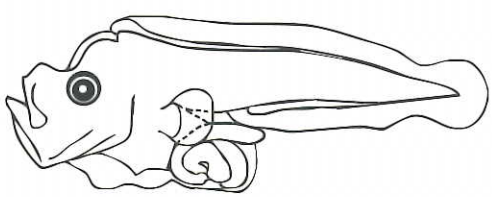
Body depth moderate (BD = 20-40% BL)
Gut coiled early, but not compact



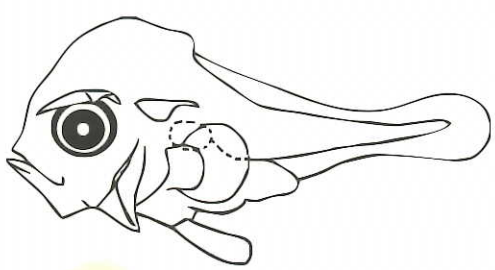
Poecilopsettidae



Psettodidae

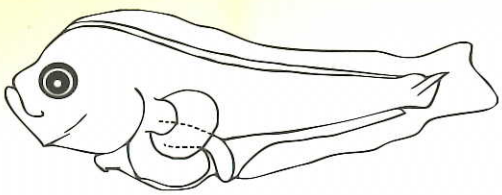


Samaridae

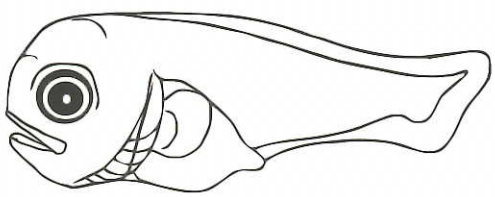


Scatophagidae

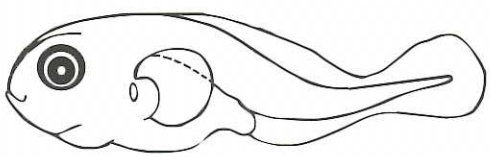
Serraninae
Serranidae



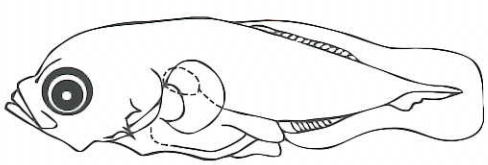
Soleidae



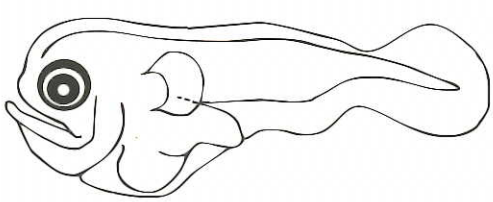
Stromateidae



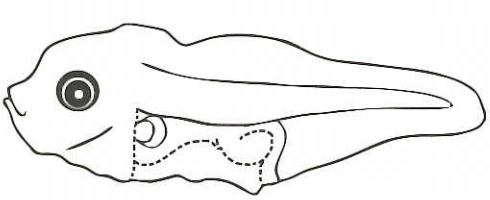
Tetraodontidae



Toxotidae



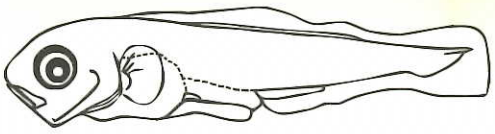
Uranoscopidae



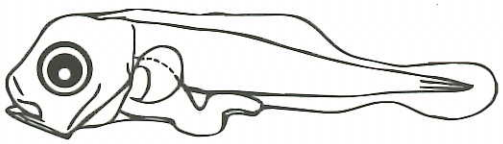
Zanclidae

Group 11 ($IIIC_1$)

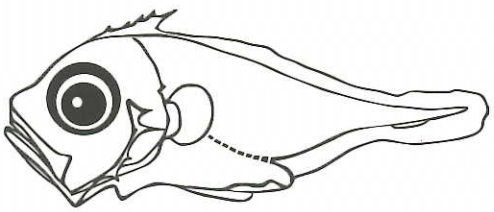
Body depth moderate (BD = 20-40% BL)
Gut initially uncoiled, coiling before flexion



