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STAGES IN THE EARLY DEVELOPMENT OF 40 MARINE FISH SPECIES WITH PELAGIC EGGS FROM THE CAPE OF GOOD HOPE

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ABSTRACT

Pelagic marine fish eggs were collected over a period of 28 months from inshore waters of the Cape of Good Hope. Some 40 species were encountered, of which about 30 were identifiable — either with the aid of published descriptions (particularly those of J. D. F. Gilchrist) or by rearing in the laboratory. Notes are included on the identification of eggs and larvae, duration of the incubation period, spawning season and distribution of the adult, and laboratory rearing. The text is accompanied by 184 figures of eggs, larvae, and juveniles.

INTRODUCTION

The first in-depth studies of eggs and larvae of South African marine fishes were those undertaken by Prof. J. D. F. Gilchrist, who came to the Cape Colony from England in 1896. Originally as Cape Government Biologist and Honorary Curator at the South African Museum, later as Professor of Zoology at the South African College School (which became the University of Cape Town under his professorship) (Day, 1977), Gilchrist produced seven publications on the subject (Gilchrist 1903, 1904, 1914a, 1916, 1918, 1921; Gilchrist & Hunter, 1919). A total of 68 marine teleost species were dealt with in these articles. He described ripe ovarian eggs of 25 species, of which he successfully artificially fertilized 8; he described sea-spawned pelagic eggs of 31 species, of which he identified (correctly) 9. In addition, he dealt with the non-planktonic eggs of 10 species and with early viviparous stages of two more.

Since Gilchrist's death in 1926, there have been no local contributions to South African fish egg and larva biology on a comparable scale. Early life histories of several of the commercially important species have received attention, however, *e.g.* the South African pilchard, *Sardinops ocellata* (Davies, 1954; Louw & O'Toole, 1977), the Cape anchovy, *Engraulis capensis* (King et al., 1978); the hakes, *Merluccius* spp. (Matthews & De Jager, 1951; Haigh, 1972a), the maasbanker, *Trachurus trachurus capensis* (Haigh, 1972b; King et al., 1977), and the snoek, *Thrysites atun* (De Jager, 1955; Haigh, 1972a).

The present author's studies on water quality requirements for first-feeding (Brownell, 1979) necessitated the collection and identification of pelagic fish eggs from the inshore plankton of the Cape of Good Hope. Although many of the eggs encountered during those studies have already been quite adequately described by Gilchrist, enough new material was made available to warrant a review of the subject. Whenever possible in the treatment which follows, reference is made to Gilchrist's original descriptions.

Several limitations have been placed, intentionally or unintentionally, on the scope of this project: (1) Only species with planktonic eggs have been included. (2) All material (with one exception) was collected in the egg stage by plankton net and maintained in the laboratory until the desired developmental stage had been reached. (3) No descriptions were based on ripe ovarian eggs or on artificially fertilized eggs or larvae. (4) All drawings were based (with two exceptions) on live, anaesthetized specimens.

[1] The publication of this work has been subsidized by grants from The Department of National Education, The Fisheries Development Corporation of South Africa Ltd, and The University of Cape Town.

MATERIALS AND METHODS

Collecting sites, four on the Atlantic side of the Cape Peninsula, three on the False Bay side, are indicated on the accompanying map (Fig. 1). An introduction to the biotic and abiotic features of the region may be obtained by consulting the reviews by Heydorn et al. (1978), Brown & Jarman (1978), and Harris (1978).

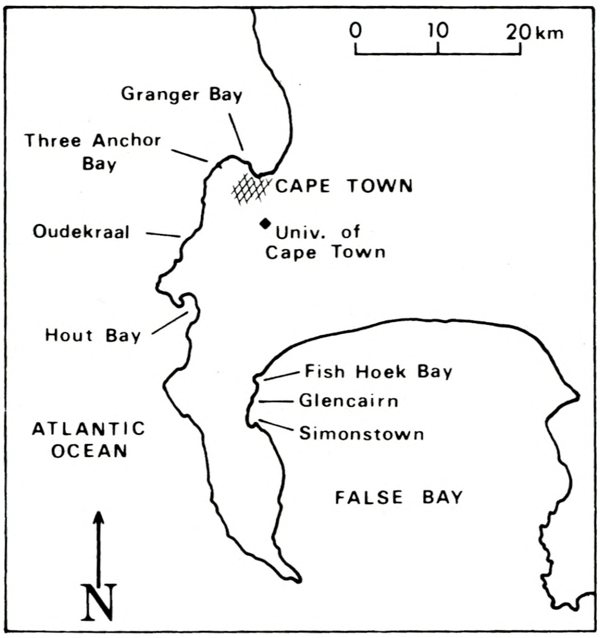

Figure 1
The Cape of Good Hope

Tows were made within 3 km of shore with a 3-m fibre-glass boat, powered by a 4-hp outboard motor. Two plankton nets were fixed to a bent steel beam clamped across the boat in the fashion shown in Fig. 2. The nets have mouths of 0.5 m^2 (80 cm diam.), are about 3 m long, and are fitted with a 1.5—1 perspex codend that unscrews from a threaded polyethylene ring sewn to the fabric. The ratio of filtering area to mouth area is 7.0:1. The mesh is an inexpensive synthetic cloth sold as curtain material, with openings 1.0 by 0.3 mm . Course mesh (5 mm openings) stretched across the mouth kept larger animals and floating debris out of the nets. The position of the nets relative to the motor meant that care had to be taken to avoid fouling the propeller. This disadvantage was out-weighed, however, by the fact that the codends could be alternately drawn into the boat by a cord attached to the polyethylene ring, and emptied every few minutes, without fully cutting speed and without disconnecting the nets. Towing speed varied from 0.5 to 1.0 m sec^{-1}, and an estimated 500—2000 m^3 of water was sieved during a typical sortie.

Viable eggs were picked out under a dissecting microscope and all pre-feeding stages were held in a special closed-circulation system described by Brownell (1979). Rearings were conducted in eight rectangular, all-glass, 10 *l* tanks connected to another closed-circulation system. The latter incorporates a 500 *l* reserve tank and a 40 *l* submerged biofilter, and is powered by air-lift. Half the sea water in the system was replaced at approximately 12-month intervals. Several simple rearing tank designs were experimented with. The most successful is based on the well-known (see Spotte, 1970) "false-bottom" or "sub-sand filter" arrangement. The tank has a perforated filter plate raised a centimetre off the bottom. A 1-cm bed of coarse beach sand (1.5—2.5 mm particle size) covers the filter plate; a thin (0.5 cm) layer of crushed (100—700 μm particle size) coal or bone charcoal covers the beach sand. The back and side walls of the tanks are covered externally by black polyethylene sheet, which with the black-sand bottom, provides a background against which larvae can presumably better perceive their prey. When the tank is emptied for cleaning, the two layers can be rapidly separated with a 1-mm sieve. Water from a small header tank enters at a rate just sufficient to result in a 90% replacement every 24 h (*i.e.* ca. 15 ml min^{-1}). Water exits from beneath the filter plate by constant-level siphon. A fine jet of compressed air directed obliquely at the surface of each rearing tank keeps the contents sufficiently mix-

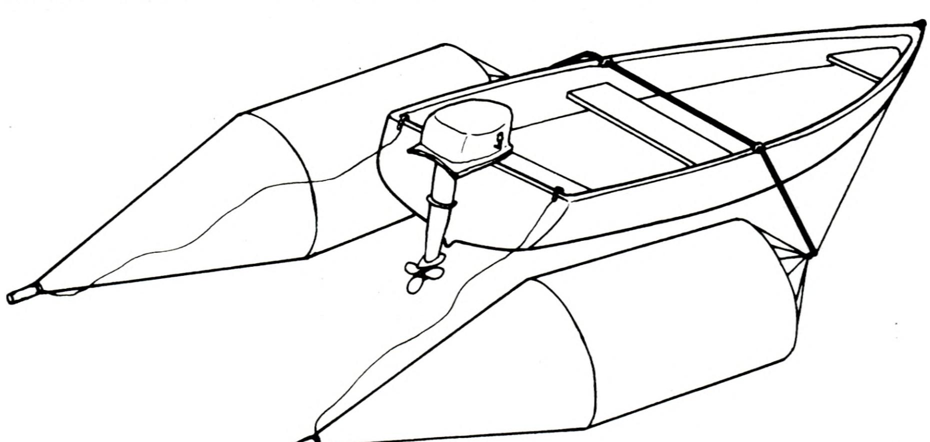

Figure 2
The collecting gear

ed without recourse to bubbling or mechanical mixing. Fluorescent lighting directly over the tanks produces about 2500 lux at the water surface on a 14L:10D cycle. During the 10 h of darkness, there is low-level lighting from other sources in the room. Almost all rearings were carried out at 15°C.

Cultured rotifers were the first food given the larvae: Very small-mouthed larvae were offered *Proales* cf. *similis,* and larger-mouthed larvae were given *Brachionus plicatilis.* Later, cultured copepods *(Tisbe* sp. and *Pseudodiaptomus hessei),* ostracods (*"Cypridopsis" sensu lato* sp.), and amphipods *(Austrochiltonia subtenuis)* were offered. Suspensions of phytoplankton *(Chlorella* or *Phaeodactylum)* were added daily, along with the food. Additional rearing notes accompany species descriptions.

When possible, drawings were made at the following ages (post-hatch): egg, newly-hatched (0—6 h, 2 d, 4 d, 8 d, 16 d, and 32 d. They were done with the aid of a camera lucida from living (with two exceptions: Figs. 94 and 106) eggs and larvae, anaesthetized with MS-222. The fish drawn were subsequently fixed (3—5% formalin) for later reference. The specimens will be deposited in the collection of the South African Museum, Cape Town. It must be stressed that a series of drawings of a particular species does not represent subsequent stages of the same individual.

Notochord length (NL) was measured from the snout (not mandible) tip to the posterior end of the notochord; standard length (SL), from the snout tip to the posterior end of the hypural; total length (TL), from the most anterior point (either snout or mandible (but with mouth closed), sometimes yolk sac) to the most posterior. Myomeres were counted in the following way: 1) Any myomere intersected by a vertical line passing through the centre of the anus was considered a pre-anal myomere. 2) The areas anterior to the first myoseptum, and posterior to the last myoseptum, were both counted as myomeres. 3) The expression "myomeres: $10+15=25$" would refer to the presence of 10 pre-anal and 15 post-anal myomeres counted in the manner just described. All ages refer to the post-hatching interval (not post-fertilization). Because of the shrinkage of larval fish, both at death and in the fixative (Blaxter, 1971; Rosenthal et al., 1978), measurements are accompanied by the expressions, "alive" or "fixed".

Taxonomic nomenclature follows that of Smith (1975) except for the following: *Trulla capensis* Kaup is included in the genus *Cynoglossus* (Menon, 1977), *Xiphiurus* Smith has been replaced by *Genypterus* Philippi in anticipation of the outcome of the petition by Robins & Lea (1976). *Trachurus capensis* Castelnau, 1861 is recognized as a subspecies (Nekrasov, 1978) of the northeastern Atlantic species *Trachurus trachurus* (Linnaeus).

COLLECTION RECORDS

The results of 58 collection outings over a period of 28 months are assembled in Table 1. Several comments must be made regarding these data.

Those species that were readily identifiable in the egg stage could be counted during the original sorting operation. Those that were only recognizable in the early larva stage could only be enumerated after hatching. Others were only counted at first-feeding, and two species *(Gymnocrotaphus curvidens* and *Chrysoblephus laticeps)* were only recognized towards metamorphosis. The values listed in the table correspond to the number of eggs or larvae alive at the earliest stage at which it was feasible to enumerate them. It is clear that any mortalities incurred prior to counting would induce an underestimation of abundance. The consequences of this procedure are not as serious as they might seem. With the exception of the two species mentioned, all counts were made at or prior to first-feeding. Since mortality to this stage was usually less than 50%, the values given in the table may be taken as reasonable approximations of the number of eggs taken in the collections. The same may not be said for *G. curvidens* and *C. laticeps.*

The values given refer to the total number of eggs taken during that month, regardless of how many collections were involved. The number of collections making up any month's data is also given. It may be calculated that egg density ranged from 0.00 eggs m^{-3} to about 3 eggs m^{-3}, with an overall mean of roughly 0.5. Further manipulation of these data is probably not warranted. There was tremendous variation in species composition and numbers from collection to collection — even between collections made at the same site on consecutive days. The pooling of 28 months' data has had the effect of dampening this variation.

The temperatures provided in Table 1 are the monthly means of daily readings averaged over the years 1976—1978 (by courtesy of the Maritime Weather Office, Silvermine, Cape).

DESCRIPTIONS OF EGGS AND LARVAE

CLUPEIDAE

Three clupeid species are found in Cape of Good Hope waters: *Etrumeus teres, Sardinops ocellata,* and *Gilchristella aestuarius* (Smith, 1965; Day et al., 1970). Eggs of E. *teres* (= *E. micropus* (Schlegel, 1847) *fide* Whitehead, (1963) are well known (see below for references). Eggs of *Gilchristella* have not been described, although Gilchrist (1914a) netted a pelagic clupeid egg in Knysna Lagoon (his Species XXII) that is probably referable to this species. The egg was small, 0.71—0.72 mm in diameter; perivitelline space relatively wide, 0.08 mm; without oil globule; yolk with slight traces of vesiculation.

Yolksac larvae (age unspecified, but presumably newly-hatched) had a posterior rectum and measured 1.5—1.8 mm total length, of which 37% was occupied by yolk. Melville-Smith (1978) reported that *Gilchristella* eggs were pelagic, and were probably spawned in the upper reaches of estuaries (specifically, the Swartkops Estuary, Port Elizabeth). He did not describe the eggs. There is evidence that successful spawning and development can occur in salinities ranging from 0 to at least 47‰ S (Wallace, 1975a).

Etrumeus teres (Dekay, 1824)

Previous descriptions of eggs and/or larvae

Gilchrist, 1903 (as Species VIII): egg, p. 199; larva, p. 199, fig. 32.

Gilchrist, 1916 (as Species VIII): egg, p. 21; larva, p. 21, fig. 17.

Gilchrist & Hunter, 1919 (as Species VIII (*Clupea* sp.?)): egg, p. 10; larva, p. 10.

O'Toole & King, 1974: egg, p. 445, fig. 2; larva, p. 447, figs. 3—5.

(Additional references are cited by O'Toole & King (1974).)

Egg

Table 3. The combination of coarse yolk segmentation, lack of an oil globule, and size effectively distinguishes the egg of this species from any others encountered during this study. Note, however, that the newly-spawned egg of *Synaptura kleini,* which

TABLE 1. Summary of collection records: August 1976 to November 1978. The total number of eggs taken each month is listed opposite the name (when known) of the species. More collections were made in some months than others (see text). Temperatures are averages of monthly means, 1976—78

FALSE BAY

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
NUMBER OF COLLECTIONS:	3	5	2	1	3	1	1	2	2	4	5	2
MEAN TEMP. °C:	18.9	18.3	18.0	16.8	14.8	13.4	13.0	14.5	15.6	16.1	18.1	19.1
Etrumeus teres	24	49	338	1							4	1
Sardinops ocellata	126	300										
Engraulis capensis	25	2								412	14	20
Maurolicus muelleri												
Scomberesox saurus		3										
Gaidropsarus capensis	15	14	28	25	249	81	447	9	15	89	5	
Physiculus capensis												
Merluccius capensis												
Species 1 (Carapidae)											1	30
Genypterus capensis			13				71				1	
Arnoglossus capensis	102	19			51	35	90	30		5	101	220
Austroglossus microlepis											1	
Heteromycteris capensis	346	704	93	46	22	67	2		54	636	542	
Synaptura kleini	69	44		4						123	40	3
Solea ?fulvomarginata		1									3	
Cynoglossus capensis	219	185	3	28	6	465	85	20	1	762	407	10
Paracallionymus costatus												
?Cheilodactylus fasciatus		58		25	54	20	222	75			1	
Trachurus t. capensis		4			2						1	150
?Seriola lalandi	22										12	
Pterosmaris axillaris				20	1		13					
Chrysoblephus laticeps	1									1		
Diplodus cervinus	20									4	140	11
Diplodus sargus	580	198	127	13	6	100	15	16	3	963	921	74
Gymnocrotaphus curvidens										8	4	2
Lithognathus mormyrus	1795	147								258	1664	232
Pachymetopon blochi	52	35	192	79	275	40	47					3
Liza richardsoni							2			5		
Mugil cephalus	7	25								1		
Coccotropsis gymnoderma			2								22	1
Helicolenus dactylopterus	95	5										
Perciform Species 1	7	1350									60	
Congiopodus spinifer	5	3	15		11	2	6	5	1	1		
Trigla ?capensis	22	21	37	1	27	11	3	2		2		23
Leptocephalus Species 1			30									
Species 2												
Species 3	10	5								43	9	
Species 4	14	6										
Species 5	408	426		1	2		45				84	18
Species 6												1

appears (falsely) to lack oil globules, has a size distribution which broadly overlaps that of *E. teres* (Table 3). The yolk vesiculation of *E. teres* serves to separate them at this stage.

Larva

Table 3. Uchida (1958, pl. 5—6) illustrated the entire developmental series. Feeding larval stages have much larger mouths than either the Cape anchovy or the South African pilchard of the same length. Once dorsal and anal fins appear, *E. teres* may be distinguished from the latter two species by the relative positions of these fins: there are 3—4 "postdorsal-preanal myomeres" (full myomeres between the posterior of the dorsal fin base and anterior of the anal fin base) (Houde & Fore, 1973) in *E. teres,* and usually 5—7 such myomeres in *Sardinops ocellata* (Fig. 4). The two fins overlap in *Engraulis capensis* (Fig. 6).

Geographic and seasonal distribution

Whitehead (1963) recognized "probably seven discrete populations" of this species worldwide. The southern African population occurs from (at least) Walvis Bay to Beira (Day et al., 1970). Eggs were taken intermittently all year on both sides of the Cape Peninsula. Geldenhuys (1978) found that small *E. teres* were recruited to the fishery throughout the year and deduced year-round spawning.

Rearing notes

Incubation time (15°C) was estimated (Fig. 186.1) at 70 ± 10 h, which agrees very closely with the value (about 68 h) provided by O'Toole & King (1974, fig. 6). First-feeding was generally successful

TABLE 1 (Cont.) ATLANTIC

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
NUMBER OF COLLECTIONS:	0	1	3	4	2	1	1	3	4	5	3	0
MEAN TEMP. °C:	15.3	14.5	13.5	13.4	13.1	12.8	12.9	13.2	13.2	13.5	13.7	14.3
Etrumeus teres		12	5	2			8		51			
Sardinops ocellata		3										
Engraulis capensis			8									
Maurolicus muelleri									2		5	
Scomberesox saurus												
Gaidropsarus capensis		2	960	275	600	313	21	29	484	93	28	
Physiculus capensis				1			1		29	1	9	
Merluccius capensis				9					16	1		
Species 1 (Carapidae)									1			
Genypterus capensis			2	1	180	26	12	4	17	2	1	
Arnoglossus capensis			27	6	18	9			1			
Austroglossus microlepis			26			5		4	13	1		
Heteromycteris capensis			3									
Synaptura kleini												
Solea ?fulvomarginata												
Cynoglossus capensis		3	39	50	65	75	2	1	437	4	28	
Paracallionymus costatus			231	238	12	8	11		73	52	45	
?Cheilodactylus fasciatus		5	117	109	1000	145	17	104	65			
Trachurus t. capensis								21				
?Seriola lalandi												
Pterosmaris axillaris		6	32	350	22	15	6	20				
Chrysoblephus laticeps												
Diplodus cervinus												
Diplodus sargus			18									
Gymnocrotaphus curvidens												
Lithognathus mormyrus												
Pachymetopon blochi			175		190	406	1	13	1			
Liza richardsoni								1	1			
Mugil cephalus			1									
Coccotropsis gymnoderma												
Helicolenus dactylopterus												
Perciform Species 1												
Congiopodus spinifer		7	49		11				109	12	29	
Trigla ?capensis			41	24	22	1			19	2		
Leptocephalus Species 1											10	
Species 2									113	40		
Species 3												
Species 4												
Species 5			143	22	85	55	2		130		5	
Species 6												

on *Brachionus,* and a few larvae reached an age of 30 days. None survived to metamorphosis.

Sardinops ocellata (Pappe, 1853)
Figs. 3—4

Previous descriptions of eggs and/or larvae

Gilchrist, 1903 (as Species III): egg, p. 196, figs. 23—24; larva, p. 196, fig. 25.

Gilchrist, 1916 (as *Clupea sagax*): egg, p. 20, fig. 16; larva, p. 20, fig. 16.

Hart & Marshall, 1951 (as *Sardinops sagax*): egg, fig. 1a; larva, figs. 1b—1c.

Davies, 1954: egg, p. 10, pl. 5, figs. 1—3; larva, p. 11, pl. 6, figs. 1—4.

Louw & O'Toole, 1977: larva, p. 129, figs. 2—5.

King, 1977a: egg, p. 12, fig. 6; larva, p. 26, fig. 9.

Egg

Table 3. The wide perivitelline space, single (usually) oil globule, and size sets this eggs apart from any of the others encountered.

Larva

Figs. 3—4, Table 3. Larval stages of this commercially important species have been well described (see, in particular, Louw & O'Toole, 1977).

Geographical and seasonal distribution

S. ocellata ranges from about Cape Frio (18°30'S) in the Atlantic (King, 1977b) to Richards Bay (Day et al., 1970). Davies (1956) encountered pilchard eggs in the plankton throughout the year, but concluded that major spawning only occurred from September to February, inclusive. He detected two peaks during this period: September and February. Off South West Africa, spawning begins in June or July and extends until April, with two peaks: a main peak in August-September, a lesser peak in February-March (Matthews, 1964). King (1977b) reported regional differences in spawning activity. Pilchard eggs are rare in the inshore plankton of the Cape Peninsula (Table 1).

Rearing notes

A batch incubated at 15°C demonstrated excellent hatchability (> 90%) but survival through the yolk-sac stage was very poor (< 10%). A subsequent batch incubated and maintained at 17—19°C yielded a much higher rate of survival to first-feeding. The difference may have been due to factors other than temperature: King (1977a) reported a lower thermal limit of 11°C for *S. ocellata* eggs, and 13°C for yolk-sac larvae through the eyed stage. Davies (1956) set 13°C as the lower threshold for major spawning, although eggs have been collected in waters of 11°C (Stander, 1963).

A few larvae survived to 45 days post-hatch, feeding first on *Proales,* later on *Brachionus* and *Tisbe.* None reached metamorphosis.

ENGRAULIDAE

The family is represented in Cape Peninsula waters by a single species.

Engraulis capensis Gilchrist, 1913
Figs. 5—6

Previous descriptions of eggs and/or larvae

Gilchrist, 1916: egg, p. 22.

Gilchrist & Hunter, 1919: egg, p. 9, fig. 21; larva, p. 9, fig. 22.

King et al., 1978: egg, p. 38, fig. 2; larva, p. 40, fig. 4.

Egg

Table 3. No other teleost egg known from Cape Peninsula waters is as markedly elliptical as this. All the other elliptical eggs encountered during this study have oil globules.

Larva

Figs. 5—6, Table 3. Refer to the above-cited publications for descriptions of early larvae. Older larvae are easily distinguished from clupeid larvae by the shorter gut and relative positions of the dorsal and anal fins (Figs. 5—6).

Geographic and seasonal distribution

E. capensis eggs have been taken in the E. Atlantic as far north as 18°30'S (King, 1977b). Anders (1975) reported anchovy eggs (but these may not have been *E. capensis*) in the W. Indian Ocean as far north as 28°S off KwaZulu. Day et al. (1970) reported St. Lucia as the northern range limit of the adult in the Indian Ocean. In the present study, anchovy eggs were collected October to February, inclusive, in False Bay; a few were taken in March off Three Anchor Bay (Table 1). The False Bay records are in accord with the known spawning season of this species: October to February, with a peak in November-December (Stander & Roux, 1968).

Rearing notes

Almost all the eggs hatched within 48 h of collection, one hatched between the 60th and 72nd hour (Fig. 186.2). King et al. (1978) obtained an incubation time (blastodermal cap stage to hatching) of 66 h at 15°C.

Rearing was attempted at 17—19°C. First-feeding was successful on Proales; feeding incidence was very low when only *Brachionus* was offered. None of the larvae survived to metamorphosis; the last individual died at 53 days post-hatch.

STERNOPTYCHIDAE

Maurolicus muelleri (Gmelin, 1789)

Previous descriptions of eggs and/or larvae

Gilchrist, 1904 (as Species XVI): egg, p. 139, figs. 39—40.

Sanzo, 1931a (as *Maurolicus pennanti*): egg, p. 56, pl. 5; larva, p. 57, pl. 5.

Robertson, 1976: egg, p. 313, fig. la; larva, figs. 1—2.

(Additional references are cited by Sanzo (1931) and Robertson (1976).)

Egg

Table 3. The unusual egg, characterized by a very thick, transparent chorion produced externally in concave, hexagonal facets, is immediately recognizable. The total diameter of the egg, with envelope, varied from 1.80 to 2.10 mm in the few examples encountered during the present study. Yolk diameter was more constant: 1.03—1.12 mm; oil globule: 0.25—0.26 mm .

Larva

Table 3. The larva is without pigment at hatching. Refer to the above-cited publications for further description.

Geographic and seasonal distribution

Cosmopolitan, mesopelagic species; its range includes the whole of southern Africa. Based on published data (reviewed by Robertson (1976), the period of spawning is of long duration. A maximum seems to occur in spring and summer.

Rearing notes

No larvae survived to first-feeding.

SCOMBERESOCIDAE

Scomberesox saurus Fleming, 1828

Previous descriptions of eggs and/or larvae

Gilchrist, 1904: egg, p. 145, fig. 53; larva, p. 145, figs. 54—56.

Gilchrist, 1916: egg, p. 19; larva, p. 20.

D'Ancona, 1931: egg, p. 161; larva, p. 161, p. 8—9.

Nesterov & Shiganova, 1976: egg, p. 279, fig. 3; larva, p. 280, fig. 4.

(Additional references are cited by Nesterov & Shiganova (1976).)

Egg

Table 3. Gilchrist (1904) described in detail the egg and early larva of *S. saurus*. It is readily distinguished from other eggs known from the Cape Peninsula by the combination of size, narrow perivitelline space, and absence of an oil globule.

Larva

Table 3. The larva at hatching is blue dorsally, silver ventrally. One of Gilchrist's (1904) was 8.5 mm TL. His figures illustrate very well the appearance of early larvae; those of D'Ancona (1931), the more advanced stages.