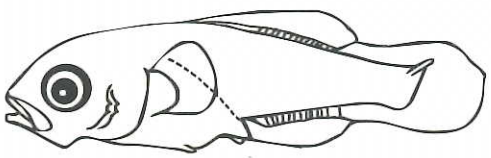
Cheilodactylidae



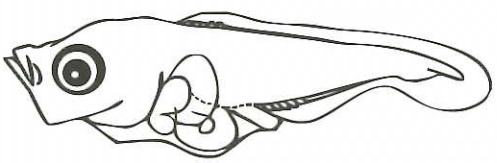
Emmelichthyidae



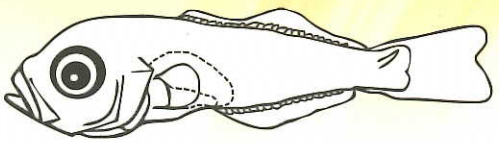
Hapalogenys



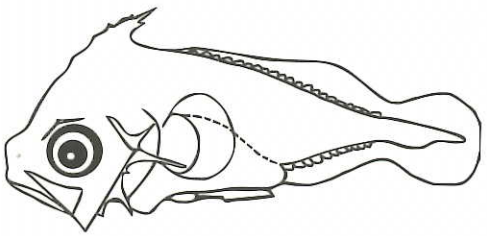
Kyphosidae



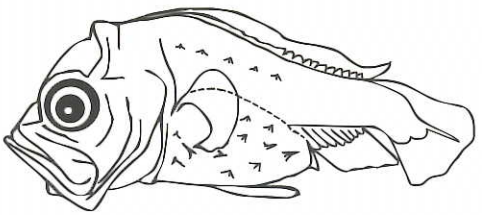
Labridae



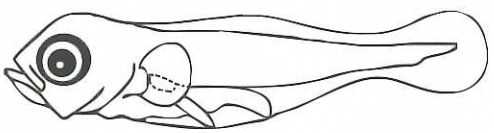
Lactariidae



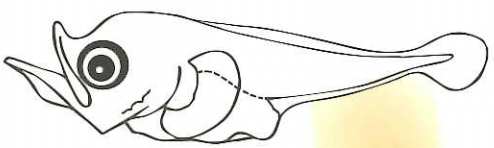
Lobotidae



Monocentridae



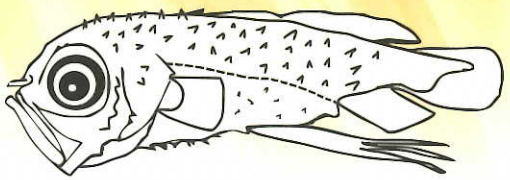
Pempheridae



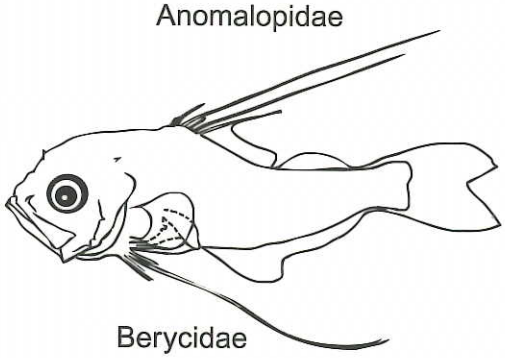
Platycephalidae

Group 12 ($IIIC_2$)

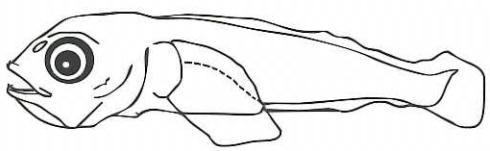
Body depth moderate (BD = 20-40% BL)
Gut initially uncoiled, coiling during or after flexion



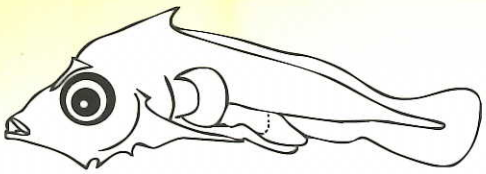
Anomalopidae



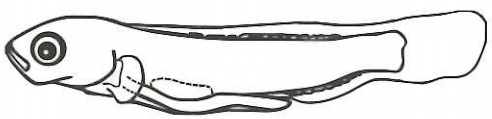
Berycidae



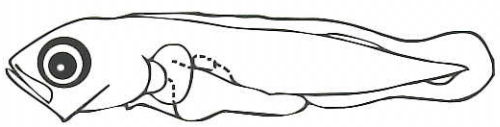
Blenniidae



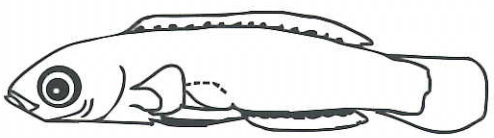
Chaetodontidae



Labridae



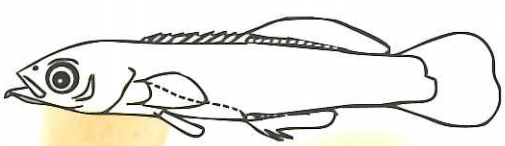
Pseudochromidae



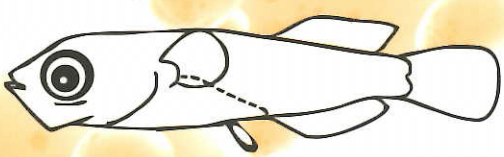
Scaridae

Group 13 ($IIIC_3$)

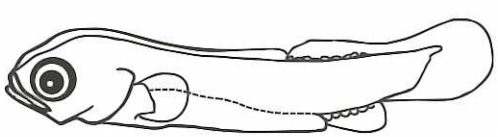
Body depth moderate (BD = 20-40% BL)
Gut initially uncoiled, remaining uncoiled