Geographic and seasonal distribution

S. saurus inhabits subtropical and warm temperate waters of the Southern Hemisphere and the N. Atlantic and Mediterranean (Parin, 1973). Day et al. (1970) reported it to be common in False Bay. The seeming rarity of the eggs in the plankton at Fish Hoek (Table 1) suggests that it does not ordinarily spawn in False Bay. The very early state of development of the three eggs taken in this study indicates, however, that they may have been spawned there. Date of capture was 3 February. Gilchrist's material was netted June—September, some 30—40 miles off the Cape of Good Hope. Spawning by this species in the N. Atlantic occurs all year in water of 16.8—23.7°C (Nesterov & Shiganova, 1976).

Rearing notes

The three available eggs were incubated at ca. 18°C. Two hatched; both hatchlings died within two days. They swam unceasingly at the surface of the 10 *l* tank; no obvious feeding manoeuvers were observed.

GADIDAE

Only three gadid species are recognized from shelf waters of the Cape Province: *Gaidropsarus capensis, G. insularum,* and *Physiculus capensis.* Penrith (1967) reviewed the nomenclature of the two *Gaidropsarus* species and provided several characters by which they could be distinguished. Collection records of the eight specimens that were available to him (Penrith, pers. comm., 1978) were insufficient to permit delineation of the ranges for the two species, but implied that *G. insularum* (type locality: Tristan da Cunha) was the rockling of the western Cape Province and *G. capensis* (type locality unknown), the rockling of the eastern Cape Province. Only *G. insularum* was listed among the False Bay fauna by Penrith in Day et al. (1970).

Gaidropsarus eggs are abundant in the plankton on both sides of the Cape Peninsula throughout the year, and were successfully reared through metamorphosis on many occasions. All the specimens examined (n = 18; SL = 2.0 – 10.1 cm) from both sides of the Cape Peninsula are referable to *G. capensis* rather than *G. insularum:* D1 50—58 (and one with 67), D2 45—52, A 37—43, P 18—21, ratio of D1 base to head length: 0.12—0.14 (A single specimen, SL = 7.3 cm, yielded a ratio of 0.09, but the fin-ray counts, eye/head ratio, and caudal peduncle/head ratio did not differ from that of other specimens of similar size.) Two juveniles (ca. 8 cm SL) in the collection of the J.L.B. Smith Institute, captured at Port Alfred and Algoa Bay, yielded counts and body ratios within the normal range of Cape Peninsula specimens.

Gaidropsarus capensis (Kaup, 1858)
Figs. 7—12

Previous descriptions of eggs and/or larvae

Gilchrist & Hunter, 1919 (as *Onos capensis*): egg, p. 7, fig. 14; larva, p. 7, figs. 15—17.

Egg

Fig. 7, Table 3. Eggs in the earliest stages have up to 5 oil globules in a single clump. These consolidate into one (occasionally more) by the time the egg hatches. After consolidation, the globule measures 0.16—0.18 mm . In advanced embryos the globule bears several (about 3—6) melanophores and is normally (see rearing notes, below) fixed in the posterior end of the yolk sac. The chorion is non-wetting, and breaches the surface when placed in a calm vessel of clean sea water.

Larva

Figs. 8—12, Table 3. The larva at hatching bears black pigment only. Particularly noticeable is the concentration of melanophores on the tail, about half-way between the yolk sac and the caudal extremity. The ventral fins develop early (about 12 days post-hatch, 15°C), becoming very prominent after about 3 weeks. The first appearance of colour is in these fins, in the form of yellow (and later red) streaks in the interradials (Fig. 11). The irridescent blue of older *G. capensis* larvae is gradually replaced by brown at about 2.1—2.5 cm TL, when the free-swimming, pelagic larva moves to the bottom and takes up a secretive life-style under stones. At 15°C, this transition to the benthos takes place at an age of about 2 months.

Meristics

D_1 50—58, D_2 45—52, A 37—43, P 18—21, Vertebrae: 44—45 (this study).

Geographic and seasonal distribution

The distributions of the two nominal South African *Gaidropsarus* species are uncertain at present. Day et al. (1970) reported rocklings in the E. Atlantic as far north as Lamberts Bay; Smith (1965) reported rocklings in the W. Indian Ocean as far east as Algoa Bay. Like Gilchrist & Hunter (1919), the present author took *Gaidropsarus* eggs all year (Table 1).

Rearing notes

Incubation time (15°C): 96 ± 10 h (Fig. 186.3). Age-at-optimal-first-feeding (as defined by Brownell, in press *a*) is 145 h post-hatch. At least 50% of larvae are capable of first-feeding on *Brachionus* between the age of 100 and 190 h post-hatch. *Proales* was also taken by first-feeding larvae.

Roughly 5% of all rockling eggs collected produced a hatchling with the oil globule freely mobile in the yolk, *i.e.,* unattached to the yolk membrane. Towards the end of yolk absorption (4—5 days post-hatch, at 15°C), these larvae develop a white area (characteristic of necrotic tissue) around the globule, and the latter is not absorbed. Although the larvae so affected were usually as active as normal larvae, they were unable to feed.

Physiculus capensis Gilchrist, 1922
Figs. 13—16

Previous descriptions of eggs and/or larvae

?Gilchrist & Hunter, 1919 (as "Species ?"): egg, p. 13; larva, p. 13.

The eggs described by Gilchrist & Hunter (1919) from Table Bay (December) more closely resemble the eggs of *Physiculus capensis* than any of the other eggs encountered in this study. Their eggs were slightly smaller, however, (0.82—0.89 mm, oil globule 0.16—0.18 mm), and the larvae at hatching were shorter (ca. 2.1 mm TL, as opposed to ca. 2.7 mm).

Notes on identification

The identification of this material as *P. capensis* is based on the similarity of the early larva to that of *P. dalwigki,* from the N.E. Atlantic and Mediterraenean (see De Gaetani, 1928, figs. 2—3 or D'Ancona, 1933, figs. 206—207).

Egg

Table 3. The dimensions of the egg and oil globule fall within the range of several common perciform species. As hatching nears, the egg may be identified by characteristics of the embryo (see larval characters below). There are no xanthophores, only diffuse patches of brown (by reflected light) pigment.

Larva

Figs. 13—16, Table 3. Gadid features are already present at hatching: the lateral position of the anus, the relatively high myomere count (40—45). The yolk sac is pear-shaped at hatching, with the oil globule fixed in the narrow posterior end. At first-feeding there is a very marked downward flexure of the notochord at the level of the nape. Ventral fins appear early (by the 8th day at 15°C), and if development parallels that of *P. dalwigki,* they attain considerable size in later larval stages. A 30-mm specimen of *P. capensis* examined by Barnard (1925—1927) already had the basic features of an adult.

Meristics

The two South African *Physiculus* species differ in fin-ray counts and vertebral number. *P. capensis:* D 10 + 53 – 55, A 60 – 62, Vertebrae: 51. *P. natalensis:* D 8 – 9 + 62 – 64, A 65 – 70, Vertebrae: 54 (Winterbottom, 1974).

Geographic and seasonal distribution

Cape Peninsula to East London (Smith, 1965). Eggs were taken in small numbers in April, July, and September through November, inclusive, on the Atlantic side of the Peninsula; none was found in collections from False Bay (Table 1).

Rearing notes

The distribution of captive incubation times is shown in Fig. 186.4. Rearing attempts were unsuccessful. A few larvae first-fed on *Brachionus* at 160—200 h post-hatch, but the majority were extremely sluggish and failed to feed at all. None survived beyond two weeks of age. De Gaetani (1928) kept *P. dalwigki* alive for 15 days after hatching; Mancuso (1926) maintained a 20-mm, sea-caught larva through metamorphosis.

MERLUCCIIDAE

All published descriptions of early stages of hakes from southern Africa have been attributed to the shallow-water hake, *Merluccius capensis,* although two other hake species are known to inhabit these waters *(M. paradoxus* and *Macronurus capensis)*. It is only relatively recently that there has been any attempt to distinguish the adults of the two *Merluccius* species, not to mention eggs and larvae. The present author has little hesitation in claiming that the material collected in this study is referable to *M. capensis*. The eggs were netted within 3 km of shore. *M. paradoxus* is restricted to deeper water, and only juveniles are taken at depths of less than about 300 m (Botha 1973). *Macronurus* was first described from the western Cape Province (Davies, 1950), but it appears to be very rare in this region (Andrew Payne, pers. comm., 1979, Sea Fisheries Branch, Cape Town).

Merluccius capensis Castelnau, 1861
Figs. 17—19

Previous descriptions of eggs and/or larvae

(Some of the following references may not pertain to *M. capensis*. The vertebral counts cited by Haigh (1972a, table 1), for example, fall into the known range of *M. paradoxus*.)

Gilchrist, 1916: egg, p. 14.

not Gilchrist & Hunter, 1919 (= *Liza richardsoni)*

Hart & Marshall, 1951: larva, fig. 1d.

Matthews & De Jager, 1951: egg, p. 4, figs. 1—15 (these authors neglected to include the oil globule in their illustrations); larva, p. 6, fig. 19.

Haigh, 1972a: larva, p. 50, figs. 1—2.

O'Toole, 1978: egg, p. 21.

Egg

Table 3. The oil globules of the ovarian eggs described by Gilchrist (1916) measured 0.25 mm, only marginally less than the 0.26—0.28 mm of the eggs seen by the present author. Matthews and De Jager (1951) reported an oil globule diameter of only 0.16 mm in the eggs that they artificially fertilized. O'Toole (1978) measured oil globules of 0.15—0.26 mm in eggs he collected from the plankton off South West Africa. This much intraspecific variation in oil globule diameter is highly unusual, and suggests that more than one species is involved. There is general agreement concerning the diameter of the chorion: ca. 0.95—1.05 mm (although O'Toole (1978) identified eggs as small as 0.85 mm as *M. capensis*). If *M. capensis* eggs are, indeed, so variable, there is a wide overlap of dimensions with a host of other species, including the gadid, *Physiculus* and many perciforms.

Larva

Figs. 17—19, Table 3. Of the three gadiforms whose eggs were encountered here, only *M. capensis* bears yellow pigment in the late embryo and early larval stages. Very little individual variation was detected in the distribution of either yellow or black pigment, and the specimens illustrated serve as typical examples.

Meristics

M. capensis: D1 11 (10—11), D2 37—40, A 37—40, Vertebrae: 51 (48—52) (Franca, 1954). The same author reported a vertebral count of 56 (55—57) for *M. paradoxus*. Modal vertebral counts of 49 and 54, respectively, were reported by Botha (1970).

Geographic and seasonal distribution

Both *Merluccius* species range into Angolan waters (Franca, 1954). Hakes range eastward as far as Port St. Johns (Day et al., 1970). Although *M. capensis* is rated "common" in False Bay (Day et al., 1970), spawning apparently occurs elsewhere: no hake eggs were collected there at any time during the year. Small numbers of eggs appeared in tows made off Three Anchor Bay in the months of April, September, and October (Table 1). O'Toole (1978), in reviewing other literature, reported year-round spawning in both *Merluccius* species, with a maximum from September to December.

Rearing notes

Insufficient data are available to permit an estimate of the incubation period. The eggs that required the longest incubation hatched 60—72 h after collection (Fig. 186.5). First-feeding was successful on *Brachionus* but none of the larvae survived beyond three weeks of age.

CARAPIDAE

No carapids have yet been recorded from the Cape Province. Three species are known from Natal: *Jordanicus gracilis* (Bleeker), *Carapus margaretiferae* (Rendahl), and *C. reedi* Smith (Smith, 1955). In addition, a carapid species has been taken in the SE Atlantic off Lobito, Angola (Poll, 1959: identified as *Carapus imberbis (= C. acus)*). At present, it cannot be determined to which, if any, of these species the material described below might be referable. It is clear that the eggs and early larvae described here are different from those referred to *Carapus acus* by Padoa (1956). The latter have a considerably larger oil globule and a different pattern of pigmentation. There is a much greater similarity to the egg and larva thought by Sparta (1926) to be *Echiodon dentatus* (reviewed by Padoa, 1956, figs. 665—666).

Species 1 (Carapidae)
Figs. 20—23

Egg

Fig. 20, Table 3. The only egg of the Cape Peninsula inshore plankton with which this egg might conceivably be confused is that of the kingklip, *Genypterus capensis*. The carapid egg, however, is oval, rather than spherical, smaller, and very characteristically pigmented. The eggs were collected singly, not associated with any mucilaginous matrix as has been described for some other carapid species (see Robertson, 1975a).

Larva

Figs. 21—23, Table 3. In the larval stages figured, there is a fine tuberculated texture to the entire integument. In the 4 and 8-day stages, the tubercles along the margin of the anal fin-fold and post-anal portion of the dorsal fin-fold take the form of minute denticles (not shown in the figures here). These larvae are unusual in bearing white pigment (above and below the posterior end of the notochord in all stages figured, and at the extreme tip of the vexillum in the 8-day stage).

Geographic and season distribution

A single egg was taken in Hout Bay in September; additional eggs were collected in Fish Hoek Bay in November and December (Table 1).

Rearing notes

Incubation time (15°C) is estimated to be 80 ± 10 h (Fig. 186.6). In experiments to establish the age at first-feeding, 18 larvae of known ages (all between 111 ± 6 and 153 ± 6 h post-hatch, 15°C) were offered *Proales*. Feeding was successful in all 18 (8 larvae had full guts after the 4-h exposure to food, 10 larvae had half-full guts). Unfortunately, there were no survivors two weeks later.

OPHIDIIDAE

Only three shelf-dwelling ophidioids are known from the Cape of Good Hope, namely *Dermatopsoides talboti*, *Bidenichthys capensis*, and *Genypterus capensis*. There is good evidence for viviparity in the first two species. Smith (1943) and Cohen (1966) described horny male copulatory claspers in *Dermatopsoides*. Barnard (1934) reported a lack of such claspers in *B. capensis*, but the well-developed genital papilla in the male of this species argues for viviparity. The pelagic ophidiid eggs described below must be referred to the kingklip, *G. capensis*.

Genypterus capensis (Smith, 1849)
Figs. 24—29

Previous descriptions of eggs and/or larvae

Gilchrist & Hunter, 1919 (as Species XXVI): egg, p. 12, figs. 31—32; larva, p. 12, figs. 33—34.

Egg

Fig. 24, Table 3. The combination of single, small oil globule and moderately large, spherical egg is diagnostic.

Larva

Figs. 25—29, Table 3. Larvae are characterized by the elongated body, high myomere count, and weak development of pigment.

Meristics

Vertebrae: 65—73, with a mode of 68 in the Walvis stock and 70 in the Cape and Southeast stocks (Payne, 1977). P 21—23, V 2 (Poll, 1959).

Geographic and seasonal distribution

G. capensis is endemic to southern Africa, with a distribution from about 20°S in the Atlantic (Poll, 1959) to Algoa Bay (Smith, 1965). Three stocks, more or less geographically distinct, exist over this range (Payne, 1977). The eggs were taken on both sides of the Cape Peninsula, but more regularly and in greater numbers from the Atlantic. Based on these collections (Table 1), the spawning season in the area studied appears to extend from March to November, inclusive, with a possible maximum in May-June. The eggs described by Gilchrist & Hunter (1919) from Table Bay were collected in July and August. Payne (1977) observed ripe-running females only in August, September, and October.

Rearing notes

Incubation time (15°C): 106 ± 10 h (Fig. 186.7). First-feeding was very successful on *Brachionus* but no larvae survived more than three weeks post-hatch.

BOTHIDAE

Only two of the 16 bothids known from southern Africa occur in Cape of Good Hope waters: *Arnoglossus capensis* and *Mancopsetta milfordi*. The latter is a bathyl species (Penrith, 1965).

Arnoglossus capensis Boulenger, 1898
Figs. 30—33

Previous descriptions of eggs and/or larvae

Gilchrist, 1904: egg, p. 133; larva, p. 133, fig. 36.
Gilchrist, 1916: egg, p. 16; larva, p. 16, fig. 12.
Gilchrist & Hunter, 1919: egg, p. 8; larva, p. 8.

Egg

Fig. 30, Table 3. The egg can be distinguished from all known Cape Peninsula eggs on the basis of chorion and oil globule dimensions.

Larva

Figs. 31—33, Table 3. The newly-hatched larva bears spots of salmon-coloured pigment but lacks melanophores. The latter only appear after about 3 days (15°C), as do patches of yellow pigment, usually in association with the salmon spots. Not shown in the drawings are the minute (up to 50 μm long) denticles that occur on the margins of the dorsal and anal fin-folds. These were developed by the 4-day stage and persisted at least through the 8th day.

Geographical and seasonal distribution

Poll (1959) indicated that *A. capensis* ranges northward into the E. Atlantic as far as Gambia. Day et al. (1970) placed the eastern limit of its distribution in Natal. There appears to be year-round spawning in False Bay. Practically all the eggs taken on the Atlantic side of the Cape Peninsula were netted from March to June (Table 1). Gilchrist (1904) took an egg in False Bay in November; Gilchrist & Hunter (1919) took eggs in Table Bay in October and March.

Rearing notes

The species has a relatively short incubation time: 45 ± 10 h at 15°C (Fig. 186.8). *Brachionus* appears to be too large a first food for *A. capensis*. Feeding on *Proales* was sporadic, however, and survival beyond an age of two weeks was not achieved.

SOLEIDAE

Day et al. (1970) listed five sole species from False Bay: *Heteromycteris capensis, Austroglossus microlepis*[1], *Synaptura kleini, Solea bleekeri,* and *Solea fulvomarginata*. The first three species mentioned extend into the Atlantic as far north as Walvis Bay; the latter two are restricted to the Indian Ocean. Barnard (1925—1927) placed *A. pectoralis* in False Bay and not *A. microlepis*. Peter Zoutendyk (CSIR, Univ. of Cape Town, pers. comm., 1977) seriously doubted that *A. pectoralis* ranges as far west as False Bay.

Gilchrist (1903, 1904, 1916) and Gilchrist & Hunter (1919) described five kinds of sole eggs from the western Cape Province. They were able to identify three of them *(H. capensis, A. microlepis,* and *Synaptura kleini)* and designated the remaining two as Species X (Gilchrist, 1903; 1916) and Species XVII (Gilchrist, 1904; 1916). It is suggested here that Gilchrist's Species X may be referred to *Solea bleekeri* and his Species XVII to *S. fulvomarginata*.

Austroglossus microlepis (Bleeker, 1863)
Figs. 34—39

Previous descriptions of eggs and/or larvae

Gilchrist, 1916 (as *Synaptura microlepis*): egg, p. 16.

Gilchrist & Hunter, 1919 (as *Synaptura microlepis*): egg, p. 7, fig. 18; larva, p. 7, fig. 19.

O'Toole, 1977: larva, figs. 2—3.

Egg

Fig. 34, Table 3. The 12—20 oil globules are arranged in a single cluster, which becomes positioned in the posterior end of the yolk sac as hatching nears. Some combining of globules was seen to take place, but even some 4-day-old (15°C) larvae were multiglobulate.

Larva

Figs. 35—39, Table 3. Once the oil globules have been absorbed, the larva is very similar in appearance to *Heteromycteris capensis* larvae of the same age. In living *A. microlepis* larvae near the first-feeding stage, the fin-fold xanthophores have a slightly orange hue; in *H. capensis,* these xanthophores are straw-yellow. There is considerable variation in xanthophore distribution in both species. The difference in post-anal myomere count (ca. 40 in *A. microlepis,* ca. 30 in *H. capensis*) will help to distinguish preserved specimens of the two species. For descriptions of older larvae, the reader should refer to O'Toole (1977).

Meristics

D ca. 95, A ca. 75 (Smith, 1965). Vertebrae: 9+46=55 (Fraser & Smith, 1974).

Geographic and seasonal distribution

O'Toole (1977) stated that this sole is fished commercially in the Atlantic as far north as 19°S. False Bay is the eastern limit of its range (Day et al., 1970). From collection records presented here (Table 1), it is difficult to delineate the spawning season: eggs were taken in the Atlantic in the months of March, June, September, October, and November. A single egg was taken in False Bay in November. It is proposed that the species spawns in the Cape Peninsula area from March to November, with a maximum in September-October. Gilchrist & Hunter (1919) netted eggs in Table Bay in August and September. Off South West Africa, O'Toole (1977) took *A. microlepis* larvae from September to January, inclusive, but none in February and March (no collecting was conducted between 5 April and 13 August).

Rearing notes

Incubation time (15°C): 80 ± 10 h (Fig. 186.9). First-feeding was successful on *Brachionus,* but none of the larvae placed in rearing tanks survived more than about three weeks.

Heteromycteris capensis Kaup, 1858
Figs. 40—46

Previous descriptions of eggs and/or larvae

Gilchrist, 1903 (as *Achirus capensis*): egg, p. 191, fig. 16.

Gilchrist, 1903 (as Species V): egg, p. 197; larva, p. 197, fig. 27.

Gilchrist, 1916 (as *Achirus capensis*): egg, p. 17, fig. 13; larva, p. 17, fig. 13.

Egg

Fig. 40, Table 3. The only egg encountered during this study that is likely to be confused with the egg of *H. capensis* is that of the scorpaenid, *Coccotropsis gymnoderma,* which is similarly pigmented and also lacks an oil globule. The two eggs appear to be distinguishable on the basis of size.

Larva

Fig. 41—46, Table 3. Early larvae of *H. capensis* might be confused with those of *Austroglossus* *microlepis* (and probably, *A. pectoralis*) once the yolk sac is absorbed. Both *H. capensis* and *A. pectoralis* (Gilchrist & Hunter, 1919: 8) lack the orange pigment that develops on *A. microlepis* during the yolk-sac stage. The lower myomere count of *H. capensis* should separate it from both *Austroglossus* species.

Completion of metamorphosis (definitive fin-ray counts, end of eye migration, benthic habits) occurred in some reared specimens at standard lengths as small as 7.0 mm (alive). 10 mm might be taken as a more typical size at completion of metamorphosis, but it is difficult to say to what extent rearing conditions determine this feature. Perhaps as many as 5% of the reared *H. capensis* failed to undergo eye migration, and remained ambi-ocular as long as they were kept (up to 18 months).

Meristics

D 92—101, A 64—70 (this study). Vertebrae: $9+31-34 = 40-43$ (Fraser & Smith, 1974).

Geographic and seasonal distribution

H. capensis occurs in shallow water, often in estuaries, from Walvis Bay to Natal (Smith, 1965). It is not included in Wallace's (1975a) checklist of Natal estuarine fishes, and is probably rare east of the Cape Province. Eggs were collected in False Bay every month except August; none were ever taken along the Atlantic side of the Cape Peninsula (although a few were present in a tow made in Saldanha Bay in August). Spawning in False Bay is heaviest in spring and summer, particularly October to February, inclusive (Table 1).

Rearing notes

This sole is among the hardiest and most easily reared marine teleost species encountered in Cape Peninsula waters. Incubation time at 15°C is estimated to be 80 ± 10 h (Fig. 186.10). Both *Brachionus* and *Proales* were taken avidly at first-feeding, about 145—195 h post-hatch (Brownell, 1979). Eye migration usually begins about the third week, the larvae take up a predominantly benthic existence after a month and metamorphosis is complete 2—4 weeks later (15°C).

Synaptura kleini (Bonaparte, 1832)
Figs. 47—53

Previous descriptions of eggs and/or larvae

Gilchrist, 1903 (as Species VII): egg, p. 198; larva, p. 198, figs. 29—31.

Gilchrist, 1916 (as *Solea capensis*): egg, p. 17; larva, p. 17, fig. 14.

not Thomopoulos, 1956 (as *Solea kleini* or *S. hispida*): egg, p. 6, fig. 15; larva, p. 7, fig. 16.

?Aboussouan, 1972 (as *Solea kleini*): larva, p. 991, fig. 12.

(The meristics of Aboussouan's larvae are those of *S. kleni,* but the arrangement of melanophores in two incomplete vertical bands was never seen in the many larvae reared during the present study.)

Egg

Fig. 47, Table 3. The egg of *S. kleini* at the earliest stages of development appears to lack oil globules. The egg is, in fact, globulated, but the globules are extremely minute. They are at first evenly distributed around the yolk, giving it a fog-like quality. They gradually coalesce into irregular clumps, each consisting of hundreds of tiny globules (Fig. 47). At hatching there are still some hundred globules left; these continue to coalesce as the yolk sac is absorbed. The egg appears to be consistently smaller than that of *Solea ?fulvomarginata* (Fig. 54).

Larva

Figs. 48—52, Table 3. The living larva is unmistakable, with its heavy yellow/orange pigmentation. At metamorphosis, which occurs at about 6 weeks (15°C) at a total length (alive) of 7—9 mm, the orange pigment is gradually replaced by white, with varying amounts of black (the latter being concentrated along the dorsal and anal fin margins). Most of the juvenile soles, including those kept in black-sand tanks, were predominantly white (with black margins, and orange papillae on the underside of the head) up to a total length of about 3 cm, when the colour changed increasingly to grey.

Meristics

D 75—90, A 60—70 (Smith, 1965). D 81—95, A 65—74, Vertebrae: 45—49 of which 9—10 are precaudal (Chabanaud, 1929, S. African material). Specimens reared during this study yielded vertebral numbers slightly lower than this: $9–10+33-35 = 43-45$. These values fall in the range that Chabanaud gave for Mediterranean samples.

Geographic and seasonal distribution

S. kleini ranges from the Mediterranean to South Africa (Durban) (Chabanaud, 1929; Collignon et al., 1957: as *Solea capensis;* Day et al., 1970), but records from the E. Atlantic are rare. In the present study, eggs were collected from October to April, inclusive, in False Bay only (Table 1).

Rearing notes

Incubation time (15°C): 100 ± 10 h (Fig. 186.11). Several batches of this sole were reared through metamorphosis using *Brachionus* as first food. One 8-day-old larva was seen with the tail of an 8-day-old *Cynoglossus capensis* projecting from its mouth. It is probable that this species can first-feed on *Artemia* nauplii. Age-at-optimal-first-feeding was determined to be 154 h post-hatch (15°C) with 50% of larvae capable of first-feeding as early as 118 h and as late as 189 h (Brownell, 1979). Juveniles measured 3—4 cm SL at an age of 6 months (15°C).

Solea ?fulvomarginata Gilchrist, 1904
Figs. 54—56

Previous descriptions of eggs and/or larvae

Gilchrist, 1904 (as Species XVII): egg, p. 140, fig. 45; larva, p. 140.

Notes on identification

By elimination, this egg must be referred either to *Solea fulvomarginata* or *S. bleekeri*. The two species have different vertebral numbers. *Solea fulvomarginata:* $9+32=41$ (Fraser & Smith, 1974), $8+35=43$ (a juvenile collected by the author at Muizenberg in False Bay). *S. bleekeri:* $9+26-28$ = $35-37$ (Fraser & Smith, 1974), $8-9+24$ = $32-33$ (two recently metamorphosed specimens collected in the Swartkops Estuary by Roy Melville-Smith). Due to poor fixation of the only specimens of the larvae described below, it is now impossible to determine the exact myomere count. The values given in the captions to Figs. 55 and 56 were taken from the rough illustration and need to be confirmed. Based on these tentative myomere counts, the material is more likely to be *Solea fulvomarginata* than *S. bleekeri*.

Egg

Fig. 54, Table 3. Prior to the point when the embryo extends 180° around the yolk, the egg of this sole has several features in common with, and could be confused with, the egg of *Synaptura kleini*. It appears to be consistently larger, however. Near the 180° stage, a brick-red pigment appears on the embryonic body, and by hatching, covers the entire yolk sac, as well. *S. kleini* is yellow at this stage.

Larva

Figs. 55—56, Table 3. The red pigment in the late embryo and early larva (at least through the 16th day, post-hatch) is the most noteworthy characteristic. The larvae still bear a pink hue after several months in formalin.

Meristics

S. fulvomarginata: D 73—80, A 60—65 Smith (1965). The False Bay juvenile mentioned above yielded counts of D 71, A 59, P_r 3, P_l 3 (pectorals equal and short: 1.6% of SL). *S. bleekeri:* D ca. 60—75, A 45—55 (Smith, 1965).

Geographic and seasonal distribution

Solea bleekeri and *S. fulvomarginata* are both endemic to southern Africa, ranging from False Bay to Delagoa Bay in the case of the former, and False Bay to Port St. Johns in the case of the latter (Day et al., 1970). The eggs described above were taken in very small numbers in False Bay in November and February (Table 1). The egg figured by Gilchrist (1904) was also taken in False Bay in November. *S. bleekeri* is thought to spawn from June to August, inclusive, in the St. Lucia estuary (Wallace, 1975b), October to February, inclusive, in the Swartkops Estuary (Melville-Smith, 1978). No data are available regarding the spawning season of *S. fulvomarginata*.

Rearing notes

Most of the available material was sacrificed for the illustrations. The two larvae kept beyond first-feeding *(Brachionus)* always remained within a few millimetres of the water surface and were very sluggish. 15°C may be near the lower thermal limit for this summer spawner.

CYNOGLOSSIDAE

Ten cynoglossids were listed from southern African inshore waters by Smith (1975). Of these, only *Cynoglossus capensis* ranges as far west as the Cape of Good Hope.

Cynoglossus capensis (Kaup, 1858)
Figs. 57—64

Previous descriptions of eggs and/or larvae

Gilchrist & Hunter, 1919 (as Species XXIV): egg, p. 11, fig. 28; larva, p. 11, figs. 29—30.

Egg

Fig. 56, Table 3. The 2—16 oil globules may be clumped or isolated. Most eggs have 4, 6, or 8 globules. They are almost always smaller than *Austroglossus microlepis* eggs, the only species collected during this study that might cause confusion.

Larva

Figs. 58—63, Table 3. The oil globules in newly-hatched larvae are occasionally clumped in the posterior end of the yolk sac, resembling the situation in *Austroglossus microlepis*. *C. capensis* soon becomes more elongate than *A. microlepis*. The position of the anus distinguishes first-feeding larvae of *C. capensis* from first-feeding *Arnoglossus capensis*.

Meristics

D 105—121, A 84—100 (range of counts taken from two of the specimens reared during this study and nine specimens borrowed from the collection of the J.L.B. Smith Institute). Vertebrae: $9+41-43$ = $50-52$ (Menon, 1977, n=3); $9+49-50$ = $58-59$ (Fraser & Smith, 1974, n=2); $9+41-42$ = $50-51$ (this study, n=2).

Geographic and seasonal distribution

C. capensis is endemic to southern Africa and ranges from (at least) Walvis Bay to Delagoa Bay (Day et al., 1970). The eggs are present, sometimes abundant, on both sides of the Cape Peninsula throughout the year (Table 1).

Rearing notes

Incubation time (15°C): 62 ± 10 h (Fig. 186.12). Feeding incidence at first-feeding was nil in several experiments where only *Brachionus* was offered. The mouth of the larva at this stage is quite small; the maximum allowable size of a food particle seems to be about 100—120 μm . *Proales* is a satisfactory food during the first week following yolk absorption.

Age-at-optimal-first-feeding is about 165 h post-hatch (Brownell, 1979).

The characteristic elongate first dorsal rays become noticeable after about 20 days (15°C). Some larvae elaborated only two such rays prior to metamorphosis, others up to four. It was interesting that, in all cases, metamorphosis occurred over a single night: the prolonged rays degenerated, the right eye migrated to its final sinistral position, and the newly-metamorphosed tonguefish was found in the sand in the morning. Standard lengths at metamorphosis ranged from 10 to 15 mm . A juvenile kept in an aquarium tank (15°C) and fed primarily on cultured ostracods *(Cypridopsis sensu lato)* and amphipods *(Austrochiltonia subtenuis)* grew slowly: at 3.5 months post-hatch, it measured 37 mm (TL); at 10 months it measured 55 mm (TL).

CALLIONYMIDAE

The family is represented by a single species in the waters of the Cape Peninsula.

Paracallionymus costatus (Boulenger, 1898)
Figs. 65—69

Previous descriptions of eggs and/or larvae

Gilchrist, 1904 (as Species XVIII): egg, p. 143; larva, p. 143, figs. 47—48.

Gilchrist & Hunter, 1919 (as Species XVIII); egg, p. 10, fig. 23; larva, p. 10, fig. 24.

Egg

Fig. 65, Table 3. The combination of small size and lack of an oil globule makes the egg unique among those encountered in this study. None of the surface markings that adorn the eggs of some other callionymid species (Russell, 1976:282) is present. The yolk is weakly segmented and slightly cloudy.

Larva

Figs. 69—99, Table 3. Gilchrist & Hunter (1919) called attention to the relatively undeveloped state at hatching (see Fig. 66). Larvae at first-feeding are proportioned very similarly to *Gaidropsarus capensis* larvae at the same age (compare Figs. 69 and 10), but fundamental differences (position of anus, myomere count, pigmentation) distinguish them. Older larvae are large-bodied and somewhat dorso-ventrally depressed.

Meristics

D IV + 9 – 10, A 9 (Smith, 1965). P 20, Vertebrae: 6 + 15 = 21 (n = 1, this study).

Geographic and seasonal distribution

P. costatus ranges from St. Helena Bay to Durban (Smith, 1965). During the present study (Table 1), eggs were taken in Hout Bay and off Three Anchor Bay from March to November, inclusive. None was taken in False Bay collections, although Gilchrist (1904) netted them there, and Day et al. (1970) recorded the presence of the adult. Gilchrist & Hunter (1919) found eggs in Table Bay from September to January. It appears there is year-round spawning in these waters, with possibly two peaks: March/April and September/October/November.

Rearing notes

This species has the shortest incubation time of all those studied: 40 ± 10 h at 15°C (Fig. 186.13). *Brachionus* and *Proales* were both taken at first-feeding, though only sporadically. Rearing attempts were unsuccessful. A single larva of about 5 mm SL when collected at sea was kept for 8 months, during which time it grew to 5 mm SL. It was this specimen that supplied the vertebral count reported above.

CHEILODACTYLIDAE

Smith (in prep.) records 5 cheilodactylids from South Africa; an additional undescribed species may occur on the Atlantic coast of southern Africa at about 18—20°S (Dudnik, 1977). Only three species have thus far been recorded from Cape of Good Hope waters: *Cheilodactylus fasciatus, Chirodactylus brachydactylus,* and *Chirodactylus grandis.*

Published accounts of cheilodactylid eggs and early larvae are available from Robertson (1975b: eggs of two species of *Nemadactylus* (as *Cheilodactylus*) and one species of *Cheilodactylus* (as *Chironemus*)), Mito (1963a: eggs and prefeeding larvae of *Cheilodactylus* (as *Goniistius*), and Robertson (1978: eggs and prefeeding larvae of *Nemadactylus* (as *Cheilodactylus*)) (synonymies from Allen & Heemstra, 1976). All known cheilodactylid yolksac larvae have the oil globule in an anterior position. Late larvae and pre-juveniles (the laterally-compressed pelagic phase, sometimes termed "post-larva" (Vooren, 1972; Tong & Saito, 1977)) of four species were described by Dudnik (1977: *Cheilodactylus fasciatus, C. bergi, Cheilodactylus* sp., and *Chirodactylus brachydactylus*). Barnard (1925—1927) and Smith (1965) have also described or figured pre-juveniles of South African cheilodactylids.

?Cheilodactylus fasciatus Lacépède, 1803
Figs. 70—77

Previous descriptions of eggs and/or larvae

Gilchrist & Hunter, 1919 (as Species XXIII): egg, p. 11, fig. 25; larva, p. 11, figs. 26—27.

?Barnard, 1925—1927: pre-juvenile, p. 455, fig. 19c.

?Dudnik, 1977: larva, fig. 2; pre-juvenile, fig. 3c.

Notes on identification

It is with hesitation that the material described below is identified as *Cheilodactylus fasciatus.* The grounds for choosing this species over the other most likely candidate *(Chirodactylus brachydactylus)* are not substantial, and there is even a possibility that the eggs of both species are being confused here as one.

The oldest larvae reared in this study (about 45 days post-hatch) bear almost as much resemblance to Dudnik's (1977) youngest *brachydactylus* (his fig. 4) as to his youngest *fasciatus* (his fig. 2). Neither of his figures show the amount of black pigment over the suborbital portion of the preoperculum that is present in the reared material. The oldest reared larvae had not yet elaborated fin elements and the clear-cut difference in dorsal soft-ray counts between the two species does therefore not aid in their identification.

Egg

Fig. 70, Table 3. The advanced embryo has about a dozen melanophores on the oil globule and several on the dorsal surface of the yolk sac on either side of the trunk. The latter often disappear by the time the egg hatches. The anterior position of the oil globule in the yolk is diagnostic in embryos very near hatching. On account of size overlap between this and other species, early egg stages are difficult (if not impossible) to identify with certainty. Yellow pigment on the embryo at hatching is very pale, but intensifies rapidly over the subsequent 2—4 days.

Larva

Figs. 71—77, Table 3. The anterior position of the oil globule and rather posterior position of the anus, the homogeneous yolk, the myomere count, and the characteristic pigmentation effectively distinguish the yolk-sac larva from any of the other species described here. The "upward bend of the anterior portion of the body" noticed by Gilchrist & Hunter (1919:11) on the fourth day post-hatch was an abnormality not observed in the present material.

Meristics

Pre-juvenile *Cheilodactylus fasciatus* were reported by Dudnik (1977) to have the following counts: D XVIII—XIX, 20–23, A II, 12–13, P 14, Vertebrae: 34—36. The same author reported these counts for *Chirodactylus brachydactylus* (n = 1): D XVIII, 29, A II, 11, P 14, Vertebrae: 35.

Geographic and seasonal distribution

C. fasciatus ranges from Port Nolloth to Durban, *C. brachydactylus* ranges from Walvis Bay to Durban (Day et al., 1970). The eggs were collected on both sides of the Cape Peninsula from February to September, inclusive. A single egg of what appeared to be the same species was taken in False Bay in November (Table 1). Gilchrist & Hunter netted the eggs in large numbers in Table Bay in January, March, August and September.

Rearing notes

Despite numerous attempts, rearing through metamorphosis was unsuccessful. Although first-feeding on *Brachionus* in the 10-liter rearing tanks was excellent, and the percent survival to about 25 days sometimes exceeded 25%, mortality was consistently total over the subsequent three weeks.

Incubation time (15°C): 86 ± 10 h (Fig. 186.14). First-feeding appears to be optimal between 160 and 200 h post-hatch.

CARANGIDAE

Day et al. (1970) listed seven carangids from False Bay, four of which range into the Atlantic. Some information has been published on the early stages of all of these species. References for five of them, *Alectes ciliaris, Decapterus macrosoma, Elagatis bipinnulatus, Lichia amia,* and *Naucrates ductor,* were provided by Aboussouan (1975). References for the other two, *Seriola lalandi* and *Trachurus trachurus capensis,* are provided below.

Trachurus trachurus capensis Castelnau, 1861
Figs. 78—82

Previous descriptions of eggs and/or larvae

Gilchrist, 1903 (as Species VI): egg, p. 198; larva, p. 198, fig. 28.

not Gilchrist, 1916 (as *Caranx trachurus*): egg, p. 9; larva, p. 9, fig. 5. (Gilchrist described another carangid species here — the one treated below as *?Seriola*.)

Haigh, 1972b (as *Trachurus trachurus*): egg, p. 140; larva, p. 141, figs. 1—3.

King et al., 1977 (as *Trachurus trachurus*): egg, p. 17, fig. 2; larva, p. 18, fig. 4.

Egg

Table 3. *Trachurus* eggs cannot be separated from those of a number of other species (particularly sparids) on the basis of size alone. They can be distinguished by virtue of the combination of yolk vesiculation and chorion and oil globule dimensions. The reader should refer to King et al. (1977) for figures and a more detailed description of the egg and early larva.

Larva

Figs. 78—82, Table 3. See also: Haigh (1972b) and King et al. (1977).

Meristics

D VIII + I,30–34, A II + I,27–29, P 22, Vertebrae: 10 + 14 = 24 (Haigh, 1972b, table 1: juveniles).

Geographic and seasonal distribution

Following the nomenclature of Nekrasov (1978), the South African maasbanker is regarded here as distinct from the European horse mackerel, *Trachurus trachurus*. The limits of its distribution northward into the eastern Atlantic extend at least to Angola and perhaps as far as Nigeria (Berry and Cohen, 1972). *T.t. capensis* ranges eastward at least to Port Elizabeth (Nekrasov, 1978). *T.t. capensis* eggs appeared sporadically in the plankton hauls made during this study (Table 1), and no trends are evident. Published data on reproduction in this species are not entirely in accord. Davies (1957) and

Geldenhuys (1973) argued for a spawning season of late winter and spring. Komarov (1964) reported year-round, asynchronous spawning off South West Africa, but his data concerned only the months November to May, inclusive, and July. King et al. (1977) collected maasbanker eggs in False Bay in March; Gilchrist (1903) took the eggs in False Bay in December.

Rearing notes

Incubation time at 15°C is estimated to be 56 ± 10 h (Fig. 186.15). This value is in close agreement with the results of King et al. (1977, fig. 3), which indicated an incubation time (actually, blastula to hatching) of about 58 h at 15°C. First-feeding was successful on both *Proales* and *Brachionus*. Definitive fin counts were attained at an age of about 6 weeks (15°C). Two 70-day-old juveniles measured 25 mm SL.

?Seriola lalandi Valenciennes, 1833
Figs. 83—85

Previous descriptions of eggs and/or larvae

Gilchrist, 1903 (as Species IV): egg, p. 197; larva, p. 197, fig. 26.

Gilchrist, 1916 (as *Caranx trachurus*): egg, p. 9; larva, p. 9, fig. 5.

?Gilchrist, 1916 (as *Seriola lalandii*): ovarian egg, p. 9.

Notes on identification

The anterior position of the oil globule, the relatively long gut, the vesiculated yolk, the presence of yellow pigmentation on the finfolds, and the myomere count place this species among the Carangidae. Its tentative referral to *Seriola lalandi* is based on Gilchrist's (1916) description of ripe ovarian eggs of that species (diameter 1.27 mm, with single oil globule 0.34 mm) and on descriptions of eggs and early larvae of other *Seriola* species *(e.g.,* Mito, 1961: *S. quinqueradiata).* Although the egg of *Naucrates ductor,* as described by Sanzo (1931b), also has a vesiculated yolk and is of similar size (chorion diameter ca. 1.32 mm, oil globule 0.28 mm), the extent of the black pigmentation, especially on the yolk-sac, effectively removes it from consideration. (As pointed out by Barnard (1926), Gilchrist's (1918) description of *Naucrates* eggs as oval, bearing a filâment, and lacking an oil globule was in error.) To the author's knowledge, eggs and early larvae of the leervis, *Lichia amia,* have not yet been described, and a definitive identification of the present material as *S. lalandi* might best be deferred until such time.

Egg

Fig. 83, Table 3.

Larva

Figs. 84—85, Table 3.

Geographic and seasonal distribution

This egg was not taken in the Atlantic; it appeared in small numbers in False Bay collections in November and January (Table 1). Gilchrist (1903) collected the egg from False Bay in December; he (1916) procured a ripe female *S. lalandi* in February. Smith (1959) gave January—March as the spawning period of *S. lalandi* (as *S. pappei*).

Rearing notes

Rearing attempts were totally without success. Only one larva reached potential first-feeding age, but was obviously deformed and showed no food-searching behaviour. 15°C is probably too cold for the normal development of this species.

CENTRACANTHIDAE

This small family, closely allied to the Sparidae, is presently thought to consist of seven species (Heemstra & Randall, 1977), of which two *(Pterosmaris axillaris* and *Centracanthus australis)* are endemic to South Africa. The most-studied member of the family is probably *Spicara smaris,* a protogynous hermaphrodite with demersal eggs from the NE Atlantic, Mediterranean, and Black Sea. Its reproductive behaviour has been detailed by Salekhova (1969) and Harmelin & Harmelin-Vivien (1976). Pelagic eggs from the Mediterranean were attributed to the centracanthid, *Centracanthus cirrus* (as *Smaris insidiator*) by Sanzo (1939), Thomopoulos (1954), and Aboussouan (1964). Those eggs are peculiar in having a single, nipple-shaped protrusion at one point on the chorion (Thomopoulos, 1954, fig. 4). The egg of *Pterosmaris axillaris,* described below, differs from all previously-described centracanthid eggs in being pelagic and completely spherical.

Pterosmaris axillaris (Boulenger, 1900)
Figs. 86—93

Egg

Fig. 86, Table 3. The eggs of *P. axillaris* were often taken together with eggs of *Pachymetopon blochi,* from which they are indistinguishable until the embryo is well-formed. The distribution of yellow pigment in the late embryo can be used to separate the two species: *P. blochi* has xanthophores anterior to the eyes and slightly posterior to the otocysts, *Pt. axillaris* has neither.

Larva

Figs. 87—92, Table 3. For a comparison of early larvae of *Pterosmaris axillaris* with those of *Pachymetopon blochi* and Species 5, refer to the descriptions of the latter two species.

Meristics

D XI,12 – 13, A III,11 – 12 (Smith, 1965). P 17, Vertebrae: 10 + 14 = 24 (this study).

TABLE 2. Summary of available reproductive information on the sparids of the Cape of Good Hope. Unless otherwise stated, the spawning seasons listed here apply to populations in waters of the Cape Province.

Species	Spawning Season	Life Stages Described	Reference
Argyrozona argyrozona	artificially fertilized ripe adults in December	egg, pre-feeding larva	Gilchrist, 1903,1916
	"spawn mainly in spring and summer months"		Nepgen, 1977:19
Boopsidea inornata		juvenile of 6.3 cm	Smith, 1965
Cheimerius nufar	procured ripe eggs in January	ovarian egg	Gilchrist, 1916
		juvenile of 25 cm	Smith, 1965
	June-September (Gulf of Aden area)		Druzhinin, 1975
Chrysoblephus cristiceps		juveniles	Smith, 1943, 1965
Chrysoblephus gibbiceps	artificially fertilized ripe adults in November	egg, pre-feeding larva	Gilchrist, 1903,1916
	"spawns in midsummer"		Biden, 1930:184
Chrysoblephus laticeps	"mature roe in December"		Biden, 1930:184
	ripe-running in December and January in False Bay		Penrith, 1975 (pers. comm.)
Cymatoceps nasutus		juveniles of 15 and 20 cm	Smith, 1965
Diplodus cervinus	very probably spawns in midsummer		Biden, 1930
		larva	(this study)
Diplodus sargus	ripe eggs found in summer	ovarian egg	Gilchrist, 1916:6
	spawning peak in midsummer; most females carry ripe roe at all times of the year		Biden, 1930:200
		egg, larva	(this study)
Gymnocrotaphus curvidens	procured ripe eggs in September	ovarian egg	Gilchrist, 1916
	"spawning season is midsummer"		Biden, 1930
	October—December, inclusive	larva, juvenile	(this study)
Lithognathus lithognathus	probably spawns in July and August		Mehl, 1973
Lithognathus mormyrus	artificially fertilized ripe adults in January	egg, pre-feeding larva	Gilchrist, 1903,1916
	May to August, inclusive (in the Adriatic)	egg, pre-feeding larva	Varagnolo, 1964
	middle of May through September (western Mediterranean)		Suau, 1970
	October to February, inclusive	egg, larva	(this study)
Pachymetopon blochi		ovarian egg	Gilchrist, 1916
	spawning peaks in summer and winter; minor spawning in spring and autumn		Nepgen, 1977
	January to August, inclusive (eggs very rare during rest of year)	egg, larva	(this study)
Petrus rupestris		juvenile of 23 cm	Smith, 1965
Polysteganus undulosus	July through November (in Natal)		Ahrens, 1965
		juveniles	Smith, 1943 1965
Pterogymnus laniarius	procured ripe eggs in March and June	ovarian egg	Gilchrist, 1904,1916
	probably spawns all year with peaks in January—February and September		Budnichenko & Dimitrova, 1970
	mid-September to May		Hecht & Baird,1977
Rhabdosargus globiceps	procured ripe eggs in November and December	egg, pre-feeding larva	Gilchrist, 1903,1916
	spawning peak in midsummer; minor spawning rest of year		Biden, 1930:184
	procured fully-ripe females in August; probably spawns from August to about February		Talbot, 1955
Sarpa salpa	September—October (western Mediterranean)		Malo-Michèle, 1977
Sparodon durbanensis		juvenile	Smith, 1965
Spondyliosoma emarginatum	nest-building and spawning observed in Port Elizabeth aquarium, September to middle of November	(has demersal eggs)	Bruggen, 1965
	breeding behaviour seen in False Bay in January		Penrith, 1972

Geographic and seasonal distribution

P. axillaris ranges from Table Bay to Durban (Day et al., 1970). Its eggs were collected in Table Bay from March to September, inclusive. They were taken less regularly and in smaller numbers in False Bay over roughly the same period (Table 1).

Rearing notes

Incubation time (15°C): 90 ± 10 h (Fig. 186.16). Age-at-optimal-first-feeding was estimated (Brownell, 1979) at 190 h post-hatch. Larvae first-fed on either *Proales* or *Brachionus*. Definitive fin-ray counts were attained at an age (15°C) of 5—6 weeks. The 32-day specimen presented in Fig. 92 was slightly smaller than average — probably malnourished.

SPARIDAE

Smith (1975) listed 41 sparid species in southern African waters. Of those, Day et al. (1970) recorded 22 from False Bay, of which 15 range around the Cape of Good Hope into the Atlantic, at least as far as Table Bay. Since many of the South African sparids are important commercial and sport species, there has been a fair amount of attention paid to their biology, including reproduction. The available information on spawning and development in the 22 Cape of Good Hope sparids is summarized in Table 2.

Known eggs of the South African sparid fishes fall into the size range 0.8—1.25 mm in diameter and have a single oil globule 0.16—0.25 mm in diameter. The only species known to have demersal eggs is the steentjie, *Spondyliosoma emarginatum*. Notes on the breeding behaviour of the steentjie in an aquarium were published by Bruggen (1965); no description of the demersal eggs was provided.

The following treatment of early stages of Cape Peninsula sparids is regrettably far from complete. Six species, *Diplodus cervinus, D. sargus, Lithognathus mormyrus, Pachymetopon blochi, Chrysoblephus laticeps,* and *Gymnocrotaphus curvidens,* were reared through metamorphosis during this study. The author believes that several other sparid species spawn in these waters, but that a thorough understanding of their early life stages will depend on access to ripe adults, as well as to rearing facilities.

Chrysoblephus laticeps (Cuvier, 1829)
Fig. 94

Larva

Two *Chrysoblephus laticeps* and one unidentified *Chrysoblephus* species were reared through metamorphosis during this study. They hatched from eggs originally identified as *Diplodus sargus,* and were only recognized as unique as metamorphosis approached. Early juveniles were characterized by a prolonged first ventral soft ray and concentrations of melanophores at the following places: 1) spinous dorsal, 2) spinous anal, 3) ventral fins, 4) center of operculum, and 5) the two longitudinal patches stippled in Fig. 94.

Meristics

D XI—XII,10—11, A III,7—9 (Smith, 1965). P 16, Vertebrae: 10 + 14 = 24 (this study).

Geographic and seasonal distribution.

According to Day et al. (1970), *C. laticeps* is endemic to South Africa, occurring from Table Bay to Natal. Available data (Tables 1—2) indicate a spring/summer spawning season.

Rearing notes

An individual kept for 8 months after hatching (which died as a result of an aeration malfunction) reached a total length of 66 mm (SL = 55 mm) (15°C).

Diplodus cervinus (Valenciennes in Webb & Berthelot, 1843)
Figs. 95—97

Previous descriptions of eggs and/or larvae.

None (juvenile stage figured by Smith & Smith (1966)).

Egg

Table 3. The egg and prefeeding larva of *D. cervinus* were only recognized at the very end of this study and time did not permit proper illustration. Although the average diameter of *D. cervinus* eggs appears to exceed the average diameter of *D. sargus* eggs, the overlap in their size ranges makes identification difficult, if not impossible. Both black and yellow pigmentation in the late embryo is very similar to that of *D. sargus* (see below).

Larva

Figs. 95—97, Table 3. Newly-hatched larvae of *D. cervinus* bear xanthophores in the following places: 1) immediately anterior and posterior to each eye, 2) two (bilateral) over the middle of the yolk on the body above the level of the notochord, 3) two (bilateral) over the posterior third of the yolk on the body below the level of the notochord, 4) on the oil globule (several), 5) two (bilateral) over the oil globule on the body above the level of the notochord, 6) one (median) on the underside of the tail, about a fourth of the distance from the oil globule to the posterior tip of the notochord, 7) one (median) on the dorsal surface of the tail, slightly posterior to the level of the last-mentioned xanthophore, and 8) two on the tail, about half-way between the oil globule and the posterior tip of the notochord. Minor variations in this xanthophore distribution were noticed. Melanophore patterns at this stage are useless in separating *D. cervinus* from other sparids. At about 4 days, post-hatch, the black pigment along the dorsal surface of the gut begins to intensify. By first-feeding (optimally at 6—8 days post-hatched), the two *Diplodus* species are distinguishable on the basis of the intensity of this pigment. *D. cervinus* at this stage is more robust and has a more blunted snout than *D. sargus*. *D. cervinus* lacks the nuchal flare of yellow pigment that characterizes first-feeding larvae of *Pterosmaris axillaris, Pachymetopon blochi,* and some *Lithognathus mormyrus*. All xanthophores disappear in some individuals prior to first-feeding; they are normally lost in all cases by about the 10th day post-hatch (15°C). The 32-day specimen figured (Fig. 97) happened to lack black pigment on the caudal portion of the vertebral column. Such pigment is often present. The ventral fins are invariably black. The vertical black bands of the adult only begin to take shape at about 2 cm (SL).