Cirrhitidae



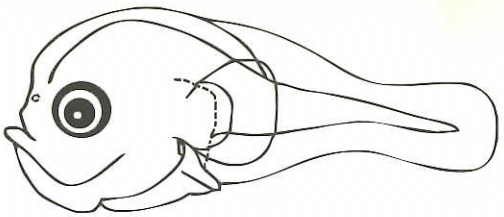
Exocoetidae



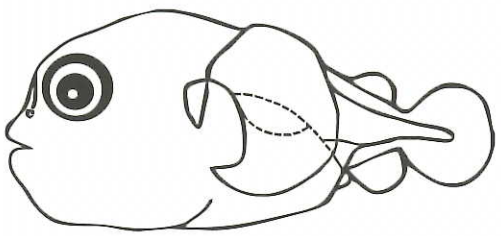
Gobiesocidae

Group 14 (IVA)

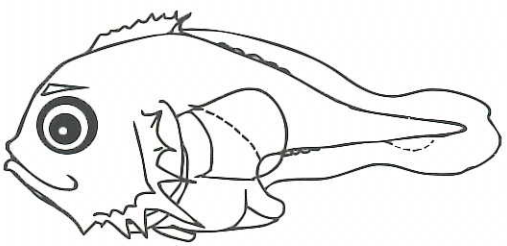
Body deep to very deep (BD > 40% BL)
Head and trunk very broad



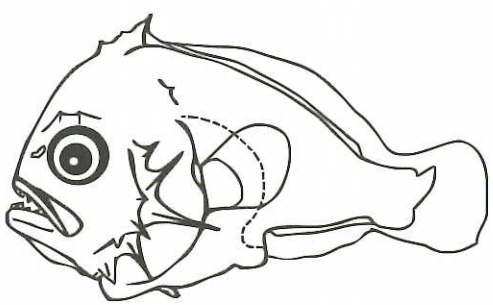
Antennariidae



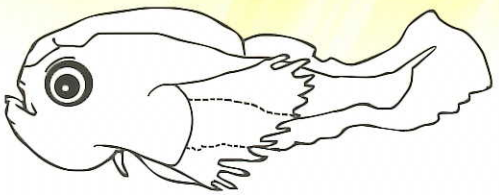
Diodontidae



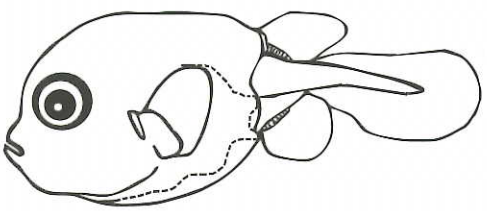
Drepaneidae



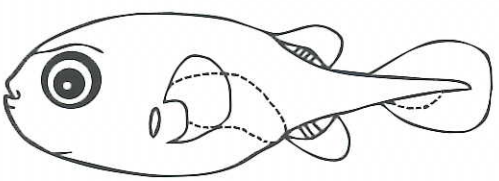
Ephippidae



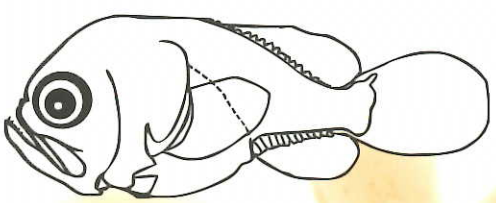
Ogcocephalidae



Ostraciidae



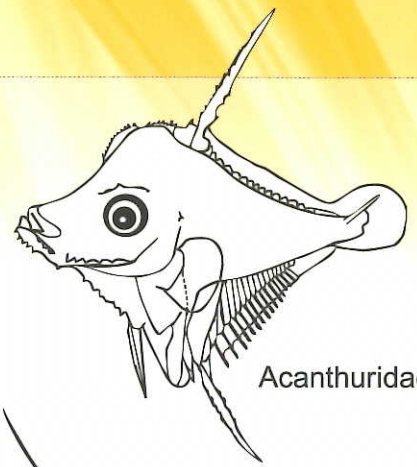
Tetraodontidae



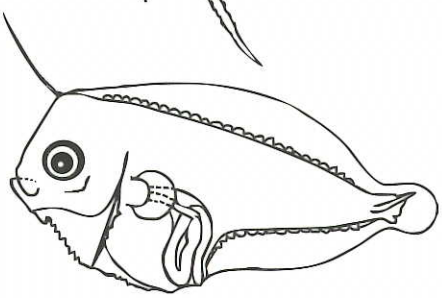
Uranoscopidae

Group 15 (IVB)

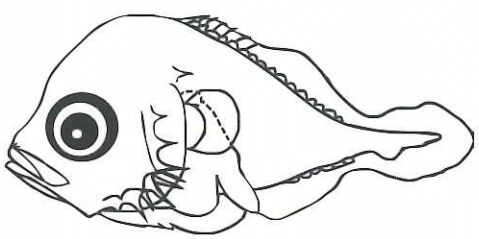
Body deep to very deep (BD > 40% BL)
Head and trunk strongly compressed