Meristics

D XI,12—13, A III,11 (Smith, 1965). One specimen was reared with 10 anal soft rays. P 14—16, Vertebrae: 10 + 14 = 24 (this study).

Geographic and seasonal distribution

Extends all round Africa (Smith, 1965). No larvae of this species hatched from eggs collected on the Atlantic side of the Cape Peninsula. The eggs were taken in False Bay from October to January, inclusive (Table 1). Christensen (1978) captured three juveniles of 1—2 cm SL in tide pools near Port Alfred in November. These are likely to have been spawned about 3 months earlier, which suggests an earlier or more extended, spawning period for this species in the eastern Cape Province.

Rearing notes

First-feeding was consistently successful on *Brachionus*. At 15°C, larvae developed a definitive fin-ray count at about 5 weeks, post-hatch. In all the batches of *D. cervinus* reared, there was a high incidence of abnormal swimming behaviour. Many larvae swam at the top of the water column, inclined at a 45°C angle to the surface. Juveniles behave normally, attaining standard lengths of about 2 cm after 3 months, 3—3.5 cm after 6 months (15°C).

Diplodus sargus (Linnaeus, 1758)
Figs. 98—105

Previous descriptions of eggs and/or larvae.

Gilchrist, 1916 (as *Sargus capensis*): egg, p. 5.
Ranzi, 1933 (as *Sargus sargus*): egg, p. 351, fig. 257; larva, p. p, 351, fig. 258, pl. 26.
(Additional references are cited by Ranzi (1933).)

Egg

Fig. 98, Table 3. The author cannot suggest any features that uniquely characterize the egg of this species.

Larva

Figs. 99—104. Table 3. The distribution of xanthophores in early larvae is somewhat variable, and at present, it would be unwise to attempt generalization. The specimens figured (Figs. 99—102) were not atypical. Melanophore distribution in pre-feeding larvae is not useful in separating them from other sparid species. After some practice, the author could confidently recognize living larvae of this species at first-feeding — as much by the general aspect (including facial expression!) as by pigmentation or size. Among flexion and early post-flexion larvae, the presence of melanophores along the anal fin base (Fig. 104), and absence of such pigment along the soft-dorsal fin base is characteristic. The black spot on the caudal peduncle only appears at a standard length of 9—10 mm (alive).

Meristics

D XII,14—15, A III,13—14 (Smith, 1965). P 16—17, Vertebrae: 10 + 14 = 24 (this study).

Geographic and seasonal distribution.

D. sargus occurs all round Africa (Smith, 1965) and as far as the Bay of Biscay in the Northeastern Atlantic (Tortonese, 1973). The South African form has been given subspecific status (Paz, 1975) as *D. sargus capensis*. From egg collection data presented here (Table 1), there appears to be a spawning peak in November—December, with reduced spawning the rest of the year. Spawning in the Mediterranean takes place April—June (Ranzi, 1933).

Rearing notes

Incubation time (15°C): 74 plus minus 10 h (Fig. 186.17). An experiment was conducted in which a group of 45 previously unfed *D. sargus* at age-of-optimal-first-feeding (ca. 173 h) were split into two 350-ml containers (described by Brownell, 1979), one containing *Brachionus,* the other *Proales*. After a 4-h exposure to food, 12 of 21 (57%) of the larvae offered *Brachionus* had fed and 19 of 24 (79%) of the larvae offered *Proales* had fed. The difference is not significant at the 5% level (Chi-square test). At least ten batches of *D. sargus* were reared through metamorphosis, and some were maintained for several months thereafter. Standard lengths of 6-month-old juveniles ranged from 3.5 to 5 cm (15°C).

Gymnocrotaphus curvidens Günther, 1859
Fig. 106

Previous descriptions of eggs and/or larvae.

Gilchrist, 1916: egg, p. 6.

Egg

Ripe ovarian eggs measured 0.9 mm in diameter, with a single oil globule 0.21 mm in diameter (Gilchrist, 1916). They were not recognized in this study.

Larva

Fig. 106. On three occasions, a few larvae of this species appeared in rearing tanks stocked with assorted eggs and larvae from False Bay. They were recognized as unique about a month after hatching,

but were not sacrificed for illustration in the hope that some would reach an identifiable stage. The individual figured here (Fig. 106) died prior to metamorphosis and was preserved. The coloured pigmentation in the drawing was taken from a live-sketch of another specimen.

Geographic and seasonal distribution

G. curvidens is endemic to South Africa: False Bay to Durban (Day et al., 1970). The above-mentioned specimens were reared from eggs collected in False Bay in October, November and December.

Rearing notes

One larva survived to metamorphosis. Growth was slow: a SL of 28 mm was reached at an age of 5 months when it died during treatment for the protozoan parasite, *Cryptocaryon irritans*.

Lithognathus mormyrus (Linnaeus, 1758)
Figs. 107—115

Previous descriptions of eggs and/or larvae.

Gilchrist, 1903 (as *Pagellus mormyrus)*: egg, p. 188; larva, p. 188.

Gilchrist, 1916 (as *Pagellus mormyrus)*: egg, p. 6; larva, p. 6.

Varagnolo, 1964 (as *Pagellus mormyrus)*: egg, p. 259, figs. 23—24; larva, p. 259, figs. 25—27.

Egg

Fig. 107, Table 3. Gilchrist (1903) gave the mean diameter of ten eggs as 0.88 mm, with an oil globule of 0.16 mm . Varagnolo's (1964) eggs, collected from the plankton of the upper Adriatic, were of the same diameter (mean 0.87, range 0.83—0.90), but the oil globule was considerably larger (ca. 0.24 mm). Even if one were to go by Varagnolo's drawings of *L. mormyrus* eggs, the globule would still be 0.20—0.22 mm (assuming the eggs drawn had diameters between 0.83 and 0.90 mm). Globule diameters of eggs collected during the present study ranged from 0.17 to 0.19 mm, making them somewhat larger than Gilchrist's and smaller than Varagnolo's.

Larva

Figs. 108—114, Table 3. The arangement of xanthophores in the newly-hatched larvae was very consistent. The specimen drawn may be considered typical. Although Gilchrist's (1903: 188) description of an egg approaching hatching conforms to this xanthophore distribution, his notes on the newly-hatched larva are contradictory: "There is no aggregation of pigment at any particular points, but is scattered sparsely over the whole larva in dots and stellate pigment cells, sometimes extending on to dorsal and anal fin."

Varagnolo's (1964) figures of pre-feeding larvae depart in several respects from those described here. He showed yellow pigment at three places (rather than one, rarely two) on the tail, including the extreme posterior of the notochord. Also, the cephalic and thoracic xanthophores of his newly-hatched larva are scattered, rather than consolidated into well-defined areas. There are, however, enough similarities between Varagnolo's larvae and those described here to admit the possibility that both concern the same species, but that noteworthy geographic differences occur in the early stages.

Although xanthophore placement at hatching is rather constant, the same cannot be said for subsequent stages. Some larvae lose all (or almost all: Fig. 111) yellow pigment prior to first-feeding, some exhibit a proliferation of yellow pigment (Fig. 112). Older larvae and early juveniles bear very modest preopercular armature (unlike that shown in one of Ranzi's (1933, pl. 25, fig. 14) illustations).

Meristics

D XI,12, A III,10 (Smith, 1965). Specimens reared during this study: D XI,12 – 13, AIII,10 – 11, P 16 – 17, Vertebrae: 10 + 14 = 24.

Geographic and seasonal distribution

L. mormyrus ranges around the whole of Africa and into the Bay of Biscay (Smith, 1965; Tortonese, 1973). Eggs were taken from October to February, inclusive, in False Bay; never on the Atlantic side of the Cape Peninsula (Table 1).

Rearing notes

Incubation time (15°C): 74 plus minus 10 h (Fig. 186.18). Age-at-optimal-first-feeding is about 172 h, at least 50% of larvae can first-feed between the ages of about 140 and 204 h post-hatch. (Brownell, 1979). First-feeding was generally successful on *Proales,* generally unsuccessful on *Brachionus*. The difference may be attributed to the small mouth of the larva. Juveniles averaged 35 mm SL at an age of 6 months.

Pachymetopon blochi (Valenciennes in C. & V., 1830)
Figs. 116—123

Precious descriptions of eggs and/or larvae

Gilchrist, 1916 (as *Cantharus blochii)*: egg, p. 6.

Egg

Fig. 116, Table 3. Since the characters of *P. blochi* eggs are not unique, it is only near hatching that the egg can be identified — and even then, it is only on the basis of xanthophore arrangement in the living embryo that identification is feasible (see notes under *Pterosmaris axillaris*).

Larva

Figs. 117—122, Table 3. The larva at first-feeding bears a vivid flare of yellow pigment that begins between the eyes and runs postero-dorsally onto the nape *(Pterosmaris axillaris* has the same kind of flare at this stage). By the second or third week, the yellow pigment disappears (15°C). The early juvenile is red-orange with well-defined black areas (Fig. 123).

Meristics

D X-XI,11—12, A III,10 (Smith, 1965). P 16—17, Vertebrae: 10 + 14 = 24 (this study).

Geographic and seasonal distribution

P. blochi ranges from Lüderitz to Algoa Bay (Day *et al.,* 1970) but is rare east of Cape Agulhas (Smith, 1965). From egg collection records (Table 1) there appears to be a protracted period of spawning from January to August, inclusive, with almost no activity during the rest of the year. See Table 2 for additional information.

Rearing notes

Incubation period (15°C): 82 plus minus 10 h (Fig. 186.19). *P. blochi* at first feeding (optimal at 6—8 days post-hatch at 15°C (Brownell, 1979) is robust, active, and voracious. It feeds equally well on *Proales* as on *Brachionus.* The author reared several batches through metamorphosis and found it to be among the hardiest species encountered. Two individuals were transfered to a 200 *l* aquarium tank and kept for 12 months. During this period they grew to a SL of 10.2 cm (average), which is roughly the expected size of a wild, one-year-old *P. blochi,* based on extrapolation of growth data provided by Nepgen's (1977) otolith studies.

Sparodon durbanensis (Castelnau, 1861)
Fig. 124

The egg and larva of this species were not recognized

A recently metamorphosed juvenile that was taken alive in a False Bay tide-pool has been included (Fig. 124).

Geographic and seasonal distribution

Endemic to South Africa: False Bay to St. Lucia (Day et al., 1970). Judging by the size range of juveniles in False Bay tide-pools in summer (about 1.3 to at least 5 cm SL), the species must have a protracted spawning season — possibly August to January.

MUGILIDAE

Only two of the 15 mugilid species recognized (Smith, 1975; Elst & Wallace, 1976) from South Africa occur in Cape Peninsula waters (Smith, 1965; Day, et al., 1970): *Liza richardsoni* and *Mugil cephalus.* Eggs of both these species were encountered in small numbers, and are described below.

Gilchrist (1916: as *Mugil auratus)* described ovarian eggs of the blue-tail mullet (ranges from Knysna eastward), *Valamugil buchanani.* Wallace (1975b) published information on reproduction in several other Natal mugilid species. A key to juvenile stages of South African mullets was prepared by Elst & Wallace (1976).

Liza richardsoni (Smith, 1846)
Figs. 125—128

Previous descriptions of eggs and/or larvae

Gilchrist & Hunter, 1919 (as *Merluccius capensis)*: egg, p. 6, figs. 10—11; larva, p. 6, figs. 12—13.

Egg

Fig. 125, Table 3. In size, the egg is similar to that of *Trigla capensis.* Near hatching, it may be distinguished by the absence of yellow pigment and greater density of black pigment.

Larva

Figs. 126—128, Table 3. As in *Mugil cephalus,* the anus is situated in the posterior half of the body and the pre-anal myomeres outnumber the post-anal. For the first 2—3 weeks after hatching (15°C), *L. richardsoni* can be distinguished from *M. cephalus* by the absence of yellow pigment and the presence of uniformly dense black pigment. Characters that might be useful in separating subsequent larval stages cannot be offered at this time.

Geographic and seasonal distribution

According to Day *et al.* (1970), *L. richardsoni* occurs along the entire southern African coast. The egg was taken in small numbers from July to October, inclusive, on both sides of the Cape Peninsula (Table 1).

Rearing notes

Insufficient data were available to establish the incubation time of this species. The two eggs that required the longest incubation hatched 72—84 h after collection (Fig. 186.28) First-feeding incidence was 100% (n = 7) on *Brachionus,* but no larvae survived beyond three weeks post-hatch.

Mugil cephalus Linnaeus, 1758
Figs. 129—134

Previous descriptions of eggs and/or larvae

Yashouv & Berner-Samsonov, 1970: egg, p. 77, fig. 5; larva, p. 86, figs. 5—6.

(Additional references are cited by Yashouv & Berner-Samsonov, 1970)

Egg

Fig. 129, Table 3. Eggs in the earliest stages usually have more than one oil globule (up to 6 were counted in eggs collected during this study), but these consolidate into a single large globule, 0.30—0.36 mm in diameter, as hatching approaches.

Larva

Figs. 130—134, Table 3. The placement of the anus in the posterior half of the body and the myomere count of 15—16 + 11 – 12 = 26 – 28 clearly distinguishes this larva from all others described, with the exception of *Liza richardsoni*. The latter lacks yellow pigment (Figs. 126—128).

Geographical and seasonal distribution

Nearly cosmopolitan in tropical, subtropical, and temperate waters. Eggs were taken in small numbers from July to October, inclusive, on both sides of the Cape Peninsula (Table 1).

Rearing notes

The chorion of the living egg has non-wetting properties (as does the egg of *Gaidropsarus capensis*). In clean, static sea water, without a surface slick, the egg almost always breaches the surface, exposing itself to air. Mortalities through hatching were about 75% under these circumstances. Survival was considerably improved when the eggs were separated from the surface by a nylon mesh. First-feeding was successful on *Brachionus*. Four of about 20 larvae not sacrificed for drawings survived through metamorphosis, which occured over the period 6—8 weeks post-hatch (15°C).

SCORPAENIDAE

This family is represented by five species in Cape of Good Hope waters. Pelagic eggs of two species *(Helicolenus dactylopterus* and *Coccotropsis gymnoderma)* were collected during this study. The latter was reared through metamorphosis. Eggs of *Scorpaena scrofa,* were not encountered, but have been described from Mediterranean material as being elliptical and lacking an oil globule (Spartà, 1956). Early stages of *Trachyscorpia capensis* have never been described. (The wide-ranging *Setarches guentheri* may be present in deep waters off the Cape Peninsula, but has not yet been recorded here).

Coccotropsis gymnoderma Gilchrist, 1906
Figs. 135—141

Egg

Fig. 135, Table 3. The egg of *C. gymnoderma* is slightly larger, but otherwise very similar, to that of the Cape sole, *Heteromycteris capensis*. Both lack an oil globule, both become heavily speckled with yellow pigment as hatching approaches. Unlike some scorpaenid eggs, the eggs of *C. gymnoderma* are spherical. The egg drawn, for example, had a minor axis of 98% that of the major axis. This much non-sphericity may be produced by the embryo and is not uncommon in nominally spherical eggs.

Larva

Figs. 136—140, Table 3. At hatching, the larva is covered, except for the tail tip, in stellate xanthophores. There is no concentration of yellow pigment in a vertical band on the tail as is the case with newly-hatched *Heteromycteris*. The yolk sac is (usually) more dorso-ventrally flattened than in *H. capensis*, and often extends anteriorly beyond the level of the snout. The extension from each otocyst (Fig. 140) develops at about 2 weeks of age (15°C) and disappears between the third and fourth week.

Geographic and seasonal distribution

Coccotropsis is a monotypic genus with distribution restricted to the south coast of South Africa, from the Cape Peninsula to Algoa Bay (Smith, 1965). Eggs were collected in False Bay during the summer (Table 1).

Rearing notes

Not enough data are available to confidently estimate incubation time for this species. The eggs with the longest incubation time hatched 42 plus minus 6 h after they were collected (Fig. 186.23). Although sea temperatures at collection varied from 18—22°C, survival of larvae at 15°C was excellent. *Brachionus* is readily taken at first-feeding, which may occur between the ages of 130 and 200 h post-hatch (15°C). The individual illustrated in Fig. 141 is just post-metamorphic.

Helicolenus dactylopterus (Delaroche, 1809)
Figs. 142—146

Previous description of eggs and/or larvae

Sparta, 1956 (as *Scorpaena dactyloptera*): larva, p. 619, figs. 500—502, pls. 38—39.

Marinaro, 1968: egg, p. 133, pl. 1; larva, p. 133, fig. B, pls. 2—3.

Haigh, 1972a: larva, p. 60, figs, 6—8.

Moser et al., 1977: larva, p. 38, fig. 23.

(Additional references are cited by Sparta (1956) and Moser et al. (1977).)

Egg

Fig. 142, Table 3. The egg is distinguishable from all others described here by a combination of its non-sphericity, yolk vesiculation, and presence of an oil globule. The oil globule of False Bay eggs was larger (0.23—0.25 mm) than that of the Mediterranean eggs described by Marinaro (0.19—0.20 mm).

Larva

Figs. 143—146, Table 3. The refringent granules illustrated by Marinaro (1968) in the integument of the newly-hatched larva are also apparent in the present material. The peculiar profile of the snout seen in the 8-day specimen (Fig. 146) was a feature common to all the individuals examined and is apparently not a deformity.

Meristics

D XII,13, A III,5 (Smith, 1965). Eschmeyer (1969) reported a wider range of fin elements, but his material was drawn from a much wider area. He reported: P 19 (16—21), Vertebrae: 25 (usually).

Geographic and seasonal distribution

The range of the subspecies *H. d. dactylopterus* includes the western Atlantic from Nova Scotia to

Venezuela, and the eastern Atlantic from Norway to South Africa (Eschmeyer, 1969). Day et al. (1970) report it as far east as Durban. The eggs were taken in False Bay in January and February, never on the Atlantic side of the Cape Peninsula (Table 1).

Rearing notes

There is evidence of internal fertilization in this species (Krefft, 1961). It would appear that extrusion of eggs may occur at various times thereafter. No record was made of the stage of development of the embryos at the time of collection. Out of the 100 eggs identified, 97 hatched during the first 60 h following collection, 3 hatched during the subsequent 12 h (Fig. 186.25). Judging from the immature appearance of the larvae on hatching (not so apparent in the individual illustrated here (Fig. 143), which may be up to 6 h old, but very apparent in the individual photographed by Marinaro (1968, pl. 2)), these eggs could not have been extruded in an advanced state of development.

The interval between hatching and completion of eye pigmentation is unusually long in this species: ca. 140 h at 15°C. First-feeding *(Brachionus or Proales)* incidence was generally poor (50%). No larvae survived to an age of 16 days.

CONGIOPODIDAE

This family consists of a total of eight southern hemisphere species (Hureau, 1970), of which two (*Congiopodus torvus* and *C. spinifer*) are known from southern Africa. Both reportedly occur at the Cape of Good Hope. The identification of the eggs and larvae described below as *C. spinifer* was made on the basis of successful rearing through metamorphosis. One cannot exclude the possibility, however, that eggs of both species were taken, but that only *C. spinifer* happened to survive to an identifiable stage.

Gilchrist (1903) described ovarian eggs of a horsefish he identified as *Agriopus verrucosus* (synonymized by Barnard (1925—1927) with *C. torvus*). His 1904 publication described artificially fertilized eggs and a late embryo of *Agriopus spinifer* (synonymized by Barnard with *C. spinifer*). Athough the *C. spinifer* eggs (1.74—1.83 mm) were slightly larger than the *C. torvus* eggs (1.53—1.7 mm), there was some doubt as to the maturity of the latter, as noted by Gilchrist (1904). He did not mention any other differences between the eggs of the two species. If one can rely on Gilchrist's identifications of the ripe adults, and on Barnard's synonymies, one can only conclude that the eggs of the two species are very similar. Eggs have been described for one other congiopodid species, the southern pigfish of New Zealand (*C. leucopaecilus*). They also lack an oil globule, but are (on average) larger (1.93—2.18 mm) than those of the South African species (Robertson, 1975b). Eggs and early larvae of a related (but not included among the Congiopodidae by Hureau (1970)) species from Japan (*Hypodytes rubripinnis*) were figured by Mito (1963b).

Congiopodus spinifer (Smith, 1839)
Figs. 147—151

Previous descriptions of eggs and/or larvae:

Gilchrist, 1904 (as *Agriopus spinifer*): egg, p. 144, fig. 49 embryo, p. 144, fig. 50.

Gilchrist, 1916 (as *Agriopus spinifer*): egg, p. 7; embryo, p. 7, fig. 4.

Gilchrist & Hunter, 1919 (as *Agriopus spinifer*): egg, p. 3, fig. 4; larva, p. 3, fig. 5.

Egg

Fig. 147, Table 3. Gilchrist (1903) reported that the ovarian egg (presumably of *C. torvus*) was covered by a "network of well-marked striations". He subsequently (1904) artificially fertilized *C. spinifer* eggs and followed their development for 4 days. He remarked on the "corrugated appearance" of the eggs, and provided an illustration on an egg to show the striated chorion. The present author can confirm the existence of striae on the chorion, but would hesitate to call them "well-marked". In fact, they are discernible only under special lighting conditions, and the same kind of markings are present on the chorion of a number of other species handled by Gilchrist.

Larva

Figs. 148—151, Table 3. *Congiopodus* passes through a unique and strikingly beautiful larval phase, characterized by the exaggerated development of the pectoral fins. In early larval stages (up to ca. 10 days post-hatch) there is often a silvery-orange colouration to the postero-dorsal part of the pectoral fins (not shown in the figures here).

Geographic and seasonal distribution

C. spinifer ranges from Walvis Bay to Delagoa Bay (Day *et al.* (1970). Gilchrist and Hunter (1919) reported *C. spinifer* eggs throughout the year in Table Bay. Assuming that all the congiopodid eggs collected during the present study were those of *C. spinifer,* the collection records (Table 1) confirm year-round spawning for this species.

Rearing notes

Incubation time (15°C): 206 plus minus 10 h (Fig. 186.22). First-feeding was very successful on *Brachionus;* an experiment showed that *Proales* was not taken — no doubt because of its small size. *Artemia* nauplii were not offered as food, although a New Zealand species (*C. leucopaecilus*) is able to first-feed upon them (Robertson, 1974). Unlike *C. leucopaecilus, C. spinifer* cannot first-feed until about 36 h after hatching (Brownell, 1979). Following metamorphosis (about 8 weeks post-hatch), growth slows: an individual kept for 2.5 years reached only 85 mm SL. During this period the fish was never seen to shed its skin — a phenomenon which Gilchrist (1914b) observed in specimen(s) kept in the old aquarium at St. James.

TRIGLIDAE

Four triglid species are recognized in waters around the Cape of Good Hope: *Trigla capensis, Trigla kumu, Trigla queketti,* and *Trigloporus africanus*. No triglids were reared through metamorphosis during this study and there is some doubt as to the identity of the eggs and larvae described below. They have been tentatively referred to *Trigla capensis* on the grounds that it is the more abundant of the four species. The wide size-range of triglid eggs encountered here (1.16—1.40 mm) suggests that more than one species is involved. Early stages of *Trigla kumu* (Mito, 1963b; Robertson, 1975b) and, apparently, *Trigla capensis* (as *Trigla kumu,* see references below) have been described, but the descriptions do not permit a clear-cut distinction. There is a need for a comparison of material from artificial fertilization of identified parent stock of all four species.

Trigla capensis Cuvier in C. & V., 1829
Figs. 152—157

Previous descriptions of eggs and/or larvae

Gilchirst, 1903 (as *Trigla kuma (sic)*): egg, p. 190, fig. 14; larva, p. 190, fig. 15.

Gilchrist, 1916 (as *Trigla kumu*): egg, p. 7, fig. 3; larva, p. 7, fig. 3.

Gilchrist & Hunter, 1919 (as *Trigla kumu*): egg, p. 3, fig. 1; larva, p. 3, figs. 2—3.

(According to Barnard (1925—1927:940) Gilchrist identified *Trigla capensis* as *T. kumu.*)

Egg

Fig. 152, Table 3.

Larva

Figs. 153—157, Table 3.

Geographic and seasonal distribution

T. capensis ranges from near Angola (18°S) (Trunov & Malevanyy, 1974) to Natal (Smith, 1965). Eggs were taken on both sides of the Cape Peninsula all year round, with no obvious peaks. Two reports on the reproductive biology of this species have appeared; both provide information on the seasonal frequency of females with ripe ova. Trunov & Malevanyy (1974) concluded that spawning takes place off South West Africa throughout the year, but reaches a height during the warmest period (December-March). Hecht (1977) suggested that *T. capensis* off the eastern Cape Province spawns twice during the period November—January, and again in March—April. The specimens that Gilchrist (1903) artificially fertilized were taken in False Bay in December.

Rearing notes

Incubation time (all triglid eggs) at 15°C: 110 plus minus 10 h (Fig. 186.24). Incidence of first-feeding (*Brachionus*) was consistently high (90%) between the ages of about 100 h and about 180 h post-hatch during 4-h feeding tests, however only one larva approached metamorphosis. The specimen was partially consumed by a newly-metamorphosed stomatopod that the author unwittingly placed in the tank.

EGGS AND LARVAE OF UNKNOWN AFFINITIES

Leptocephalus Species 1
Figs. 158—161

Previous descriptions of eggs and/or larvae

None. Day *et al.* (1970) recorded only two anguilliform species from False Bay: the congrid, *Gnathophis capensis* and the ophichthid, *Ophisurus serpens*. Eggs of both species have been described, the former by Castle (1969) and Gilchrist (1904, Species XX), and the latter by Grassi (1913). The apode eggs collected during the present study are attributable to neither of these species. *G. capensis* eggs lack oil globules; *O. serpens* yolk-sac larvae have about 88 pre-anal myomeres (versus about 60 in my larva).

Egg

Fig. 158, Table 3. Its large size and wide perivitelline space immediately sets this egg apart from all others described here. The presence of ca. 5—35 oil globules distinguishes it from the egg of *Gnathophis capensis*. The author cannot distinguish it (by size or globules) from the egg described as *Ophisurus serpens* by Grassi (1913).

Larva

Figs. 159—161, Table 3.

Geographic and seasonal distribution

Eggs were taken on three occasions, once in Hout Bay in November, twice in Fish Hoek Bay in March (Table 1).

Rearing notes

Of the 40 eggs collected, 24 hatched within the first 156 h; one hatched almost 3 days later in an advanced state (eye pigmentation appeared the following day); one was kept out for illustrating, and the other 14 died in the shell. The distribution of incubation times from blastodisc stage to hatching indicates an embryonic life (at 15°C) of slightly over 6—6,5 days (Fig. 186.26). Mortality was high in the yolk-sac stage, and only 5 survived to 8 days post-hatch. These were placed in rearing tanks with *Brachionus* and *Proales,* but virtually no feeding took place. On the following day, two of the larvae were seen to have a single whitish particle in the gut, probably food, but this was not confirmed by microscopic examination. All larvae died over the subsequent 48 h.

Perciform Species 1
Figs. 162—168

Egg

Fig. 162, Table 3. For all practical purposes, the egg is spherical: The length of the minor axis was never found to be less than 98% (and was usually between 99 and 100%) that of the major axis. Yolk segmentation is peripheral.

Larva

Figs. 163—167, Table 3. The vesiculation of the yolk and the ventro-posterior (rather than dorso-posterior) position of the oil globule at hatching is probably the most noticeable difference between this species and the several sparids with similarly- sized eggs. The arrangement of melanophores like small lumps on the dorsal surface of the oil globule (Fig. 164) was a general feature in 2-day-old larvae. Most specimens lost all yellow pigment by the age of 16 days.

Notes on identification

A single individual survived through metamorphosis and was illustrated at an age of 93 days (Fig. 168). Although the fin ray counts for this juvenile (D XIII,15; A IV,7; P 20) are very close to those reported for *Sebastes capensis* (Gmelin) (Smith, 1965), the lack of a suborbital stay and spines on the head bones (W. N. Eschmeyer, personal communication) precludes its identification as a scorpaeniform.

Rearing notes

Most of the eggs hatched between the 48th and 60th hour after collection (15°C) (Fig. 186.21), in a relatively immature state (Fig. 163). First-feeding incidence varied widely from batch to batch. The highest recorded was 76% (16 out of 21 larvae offered *Proales* for 4 h). Only one individual survived through metamorphosis. At a SL of 9 mm, it took up a benthic life-style and gradually acquired a variegated orange coloration.

Species 2
Figs. 169—173

Perevious descriptions of eggs and/or larvae

Gilchrist, 1904 (as Species XII): egg, p. 134; larva, p. 134.

Egg

Fig. 169, Table 3. The absence of any pigment on the late embryo distinguishes the egg from those of a number of other species (particularly sparids) with which it might easily be confused.

Larva

Figs. 170—173, Table 3. The larva is characterized by an absence of all pigment for the first 24—36 h after hatching. Heavy black pigmentation subsequently forms over the gut.

Geographic and seasonal distribution

These eggs were taken on the Atlantic side of the Cape Peninsula only, during the months of September and October (Table 1). Gilchrist (1904) netted what appears to be the same species in False Bay in November.

Rearing notes

Incubation time (15°C): 54 plus minus 10 h (Fig. 186.27). First-feeding was not successful on *Brachionus* and only rarely on *Proales*. No larvae survived to the 16th day post-hatch.

Species 3
Figs. 174—177

Egg

Fig. 174, Table 3. The most striking feature of the advanced egg of this unidentified species is the heavy yellow pigment covering the oil globule, as well as parts of the body. The combination of chorion and oil globule size and yolk vesiculation distinguishes the egg from all others described here.

Larva

Figs. 175—177, Table 3. Note the heavy yellow pigmentation on the oil globule of the newly-hatched larva.

Geographic and seasonal distribution

Eggs of Species 3 were taken in False Bay from October to February, inclusive. None were found in collections from the Atlantic (Table 1).

Rearing notes

Incubation time (15°C): 62 plus minus 10 h (Fig. 186.29). First-feeding was sporadic on both *Brachionus* and *Proales;* rearing attempts were unsuccessful.

Species 4
Figs. 178—179

Egg

Not recognized. Judging from the size of the newly-hatched larva, the egg diameter is likely to be in the range 0.85—0.95 mm . There is a single oil globule in the newly-hatched larva of 0.23—0.24 mm in diameter.

Larva

Figs. 178—179, Table 3. The larva at hatching is unique among those described here by virtue of its pigmentation: black and orange spots scattered on the body.

Geographic and seasonal distribution

The eggs were taken in False Bay in January and February (Table 1).

Rearing notes

The yolk-sac larvae appeared to be exceptionally sensitive to entrapment on the surface film. None survived to first-feeding.

Species 5
Figs. 180—184

Previous descriptions of eggs and/or larvae

The egg and pre-feeding larva is similar in many respects to those obtained by artificial fertilization of

Argyrozona argyrozona (Gilchrist, 1903 (as *Dentex argyrozona*): egg, p. 188; larva, p. 188; and Gilchrist, 1916 (as *Dentex argyrozona*): egg, p. 3; larva, p. 3). Gilchrist's eggs were smaller (0.83—0.89 mm; mine were 0.98—1.05 mm) and there are a few differences in xanthophore distribution. His larvae at hatching apparently lacked the caudal xanthophore of the present material. Similarities include the weak development of pigment, either yellow or black, and the absence of pre-orbital xanthophores. From examination the absence of pre-orbital xanthophores. From examination of *A. argyrozona* gonads, Nepgen (1977: 19) concluded that spawning occured "mainly" in spring and summer. This does not necessarily contradict the temporal distribution of eggs in the plankton recorded here (*i.e.,* year-round; Table 1).

Egg

Fig. 180, Table 3. The range of chorion and oil globule diameters of this egg overlaps that of several other species; prior to development of yellow pigment it is not identifiable using morphological criteria.

Larva

Figs. 181—184, Table 3. At hatching, the larva usually has five areas of yellow pigment: a spot behind each eye, a spot on the postero-dorsal surface of the oil globule, and two spots (laterally, opposite one another) on the tail. A few additional spots are sometimes present laterally on the trunk over the yolk. The distribution of the five yellow areas is similar to that in newly-hatched *Pterosmaris axillaris,* whose spawning period overlaps. The eggs of the two species may be separated by size alone; living yolk-sac larvae may be separated on characteristics of the xanthophores: in Species 5 the post-orbital spots are small, pale but distinct, and well-separated from one another (Fig. 181); in *P. axillaris* they are larger and brighter but more diffuse, with stellate branches that may inter-twine with those of the other spot, sometimes giving the impression of a

TABLE 3. Summary of salient characters of eggs and early larvae. Only species encountered in the plankton during the present study have been incl Eggs are arranged in order of decreasing size. Measurements given in mm

Diameter of egg	Number of oil globules	Diameter of oil globule	Perivitelline space	Yolk texture	Chorion texture	Incubation time (± 10 h at 15°C
2.44—2.72	5—35	variable	wide[1]	segmented	smooth	> 150
2.40—2.45	0	—	narrow	hazy	smooth	long
1.80—2.10	1	0.25—0.26	narrow	segmented	see text	?
1.70—2.00	0	—	narrow	hazy	smooth	206
1.50—1.62	> 100	variable	narrow	clear	smooth	?
1.40—1.80	1	0.13—0.17	wide[2]	segmented	smooth	ca. 60[3]
1.33—1.45	0	—	narrow	segmented	smooth	70
1.33—1.45	1	0.30—0.35	narrow	segmented	smooth	?
1.28—1.44	> 100	variable	narrow	hazy/clear	smooth	100
1.23—1.35	1	0.26—0.28	narrow	clear	smooth	?
1.16—1.40	1 (2—5)	0.22—0.26	narrow	clear	smooth	110
1.20—1.60 × 0.55—0.65	0	—	narrow	segmented	smooth	ca. 70[4]
1.18—1.30	1	0.09—0.11	narrow	clear	smooth	106
1.10—1.28	1	0.21—0.24	narrow	clear	smooth	90
1.08—1.20	0	—	narrow	clear	smooth	?
1.06—1.22	1	0.21—0.25	narrow	clear	smooth	82
1.04—1.15	1	0.23—0.25	narrow	clear	smooth	86
1.00—1.08	1	0.19—0.21	narrow	clear	smooth	?
1.09—1.20 × 0.94—1.05	1	0.05—0.07	narrow	clear	smooth	80
0.98—1.05	1	0.19—0.21	narrow	clear	smooth	74
0.97—1.04	0	—	narrow	hazy	smooth	80
0.95—1.05	1	0.26—0.28[5]	narrow	clear	smooth	?
0.94—1.03	1 (2—10)	0.30—0.36	narrow	clear	smooth	?
0.91—1.02	1	0.19—0.21	narrow	clear	smooth	?
0.91—0.99	1	0.20—0.22	narrow	segmented	smooth	56
0.90—0.99	1	0.23—0.24	narrow	segmented	smooth	?
0.90—0.96	1	0.16—0.18	narrow	clear	smooth	?
0,92 – 0.98 × 0.88 – 0.93	1	0.23—0.25	narrow	segmented	smooth	?
0.88—0.97	1	0.19—0.21	narrow	clear	smooth	74
0.86—0.93	1	0.18—0.20	narrow	segmented	smooth	54?
ca. 0.85—0.95	1	0.23—0.24	narrow	clear	smooth	?
0.83—0.92	1	0.175—0.19	narrow	clear	smooth	74
0.80—0.90	12—20	variable	narrow	clear	smooth	80
0.74—0.84	1 (2—5)	0.16—0.18	narrow	clear	smooth	96
0.72—0.78	0	—	narrow	segmented	smooth	40
0.72—0.78	1	0.11—0.13	narrow	clear	smooth	45
0.70—0.81	2—16	variable	narrow	clear	smooth	62
ca. 0.70—0.80	1	ca. 0.18	?	clear	?	?

Footnotes: 1. Yolk diameter is ca. 1.80 mm .
2. Yolk diameter is 0.88—1.00 mm .
3. After King, 1977a.
4. After King et al., 1978
5. See text for dimensions reported by other authors.

single median xanthophore (Fig. 87). The caudal spots behave similarly.

At first-feeding in Species 5, the only yellow pigment remaining is that of the post-orbital xanthophores, which take up a median position between the eyes; a broad yellow tail-band is normally present in *P. axillaris* at this stage.

Geographic and seasonal distribution

The eggs were taken sporadically all year on both sides of the Cape Peninsula (Table 1). In general, their abundance was maximal from January to March, inclusive.

Rearing notes

Incubation time (15°C): 74 plus minus 10 h (Fig. 186.20). First-feeding was successful on *Proales* but no larvae survived to a stage where fin-ray counts could be undertaken. First-feeding was optimal over the range ca. 150—200 h post-hatch (Brownell, in press *a*).

Species 6
Fig. 185

Egg

Not recognized. Judging from the size of the larva at hatching, the egg is likely to be in the range 0.70—0.80 mm . The oil globule in the newly-hatched larva measured 0.18 mm.

Larva

Fig. 185, Table 3. The pigmentation and small size of the newly-hatched larva renders it unique among those encountered during this study.

Geographic and seasonal distribution

A single egg was taken: False Bay in December.

Table 3 (Cont.)

NL (alive) at hatching	Position of oil globule at hatching	Position of anus at first-feeding	Species	Page no.	Figures
ca. 7.0—9.0	dispersed	posterior	*(Leptocephalus)* Species 1	24	158—161
ca. 8.0—9.0	—	med/post	*Scomberesox saurus*	7	—
ca. 3	usually ventral	median	*Maurolicus muelleri*	6	—
5.2—6.0	—	median	*Congiopodus spinifer*	23	147—151
3.3—3.7	dispersed	med/ant	*Solea ?fulvomarginata*	12	54—56
3.8—4.3	usually vent/post	posterior	*Sardinops ocellata*	6	3—4
4.5—5.6	—	posterior	*Etrumeus teres*	4	—
3.7—4.3	anterior	med/post	*?Seriola lalandi*	16	83—85
3.2—3.6	dispersed	med/ant	*Synaptura kleini*	12	47—53
3.1—3.4	posterior	median	*Liza richardsoni*	21	125—128
3.5—3.9	posterior	anterior	*Trigla ?capensis*	24	152—157
2.5—3.1	—	posterior	*Engraulis capensis*	6	5—6
3.8—4.3	ventral	median	*Genypterus capensis*	10	24—29
2.3—2.9	posterior	anterior	*Pterosmaris axillaris*	16	86—93
2.1—2.4	—	anterior	*Coccotropsis gymnoderma*	22	135—141
2.6—3.1	posterior	anterior	*Pachymetopon blochi*	20	116—123
3.3—3.8	anterior	median	*?Cheilodactylus fasciatus*	14	70—77
2.3—3.0	posterior	anterior	*Physiculus capensis*	8	13—16
4.6—5.2	ventral	anterior	Species 1 (Carapidae)	9	20—23
2.2—2.7	posterior	anterior	Species 5	25	180—184
1.9—2.4	—	anterior	*Heteromycteris capensis*	11	40—46
2.6—3.2	posterior	anterior	*Merluccius capensis*	9	17—19
2.4—3.0	posterior	med/post	*Mugil cephalus*	21	129—134
2.5—3.0	posterior	anterior	*Diplodus cervinus*	18	95—97
2.2—2.7	anterior	median	*Trachurus t. capensis*	15	78—82
2.0—2.4	posterior	med/ant	Species 3	25	174—177
1.8—2.1	posterior	med/ant	Species 2	25	169—173
1.9—2.6	posterior	med/ant	*Helicolenus dactylopterus*	22	142—146
2.3—2.8	posterior	anterior	*Diplodus sargus*	19	98—105
1.4—2.2	vent/post	median	Perciform Species 1	24	162—168
ca. 2.3	posterior	anterior?	Species 4	25	178—179
1.8—2.3	posterior	anterior	*Lithognathus mormyrus*	20	107—115
1.7—2.1	posterior	anterior	*Austroglossus microlepis*	11	34—39
2.0—2.4	posterior	med/ant	*Gaidropsarus capensis*	7	7—12
1.1—1.5	—	med/ant	*Paracallionymus costatus*	14	65—69
1.9—2.5	posterior	med/ant	*Arnoglossus capensis*	10	30—33
1.2—1.8	variable	anterior	*Cynoglossus capensis*	13	57—64
ca. 1.6	ventral?	?	Species 6	27	185

INCUBATION PERIODS

After being sorted from the plankton, the eggs were placed in small numbered baskets (Brownell, 1979) floating in the water table of a closed-circulation system. They were inspected at approximately 12-h intervals, and any larva that had hatched during the previous 12 h was identified (when possible), counted, and transferred to a larger numbered basket where it remained until first-feeding age. Each basket received only hatchlings from a single 12-h interval and the time of hatching (within 6 h) of any larva was therefore known. From the time-of-hatch and the time-of-collection, it was a simple matter to calculate the duration of the captive portion of the incubation period. When samples were large, an estimate of the duration of the entire incubation period could be attempted by assuming that those eggs with the longest incubation times were newly-spawned at point-of-collection. Error arising from delays between spawning and collection are more or less offset by errors arising from post-mature hatching.

Captive incubation times for 29 species are presented graphically in Fig. 186. The author's estimates of total incubation time at 15°C for most of these species may be found in the text (under "rearing notes") and in Table 3.

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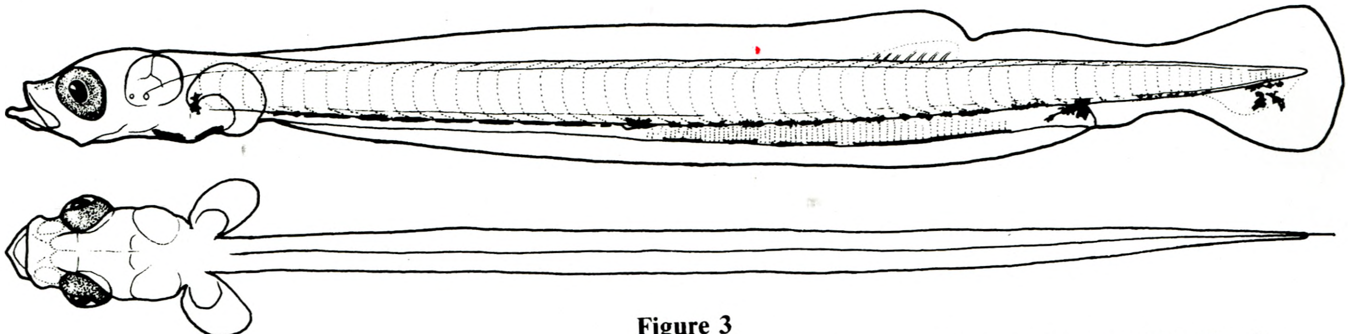


Figure 3
Sardinops ocellata at 16 days (17—19°C), lateral and dorsal views. NL (alive) = 10.1 mm, NL (fixed) = 9.3 mm . Myomeres: 41 + ca. 15

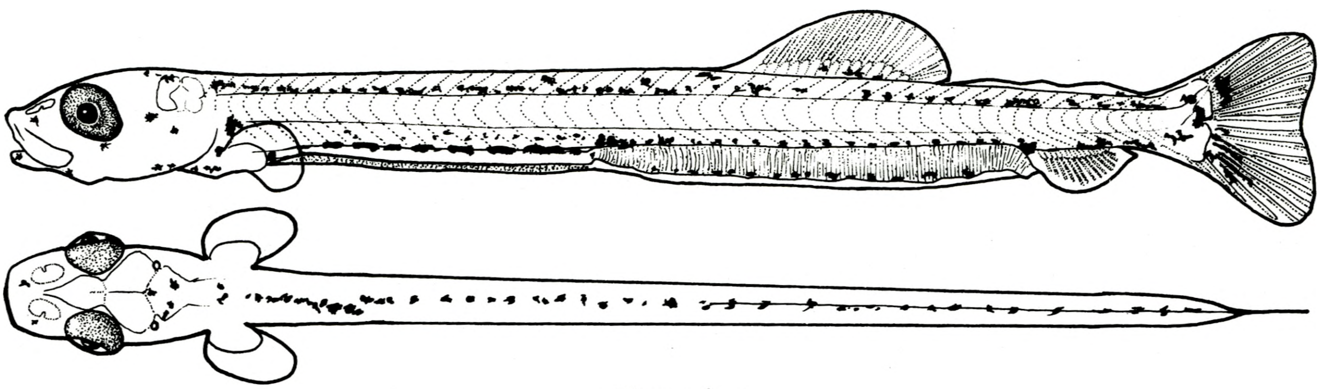


Figure 4
Sardinops ocellata at 32 days (17—19°C), lateral and dorsal views. SL (alive) = 16.7 mm, SL (fixed) = 14.7 mm . Myomeres: 41 + 9 = 50

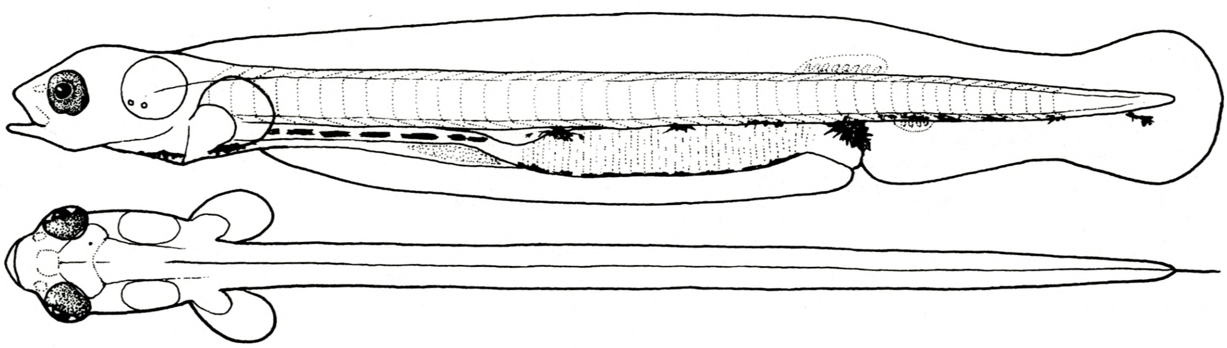


Figure 5
Engraulis capensis at 16 days (17—19°C), lateral and dorsal views. NL (alive) = 6.3 mm, NL (fixed) = 5.9 mm . Myomeres: 30 + ca. 15

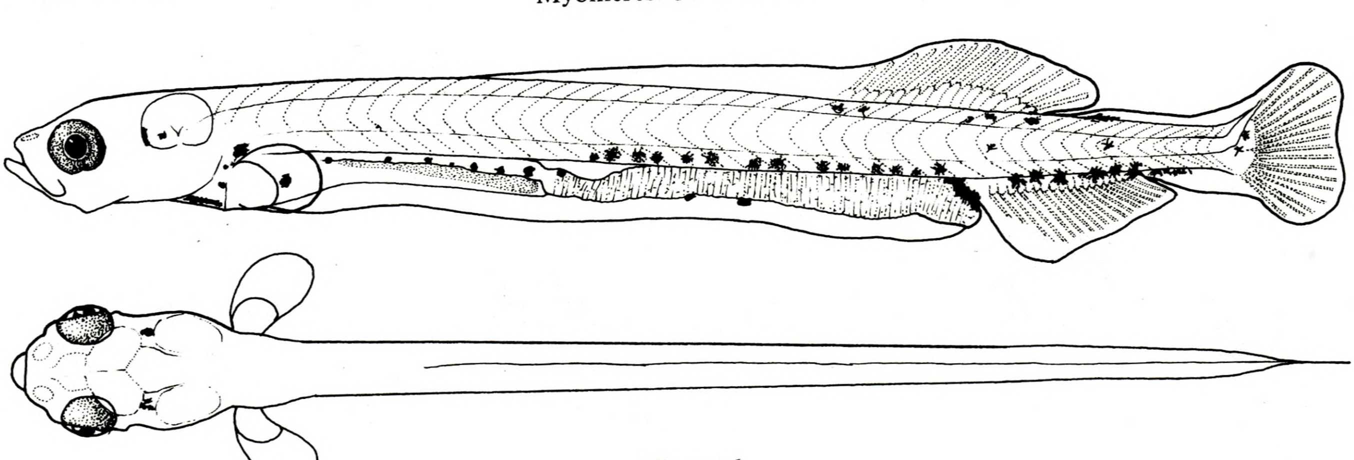


Figure 6
Engraulis capensis at 32 days (17—19°C), lateral and dorsal views. SL (alive) = 10.4 mm, SL (fixed) = 8.9 mm . Myomeres: 30 + 14 = 44

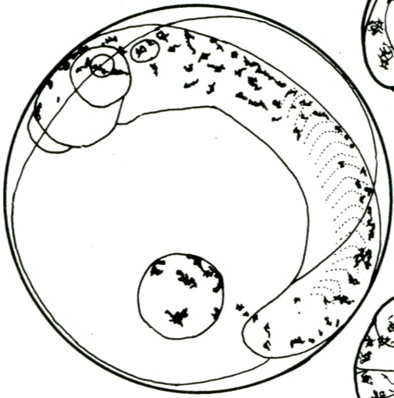


Figure 7
Gaidropsarus capensis egg, 0.75 mm diameter, oil globule 0.16 mm

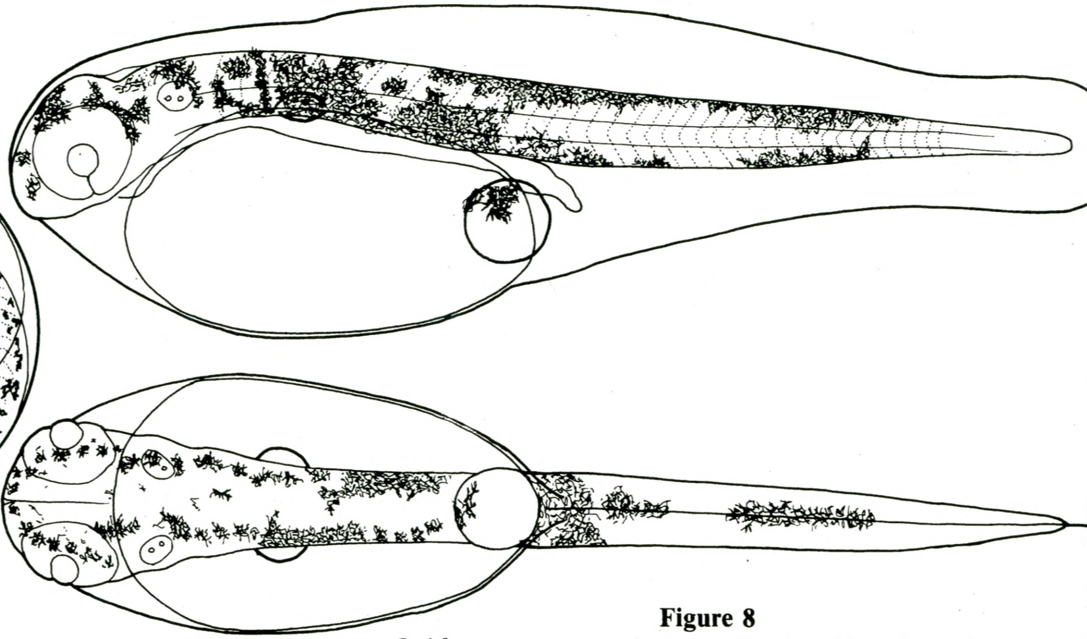


Figure 8
Gaidropsarus capensis soon after hatching, lateral and ventral views. NL (alive) = 2,1 mm, NL (fixed) = 1,8 mm . Myomeres: 17 + 23 = 40

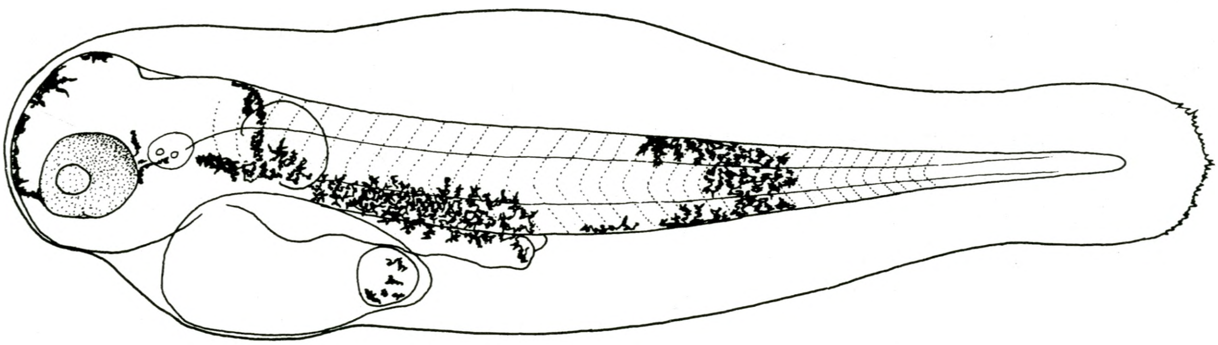


Figure 9
Gaidropsarus capensis at 2 days (15°C). NL (alive) = 2.3 mm, NL (fixed) = 2.1 mm . Myomeres: 15 + 23 = 38