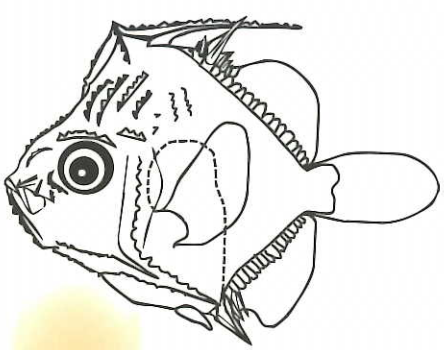
Acanthuridae



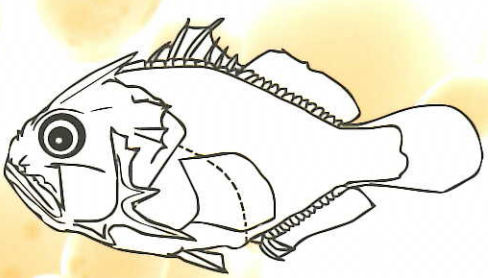
Bothidae



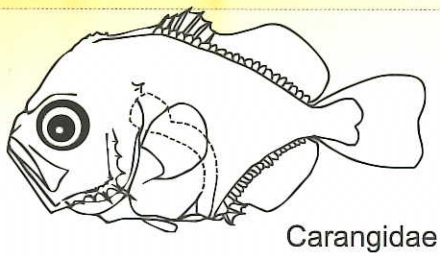
Callanthiidae



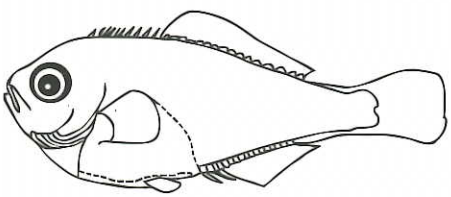
Caproidae



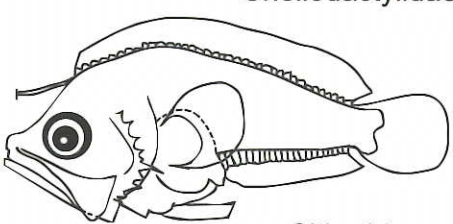
Caracanthidae



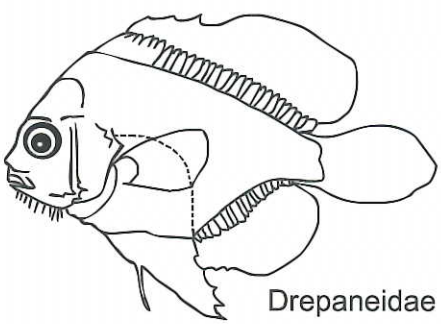
Carangidae



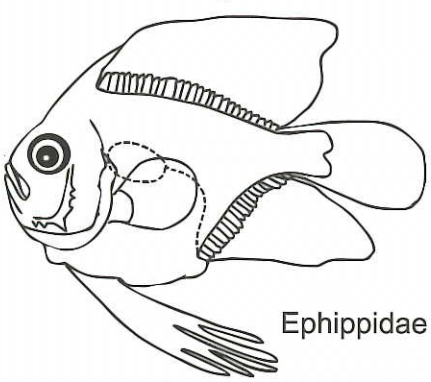
Cheilodactylidae



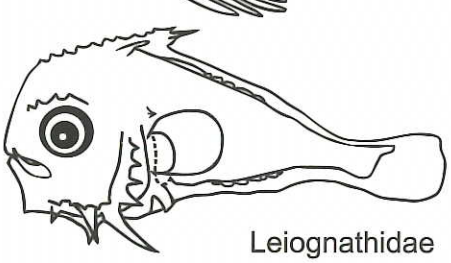
Citharidae



Drepaneidae



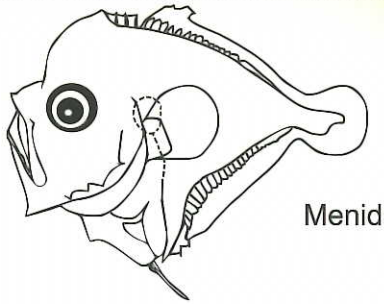
Ephippidae



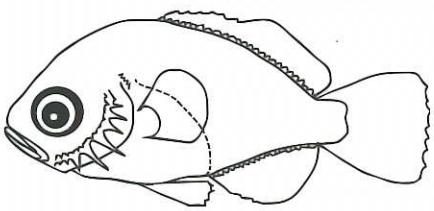
Leiognathidae

Group 15 (IVB), continued

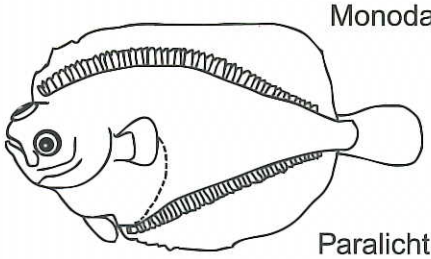
Body deep to very deep (BD > 40% BL)
Head and trunk strongly compressed



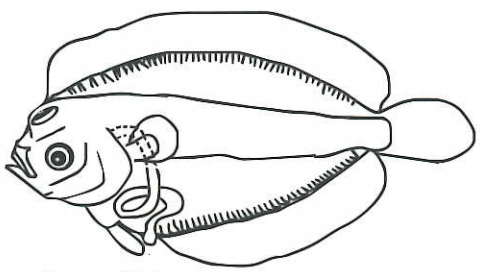
Menidae



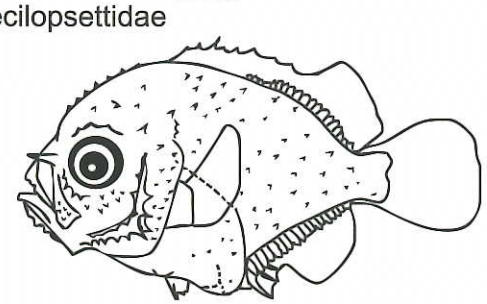
Monodactylidae



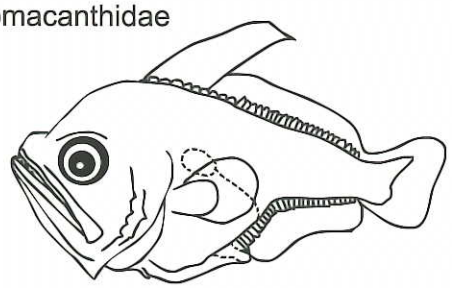
Paralichthyidae



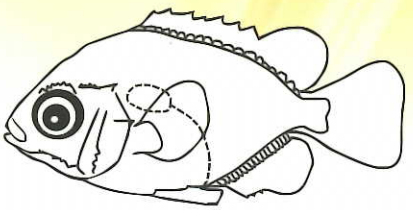
Poecilopsettidae



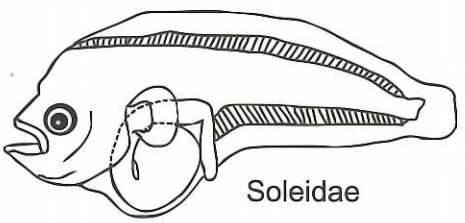
Pomacanthidae



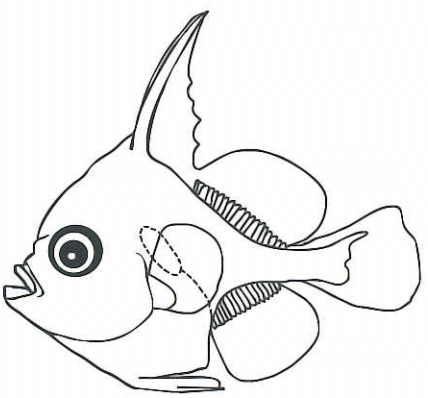
Psettodidae



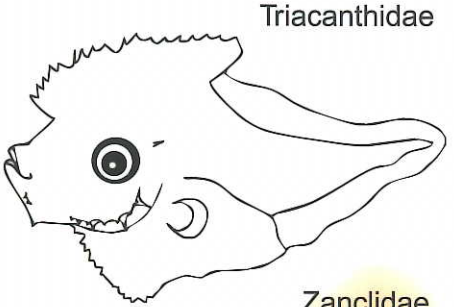
Scatophagidae



Soleidae



Triacanthidae

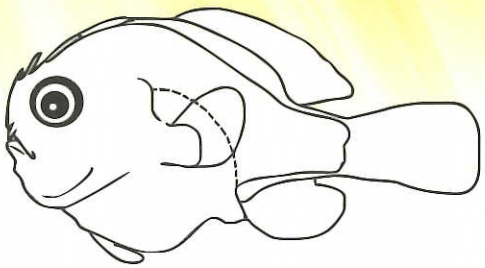


Zanclidae

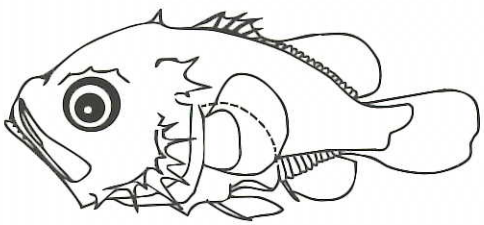
Zeidae

Group 16 (IVC_1)

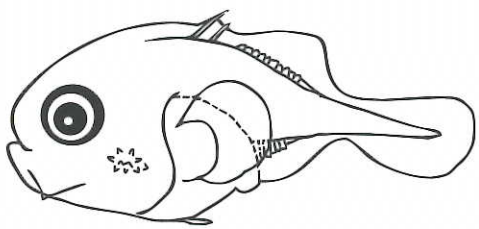
Body deep to very deep (BD > 40% BL)
Head and trunk neither broad nor strongly compressed.
Gut coiled and compact early (by 3 mm)