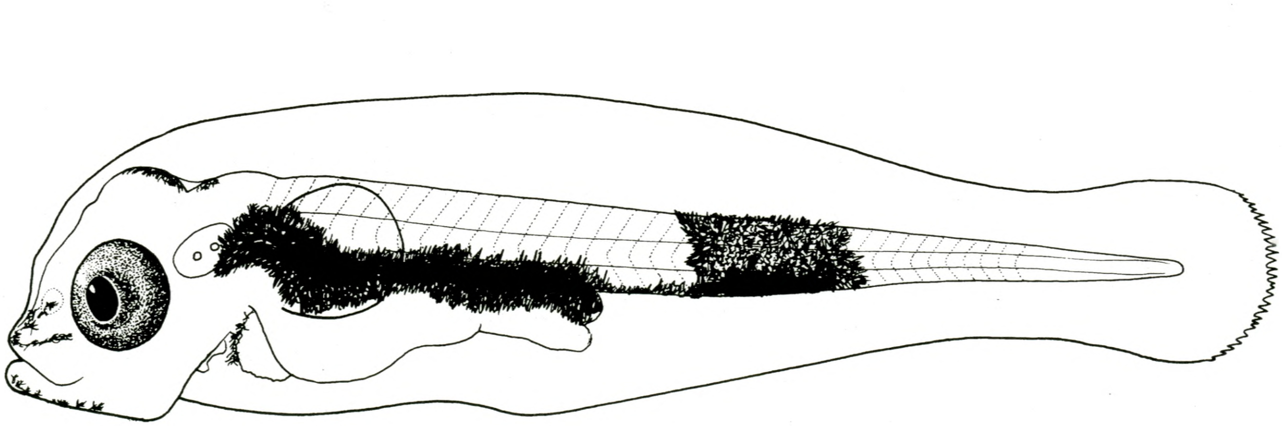


Figure 10
Gaidropsarus capensis at 4 days (15°C). NL (alive) = 2.6 mm, NL (fixed) = 2.2 mm . Myomeres: 15 + 23 = 38

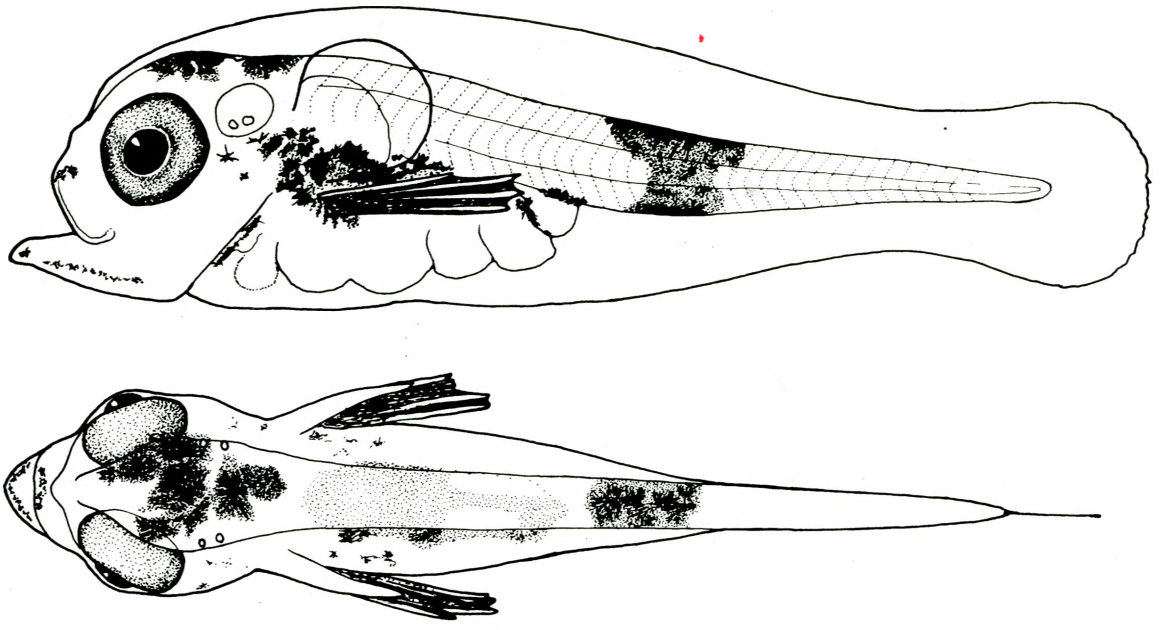


Figure 11
Gaidropsarus capensis at 16 days (15°C), lateral and dorsal views. NL (alive) = 3.1 mm, NL (fixed) = 2.8 mm .
Myomeres: 13 + 25 = 38

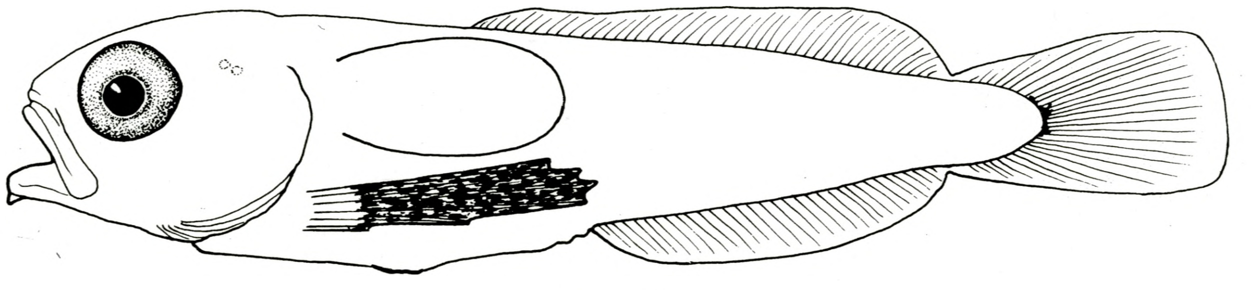


Figure 12
Gaidropsarus capensis at 55 days (15°C). SL (alive) = 12.8 mm, SL (fixed) = 12.1 mm . Fin elements have not yet reached definitive counts. D_1 0, D_2 44, A 34

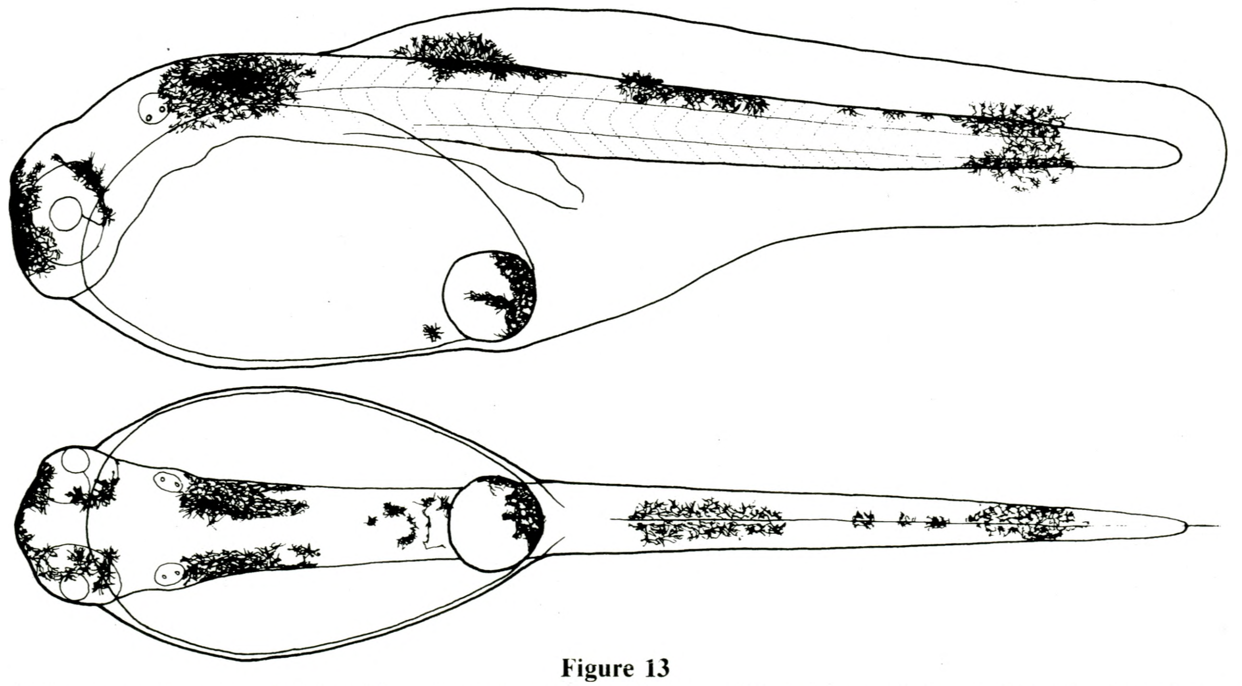


Figure 13
Physiculus capensis soon after hatching, lateral and ventral views. NL (alive) = 2.6 mm, NL (fixed) = 2.4 mm .
Myomeres: 15 + 26 = 41

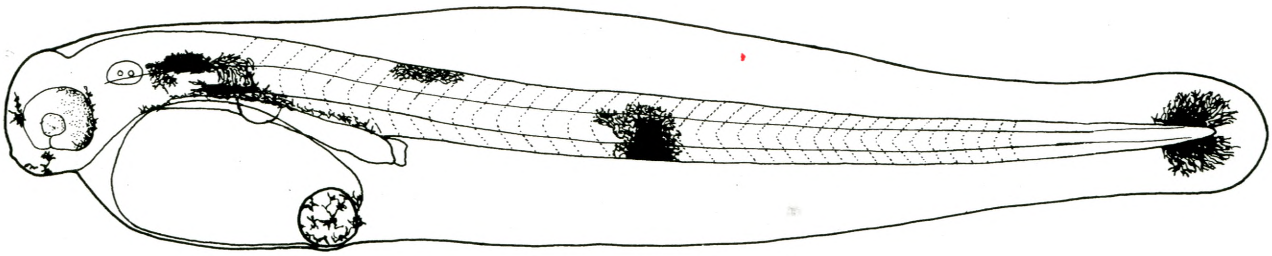


Figure 14
Physiculus capensis at 2 days (15°C). NL (alive) = 3.5 mm, NL (fixed) = 3.3 mm . Myomeres: 11 + 32 = 43

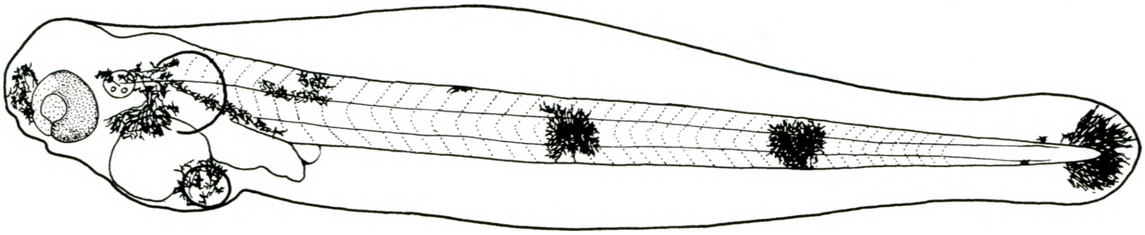


Figure 15
Physiculus capensis at 4 days (15°C). NL (alive) = 3.8 mm, NL (fixed) = 3.2 mm . Myomeres: 16 + 27 = 43

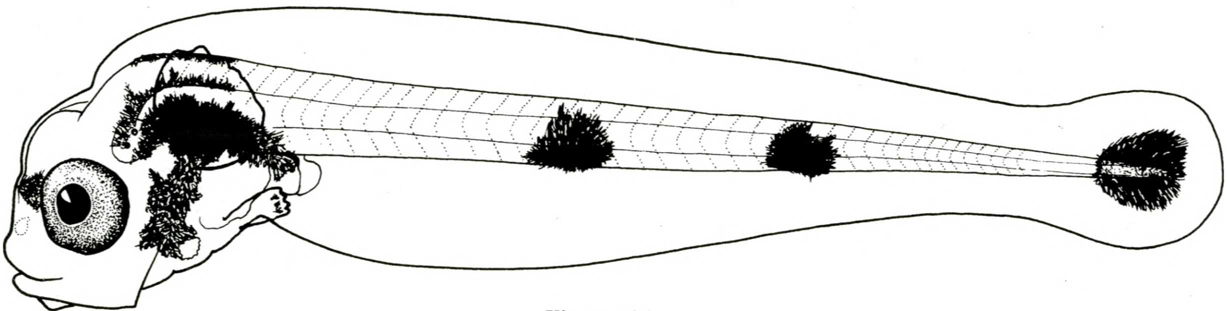


Figure 16
Physiculus capensis at 8 days (15°C). NL (alive) = 3.8 mm, NL (fixed) = 3.5 mm . Myomeres: 15 + 27 = 42

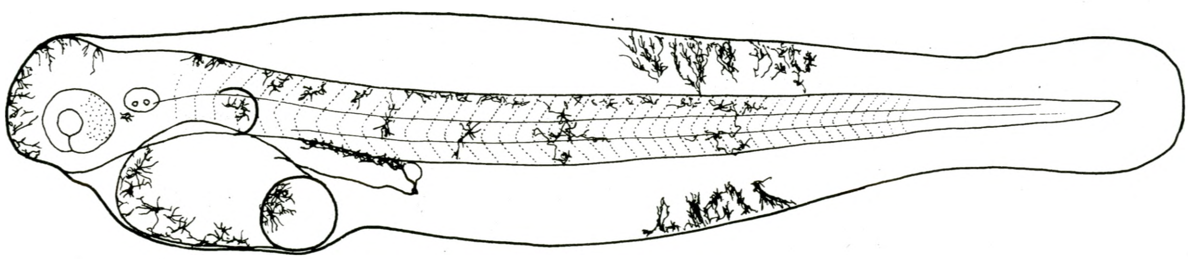


Figure 17
Merluccius capensis at 2 days (15°C). NL (alive) = 3.5 mm, NL (fixed) = 3.2 mm . Myomeres: 13 + 32 = 45

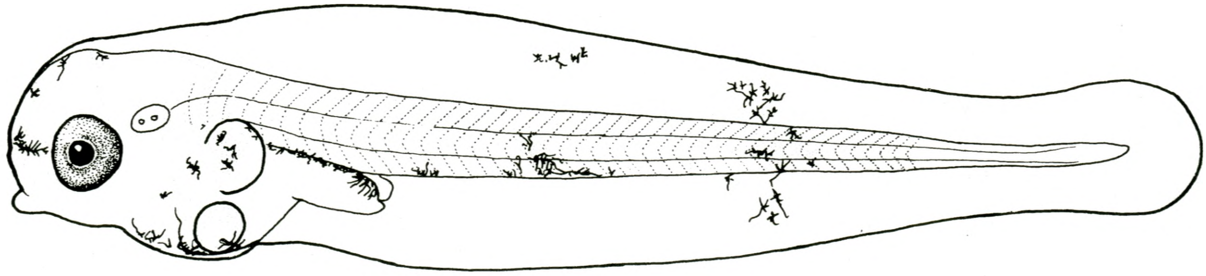


Figure 18
Merluccius capensis at 4 days (15°C). NL (alive) = 3.6 mm, NL (fixed) = 3.3 mm . Myomeres: 12 + 33 = 45

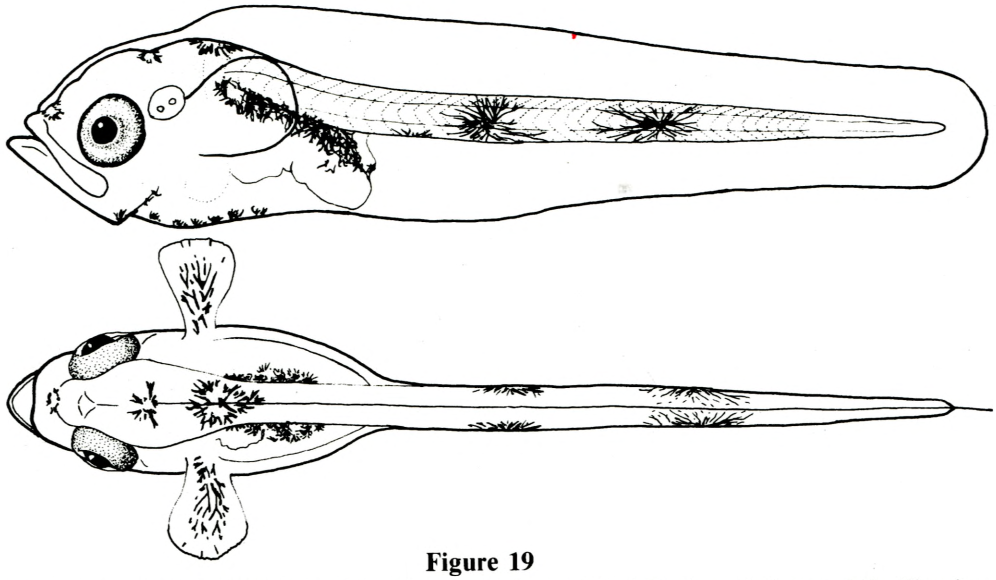


Figure 19

Merluccius capensis at 16 days (15°C), lateral and dorsal views. NL (alive) = 3.8 mm, NL (fixed) = 3.5 mm . Myomeres: 11 + 30 = 41

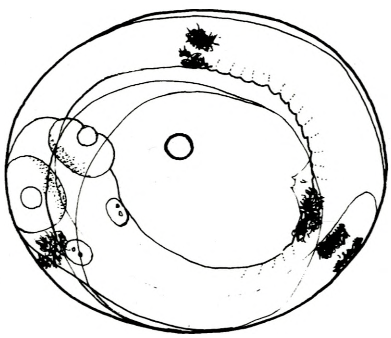


Figure 20

Species 1 (Carapidae) egg. Major axis 1.14 mm, minor axis 0.99 mm, oil globule 0.06 mm

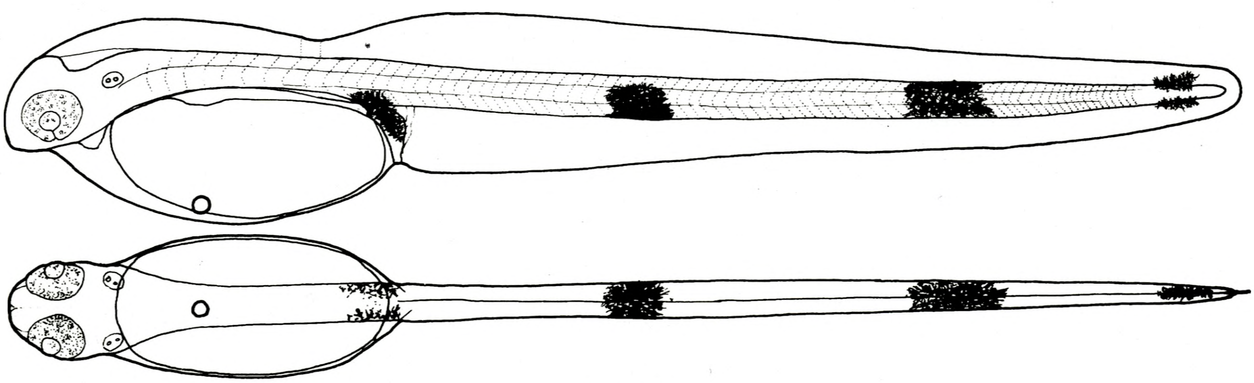


Figure 21

Species 1 (Carapidae) soon after hatching, lateral and ventral views. NL (alive) = 4.8 mm, NL (fixed = 3.9 mm . Myomeres: 15 + ca. 70

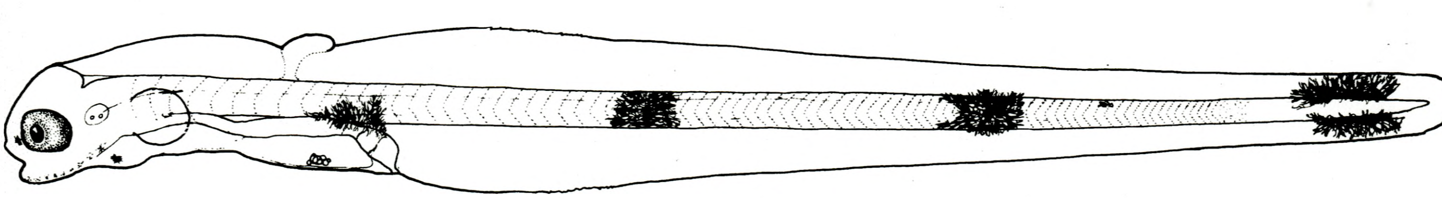


Figure 22

Species 1 (Carapidae) at 4 days (15°C). NL (alive) = 6.2 mm, NL (fixed) = 5.5 mm . Myomeres: 14 + ca. 70

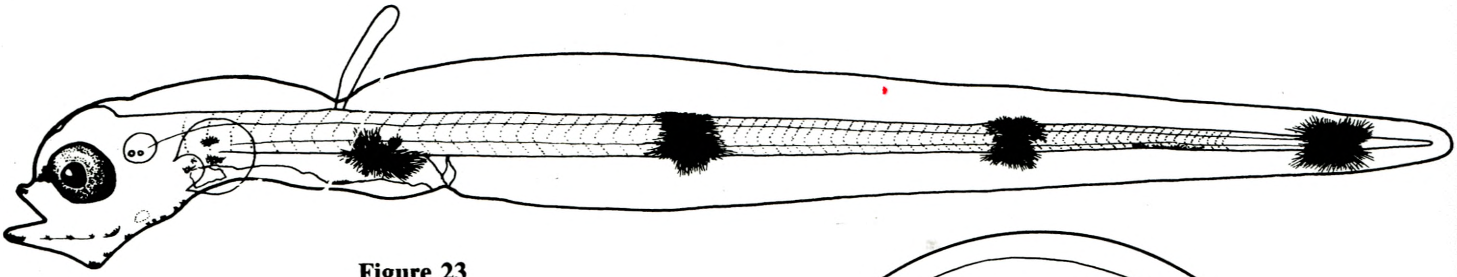


Figure 23

Species 1 (Carapidae) at 8 days (15°C). NL (alive) = 5.8 mm, NL (fixed) = 5.3 mm . Myomeres: 13 + ca. 70

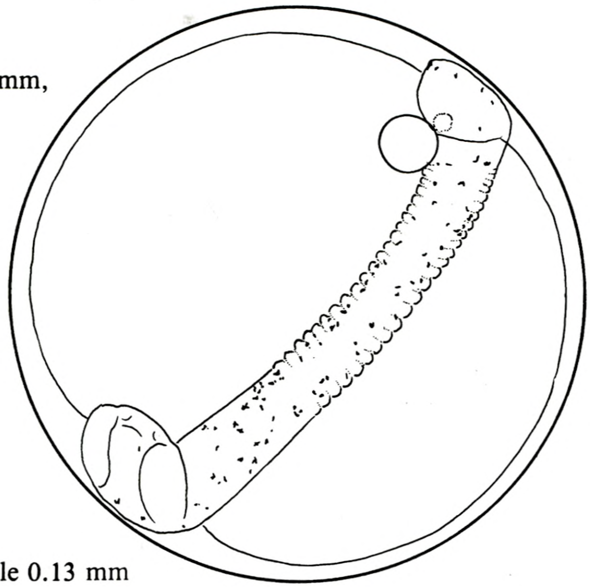


Figure 24

Genypterus capensis egg. 1.20 mm in diameter, oil globule 0.13 mm

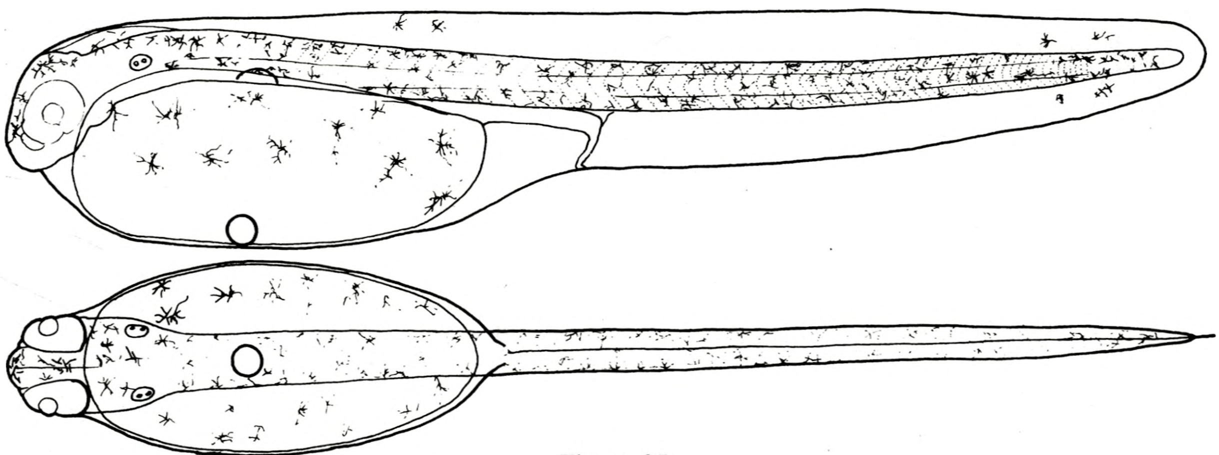


Figure 25

Genypterus capensis soon after hatching, lateral and ventral views. NL (alive) = 3.9 mm, NL (fixed) = 3.6 mm . Myomeres: 20 + ca. 45

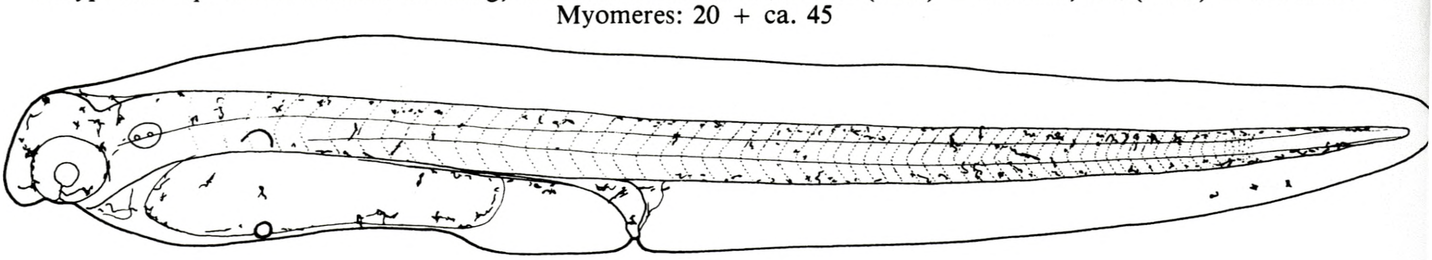


Figure 26

Genypterus capensis at 2 days (15°C). NL (alive) = 4.7 mm, NL (fixed) = 4.3 mm . Myomeres: 19 + ca. 40