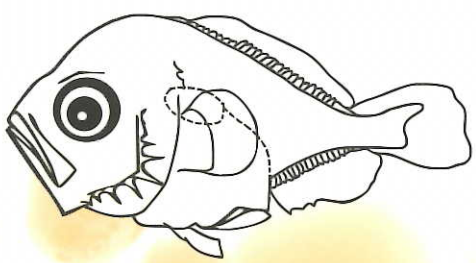
Antennariidae



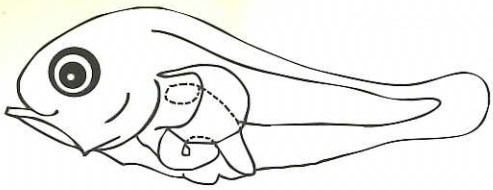
Anthiinae
Serranidae



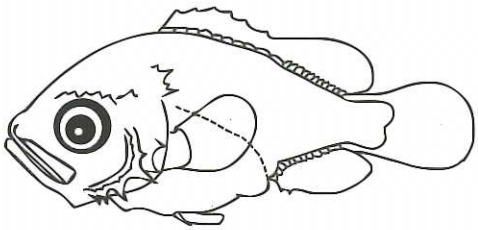
Balistidae



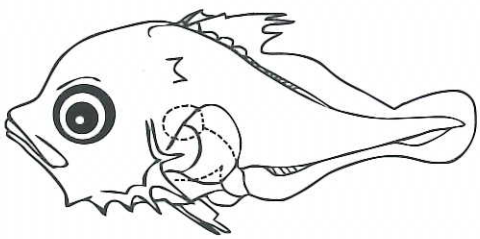
Carangidae



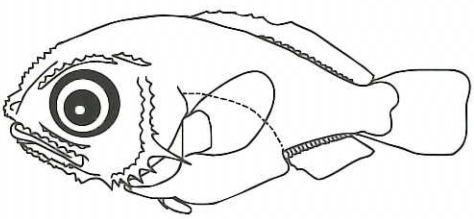
Epinephelinae
Serranidae



Haemulidae



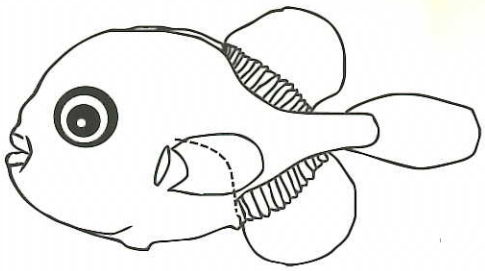
Lutjanidae



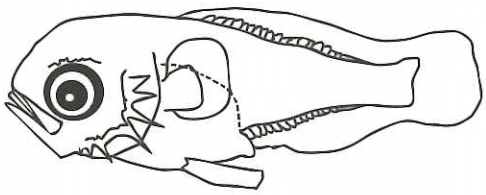
Branchiosteginae
Malacanthidae

Group 16 (IVC_1), continued

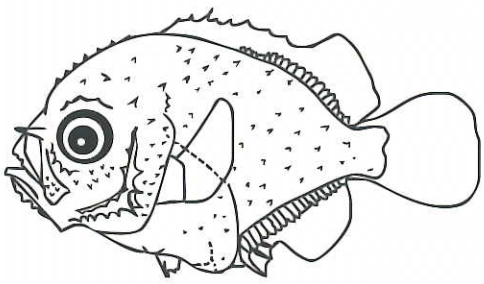
Body deep to very deep (BD > 40% BL)
Head and trunk neither broad nor strongly compressed.
Gut coiled and compact early (by 3 mm)



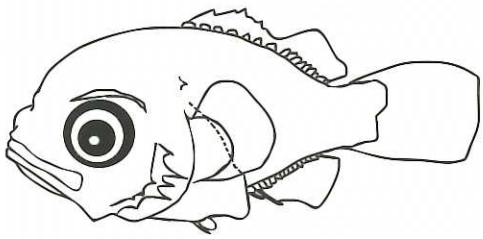
Monacanthidae



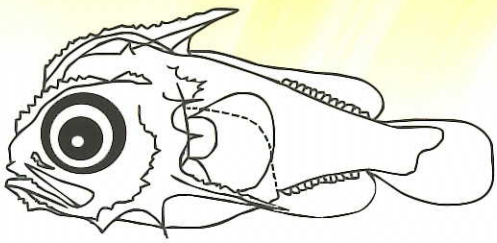
Monodactylidae



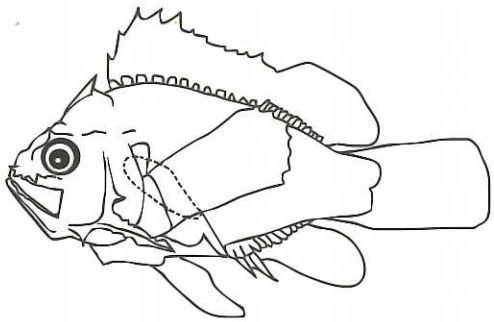
Pomacanthidae



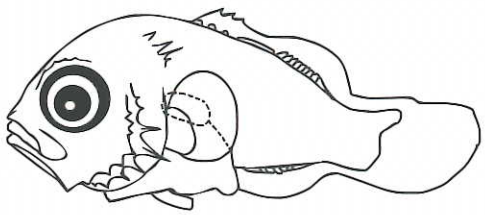
Pomacentridae



Priacanthidae



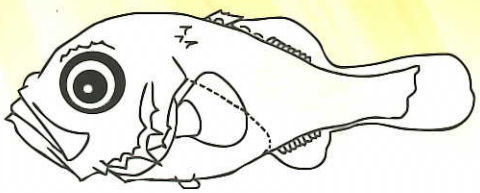
Scorpaenidae



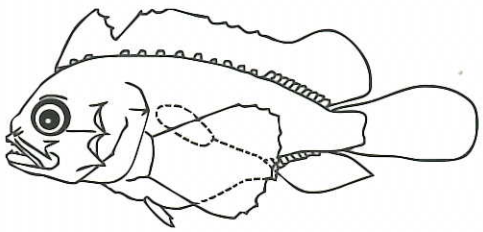
Sparidae

Group 17 (IVC_2)

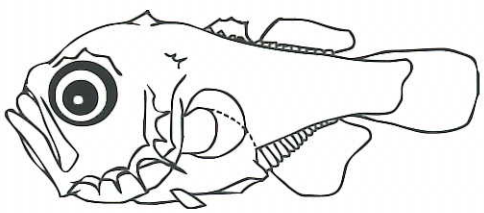
Body deep to very deep (BD > 40% BL)
Head and trunk neither broad nor strongly compressed.
Gut coiled early but not compact