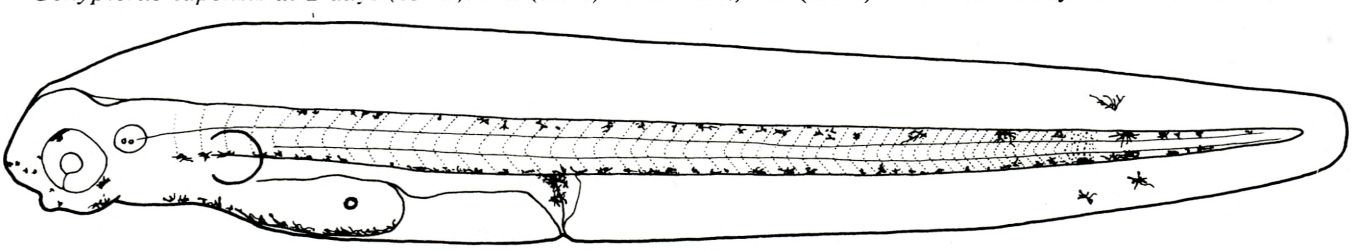


Figure 27

Genypterus capensis at 4 days (15°C). NL (alive) = 5.1 mm, NL (fixed) = 4.4 mm . Myomeres: 18 + ca. 40

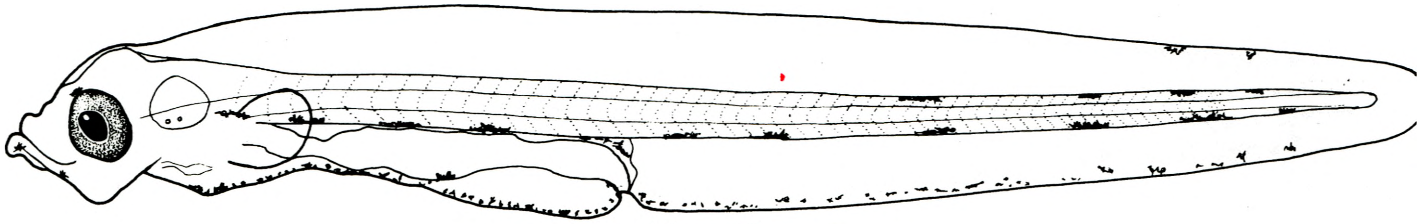


Figure 28

Genypterus capensis at 8 days (15°C). NL (alive) = 5.1 mm, NL (fixed) = 4.9 mm . Myomeres: 18 + ca. 40

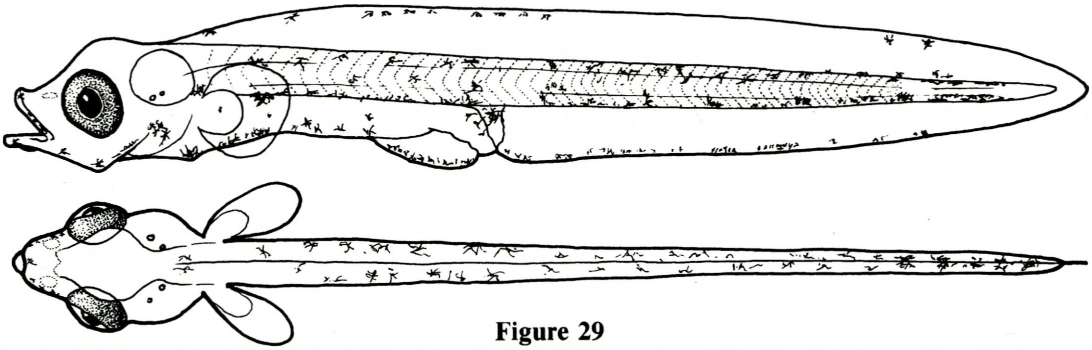


Figure 29

Genypterus capensis at 16 days (15°C), lateral and dorsal views. NL (alive) = 6.1 mm, NL (fixed) = 5.5 mm . Myomeres: 18 + ca. 40

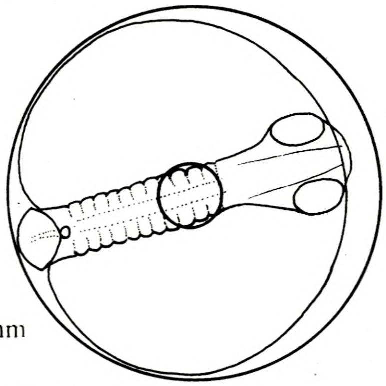


Figure 30

Arnoglossus capensis egg. 0.72 mm in diameter, oil globule 0.12 mm

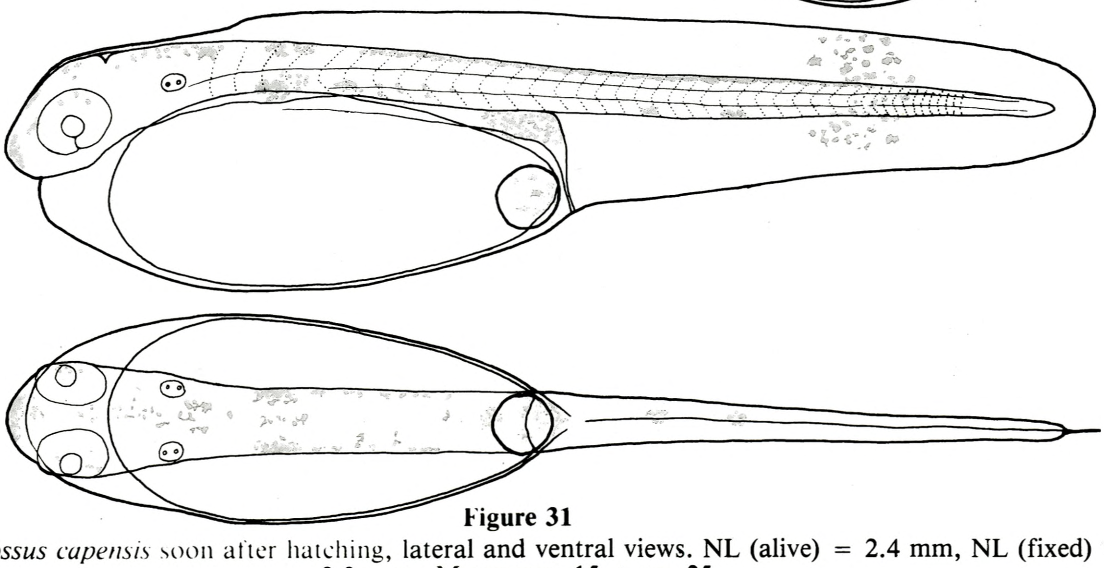


Figure 31

Arnoglossus capensis soon after hatching, lateral and ventral views. NL (alive) = 2.4 mm, NL (fixed) = 2.2 mm . Myomeres: 15 + ca. 25

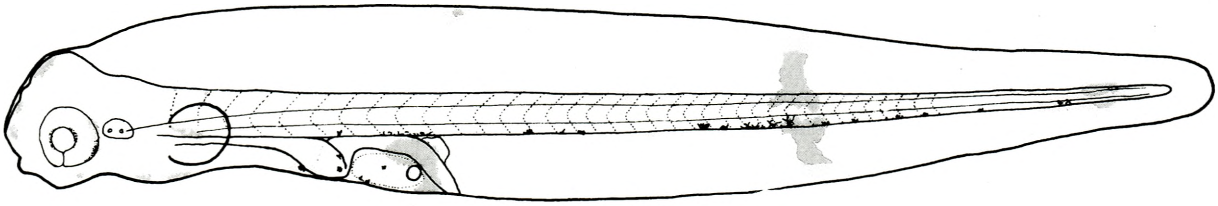


Figure 32

Arnoglossus capensis at 4 days (15°C). NL (alive) = 3.4 mm, NL (fixed) = 3.2 mm . Myomeres: 11 + 27 = 38

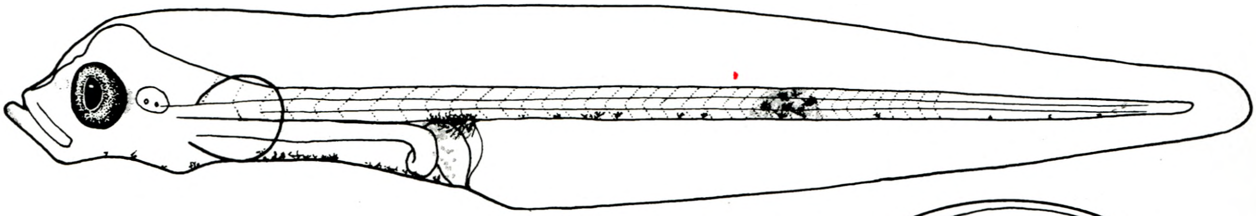


Figure 33
Arnoglossus capensis at 8 days (15°C). NL (alive) = 3.6 mm, NL (fixed) = 3.3 mm . Myomeres: 11 + 27 = 38

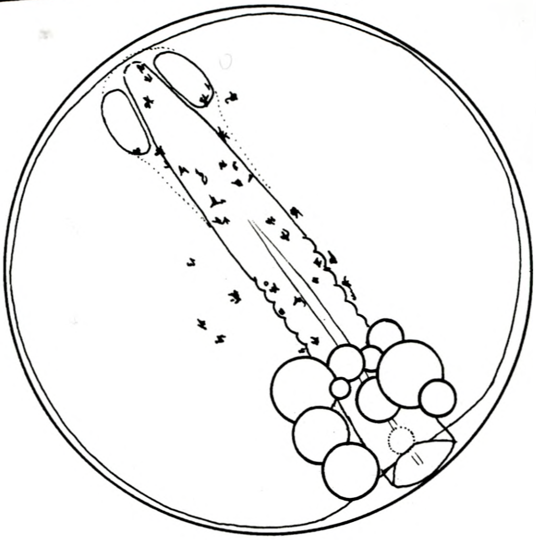
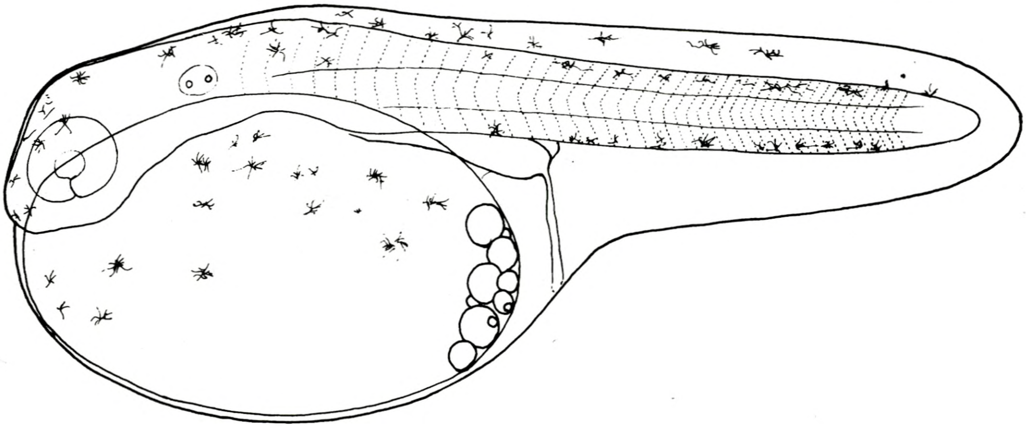


Figure 34
Austroglossus microlepis egg. 0.88 mm diameter



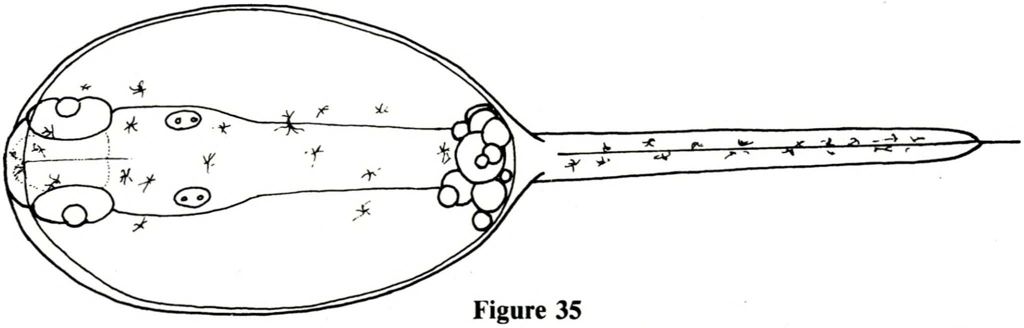


Figure 35
Austroglossus microlepis soon after hatching, lateral and ventral views. NL (alive) = 1.8 mm, NL (fixed) = 1.7 mm . Myomeres: 15 + ca. 30.

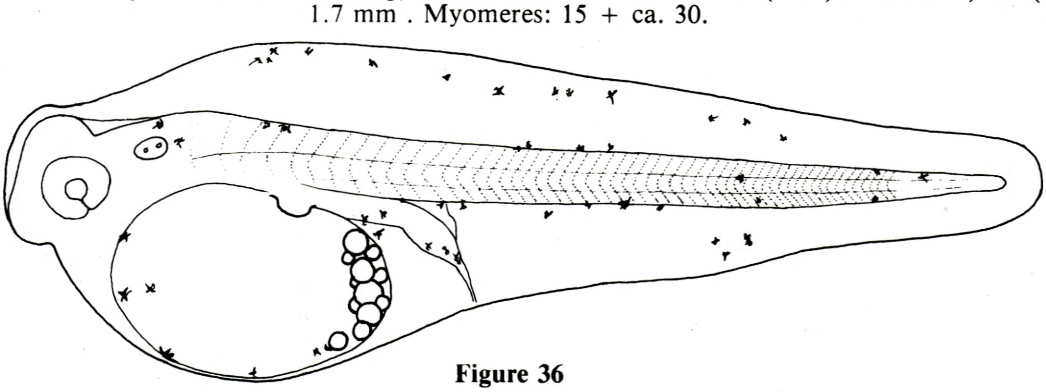


Figure 36
Austroglossus microlepis at 2 days (15°C). NL (alive) = 2.8 mm, NL (fixed) = 2.6 mm . Myomeres: 15 + ca. 40

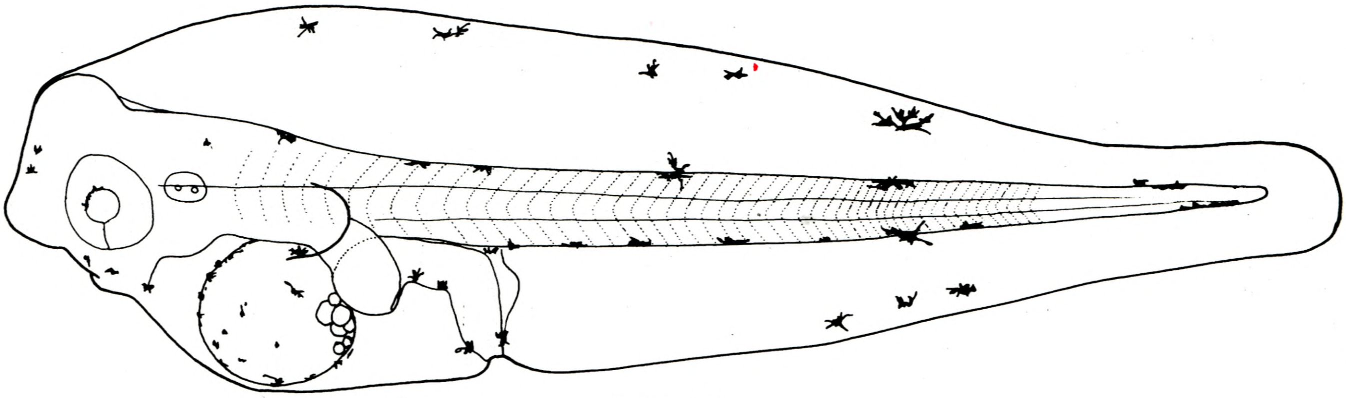


Figure 37

Austroglossus microlepis at 4 days (15°C). NL (alive) = 2.7 mm, NL (fixed) = 2.5 mm . Myomeres: 12 + 40 = 52

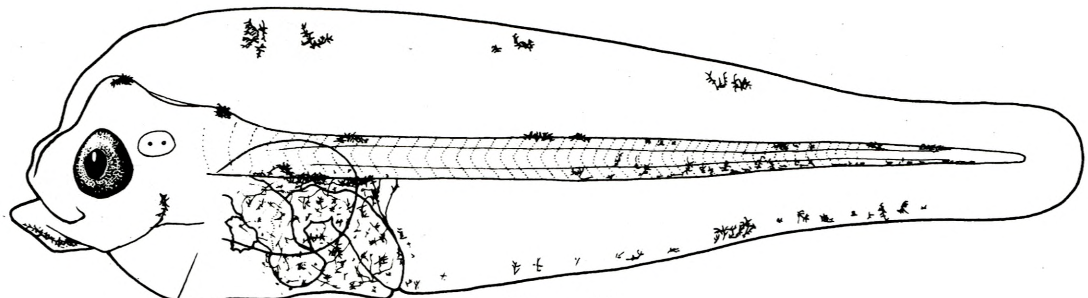


Figure 38

Austroglossus microlepis at 8 days (15°C). NL (alive) = 2.9 mm, NL (fixed) = 2.7 mm . Myomeres: 11 + 40 = 51

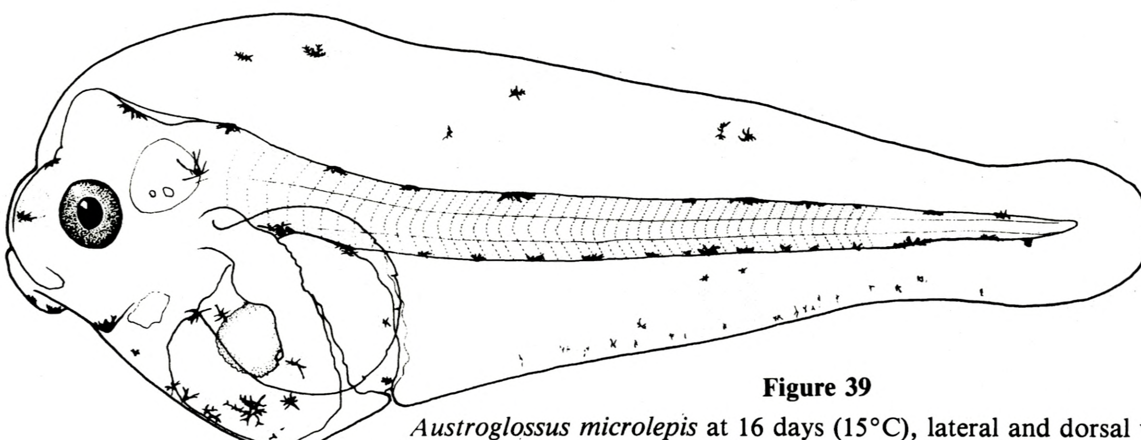
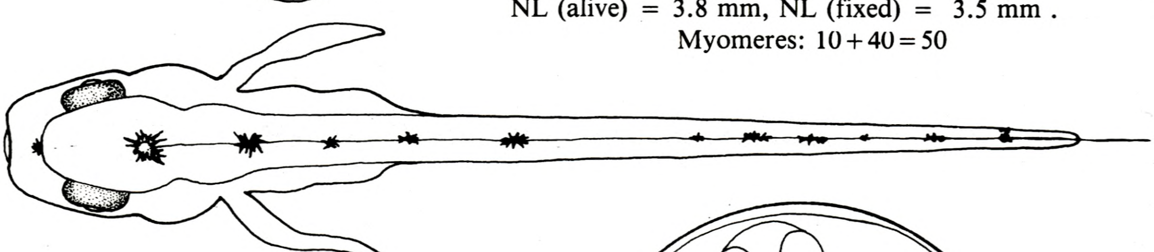


Figure 39

Austroglossus microlepis at 16 days (15°C), lateral and dorsal views.
NL (alive) = 3.8 mm, NL (fixed) = 3.5 mm .
Myomeres: 10 + 40 = 50



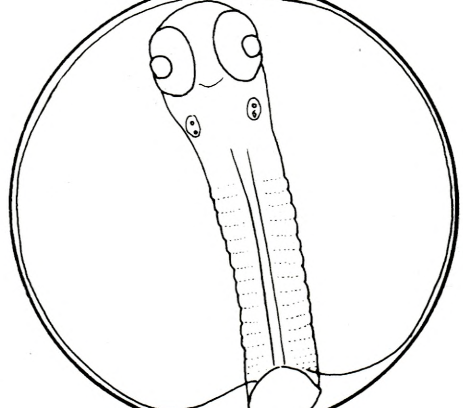
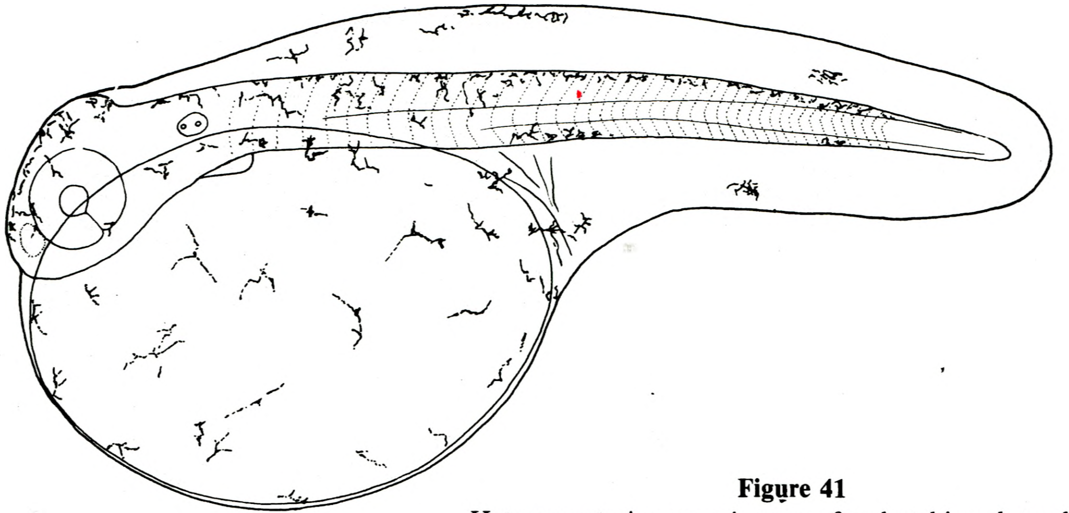


Figure 40

Heteromycteris capensis egg. 0.01 mm in diameter



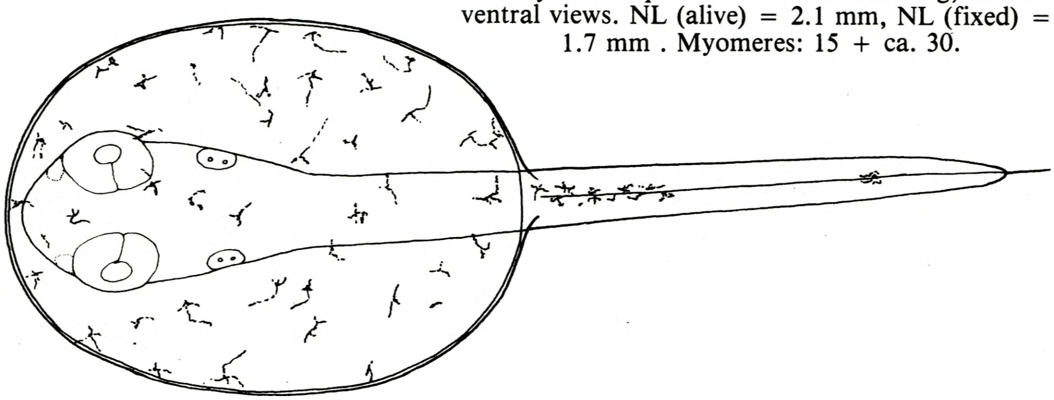


Figure 41
Heteromycteris capensis soon after hatching, lateral and ventral views. NL (alive) = 2.1 mm, NL (fixed) = 1.7 mm . Myomeres: 15 + ca. 30.