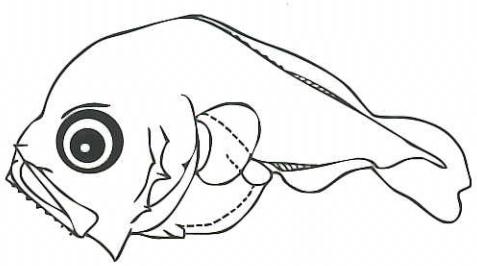
Acropomatidae



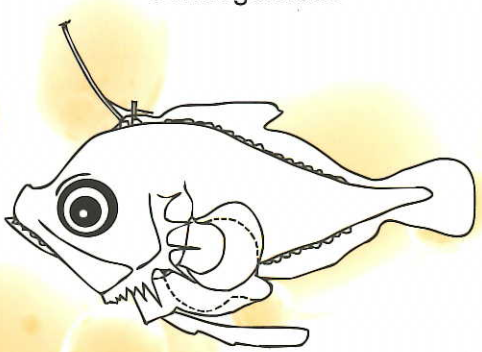
Aploactinidae



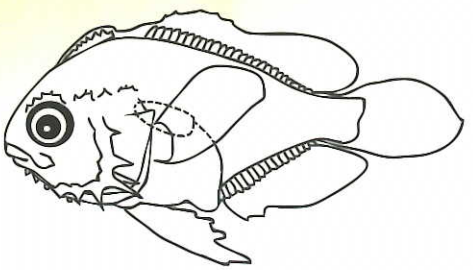
Apogonidae



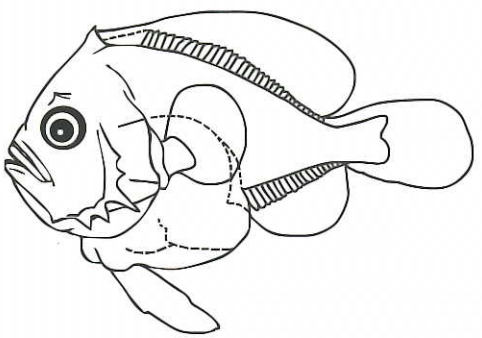
Centrogeniidae



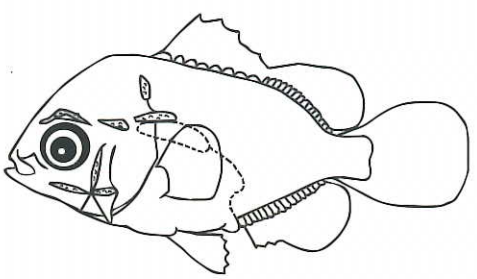
Citharidae



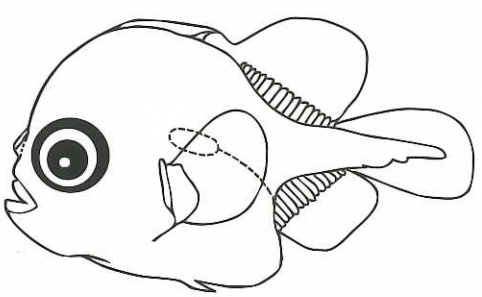
Drepaneidae



Ephippidae



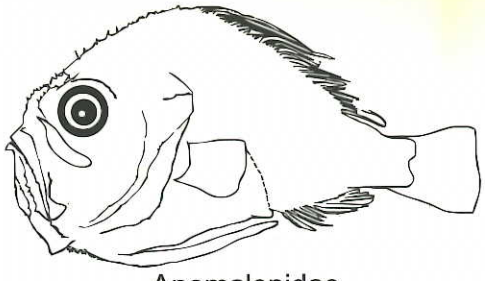
Scatophagidae



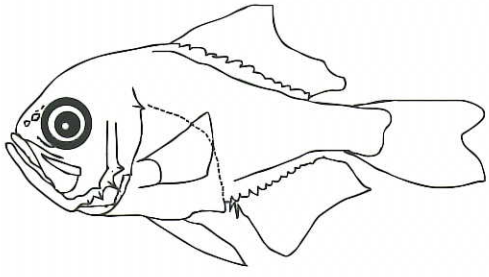
Triacanthidae

Group 18 (IVC_3)

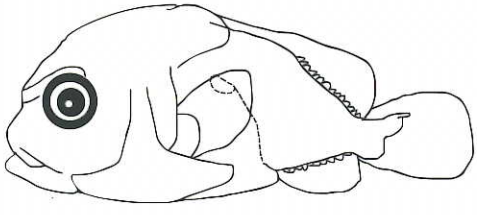
Body deep to very deep (BD > 40% BL)
Head and trunk neither broad nor strongly compressed.
Gut initially uncoiled



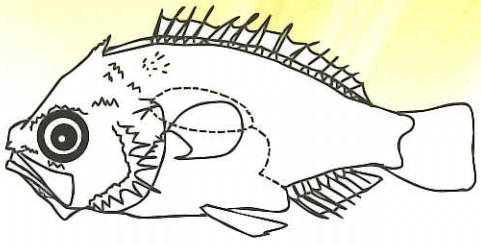
Anomalopidae



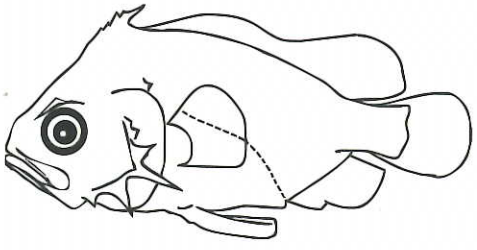
Berycidae



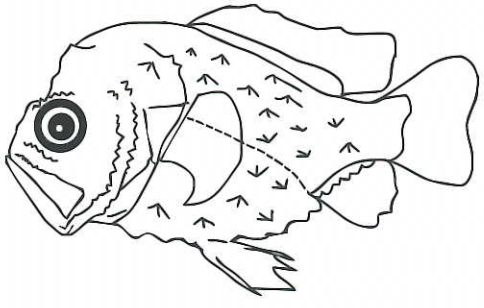
Chaetodontidae



Hapalogenys



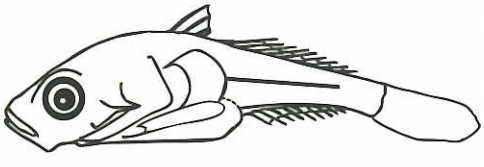
Lobotidae



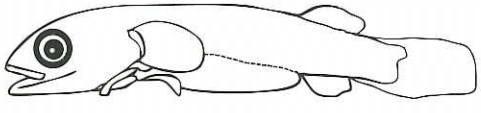
Monocentridae

Group 19 (V)

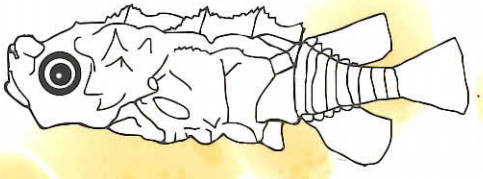
Body (not just head) dorso-ventrally flattened



Callionymidae



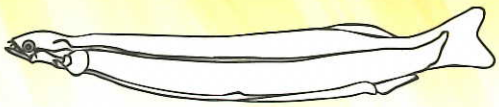
Gobiesocidae



Pegasidae

Group 20 (VI A)

Leptocephalus larva
Elopiformes Leptocephali (with forked caudal fin)

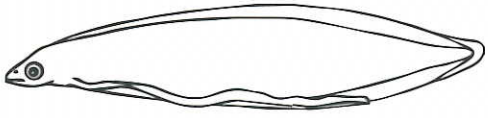


Elopidae

Megalopidae

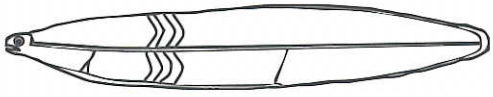
Group 21 (VI B)

Leptocephalus larva
Anguilliformes Leptocephali (without forked caudal fin)



Anguillidae

Congridae



Muraenidae

Muraenesocidae