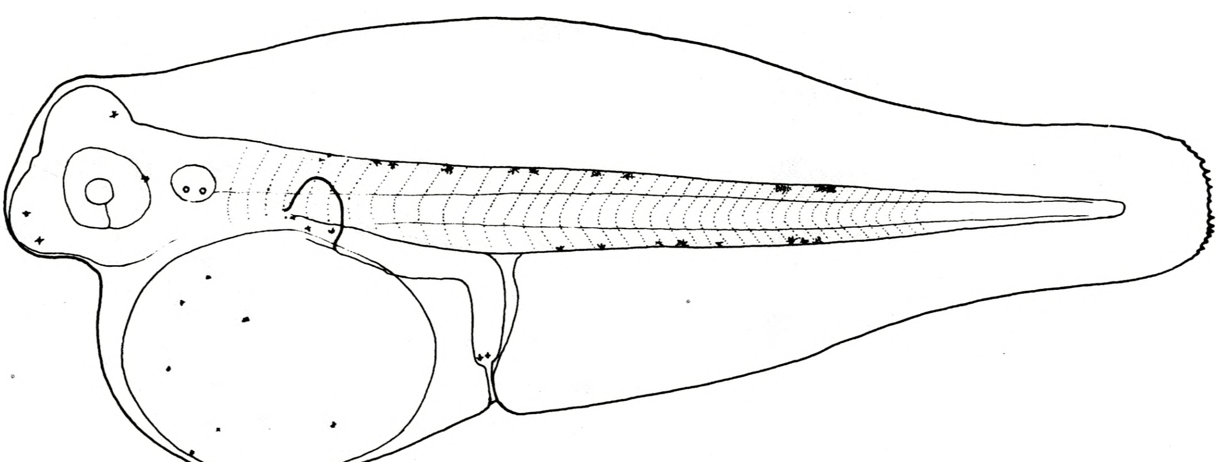


Figure 42
Heteromycteris capensis at 2 days (15°C). NL (alive) = 2.5 mm, NL (fixed) = 2.5 mm . Myomeres: 14 + ca. 30

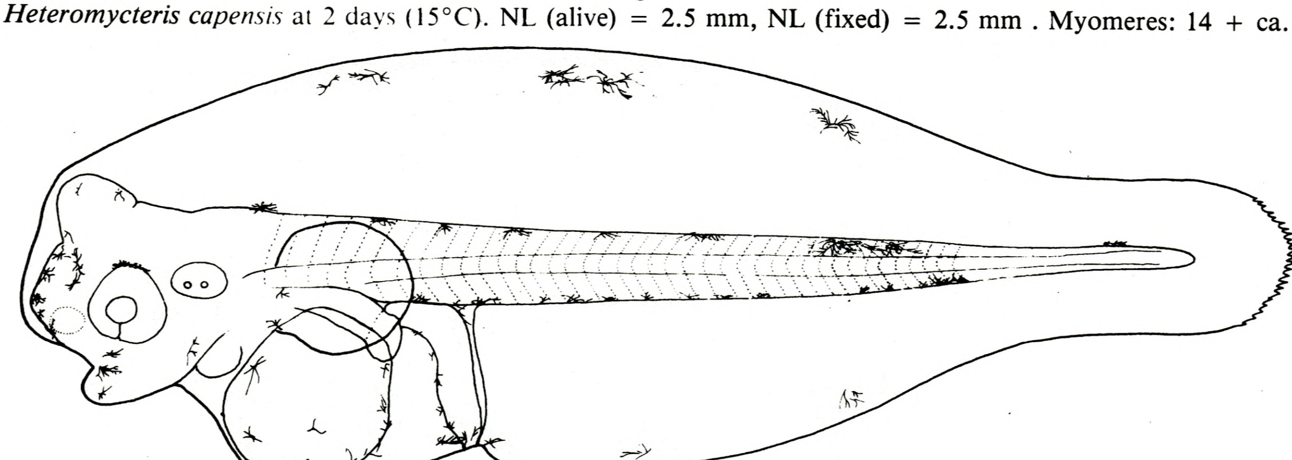


Figure 43
Heteromycteris capensis at 4 days (15°C). NL (alive) = 2.6 mm, NL (fixed) = 2.3 mm . Myomeres: 10 + 30 = 40

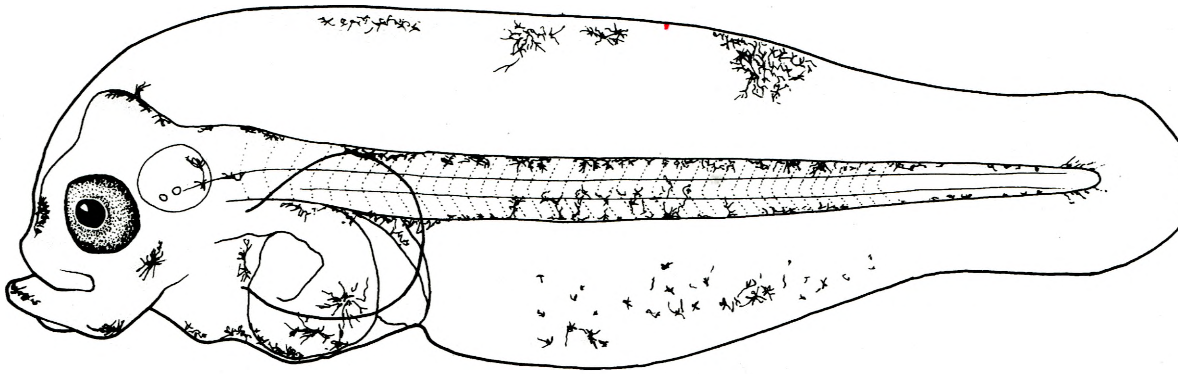


Figure 44
Heteromycteris capensis at 8 days (15°C). NL (alive) = 3.0 mm, NL (fixed) = 2.7 mm . Myomeres: 10 + 31 = 41

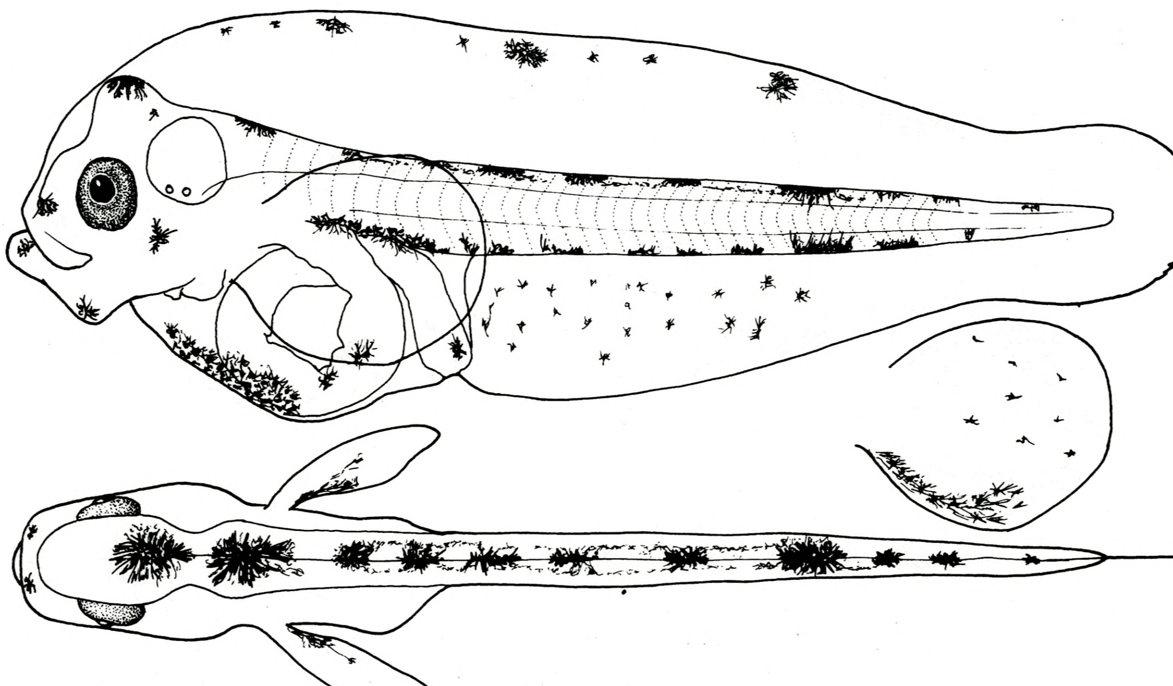


Figure 45
Heteromycteris capensis at 16 days (15°C), lateral and dorsal views, and fin detail. NL (alive) = 4.0 mm, NL (fixed = 3.6 mm . Myomeres: 10 + 29 = 39

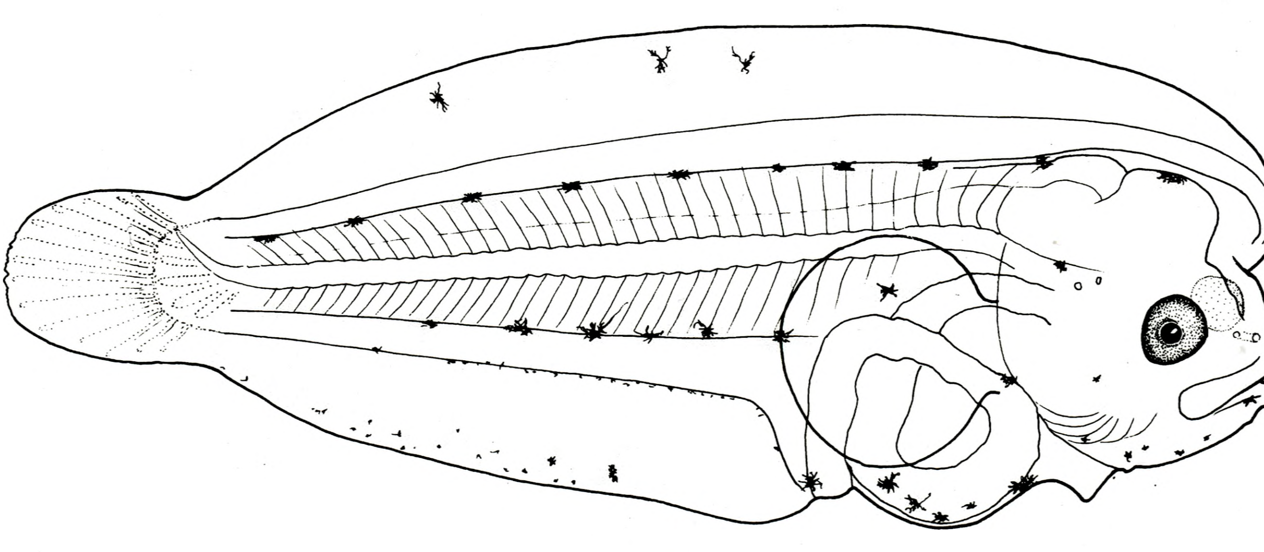


Figure 46
Heteromycteris capensis at 32 days (15°C). Onset of eye migration. SL (alive) = 6.6 mm, SL (fixed) = 6.2 mm

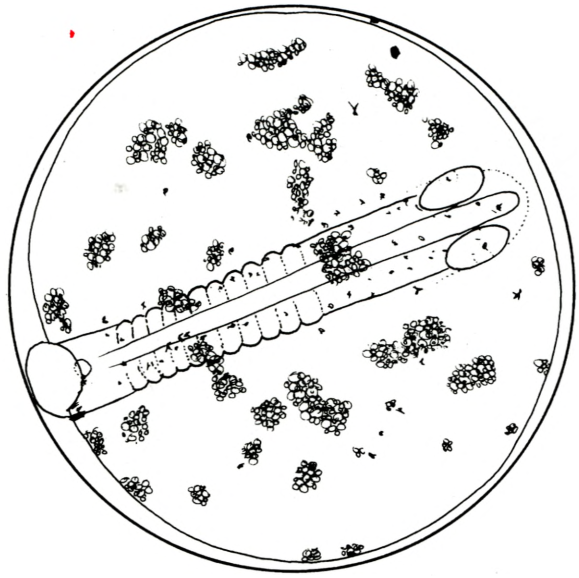


Figure 47
Synaptura kleini egg. 1.34 mm in diameter

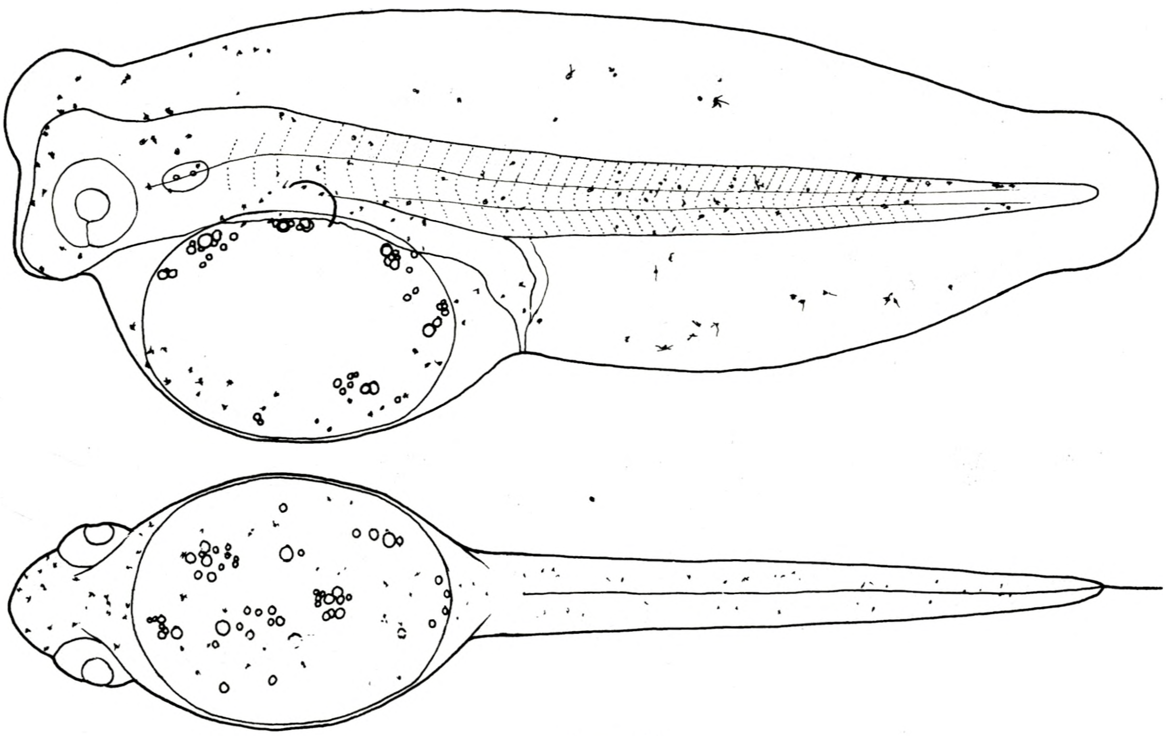


Figure 48
Synaptura kleini soon after hatching, lateral and ventral views. NL (alive) = 3.4 mm, NL (fixed) = 3.0 mm . Myomeres: 14 + 31 = 45

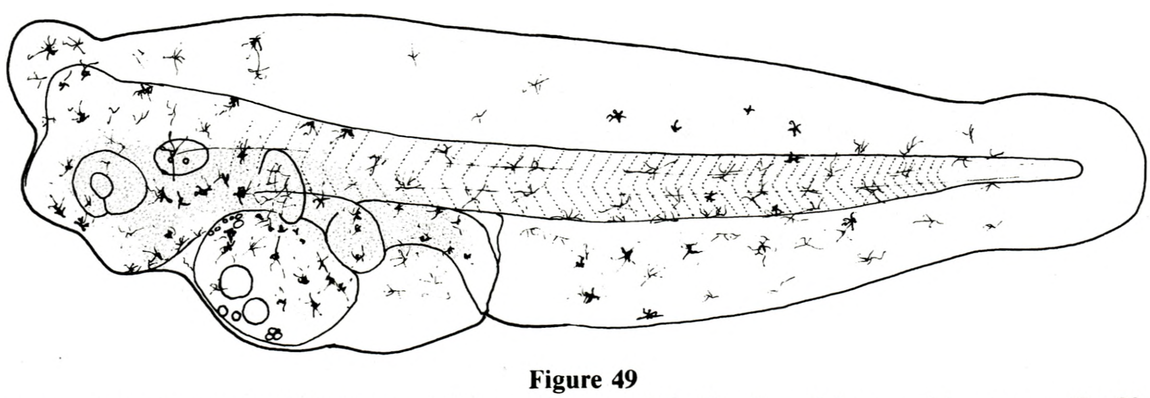


Figure 49
Synaptura kleini at 2 days (15°C). NL (alive) = 3.6 mm, NL (fixed) = 3.3 mm . Myomeres: 12 + 33 = 45

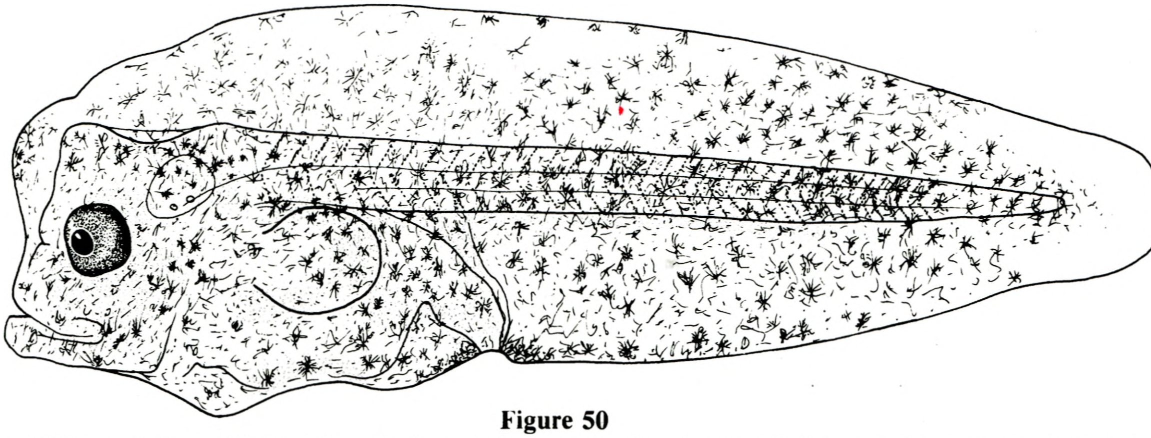


Figure 50

Synaptura kleini at 8 days (15°C). NL (alive) = 4.4 mm, NL (fixed) unavailable, specimen damaged prior to fixing. Myomeres: 11 + 32 = 43

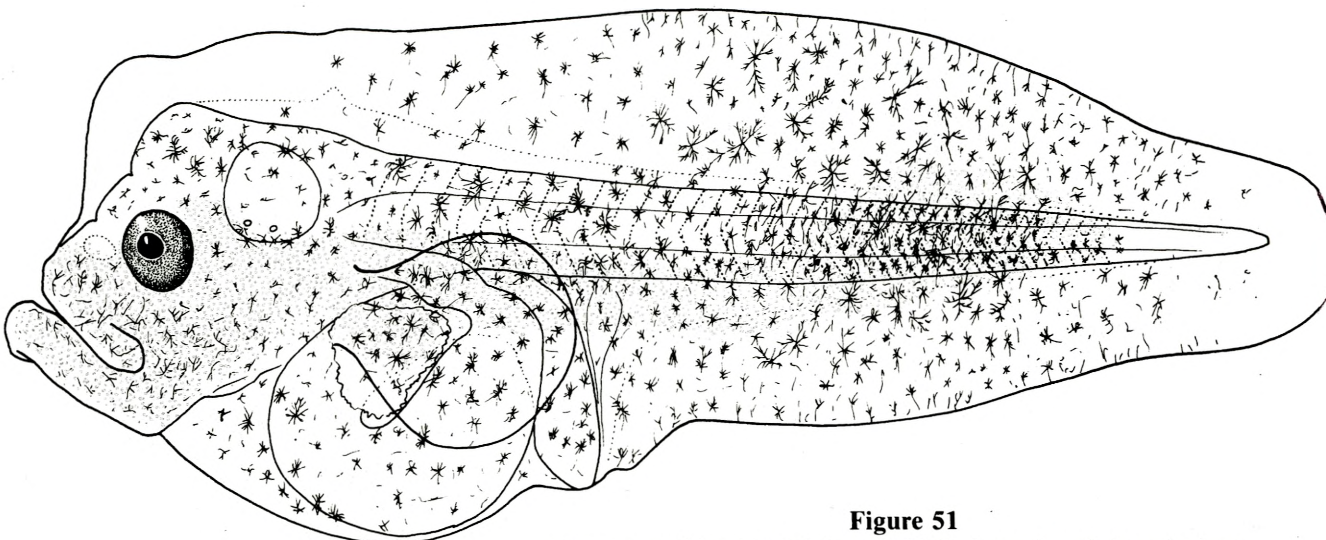
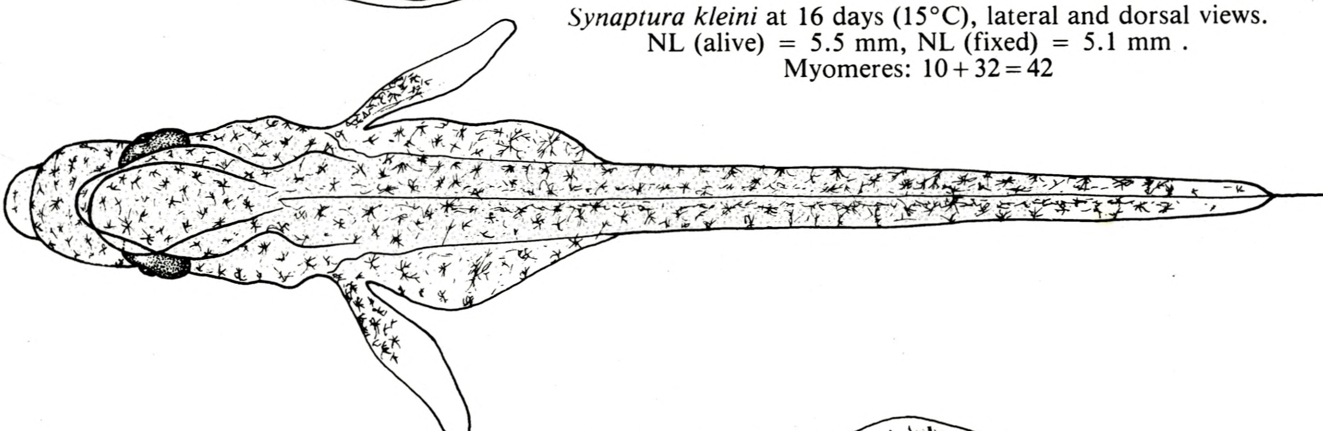


Figure 51

Synaptura kleini at 16 days (15°C), lateral and dorsal views. NL (alive) = 5.5 mm, NL (fixed) = 5.1 mm . Myomeres: 10 + 32 = 42



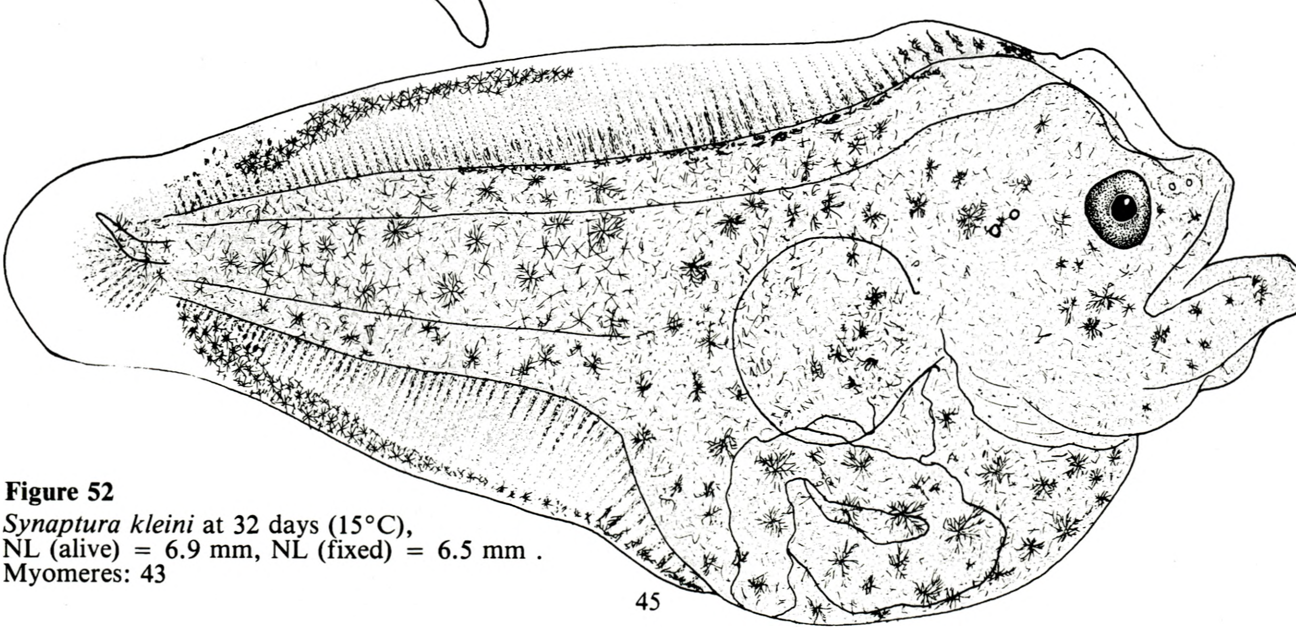


Figure 52

Synaptura kleini at 32 days (15°C), NL (alive) = 6.9 mm, NL (fixed) = 6.5 mm . Myomeres: 43

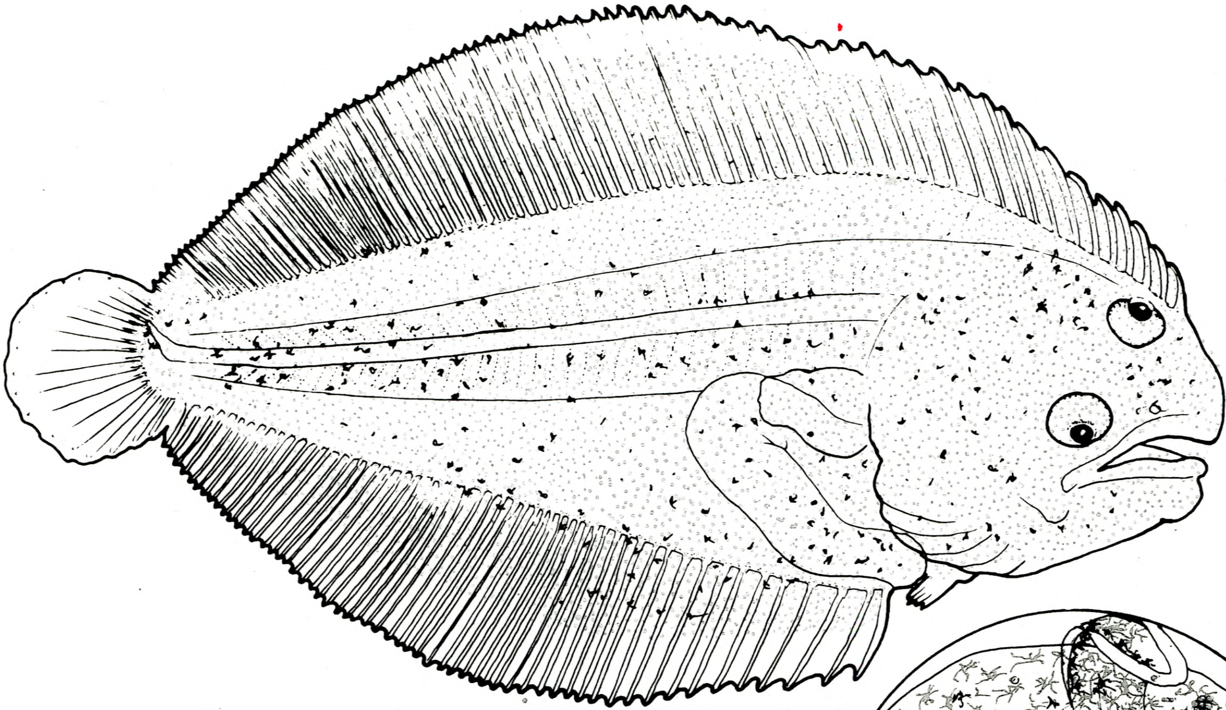


Figure 53
Synaptura kleini at 45 days (15°C). SL (alive) = 8.3 mm, SL (fixed) = 7.8 mm

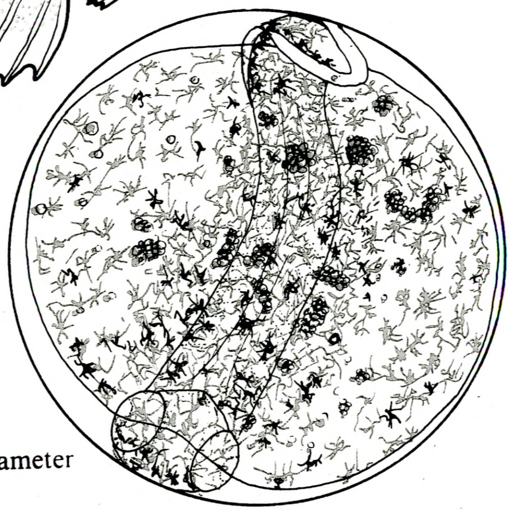


Figure 54
Solea ?fulvomarginata egg. 1.52 mm in diameter

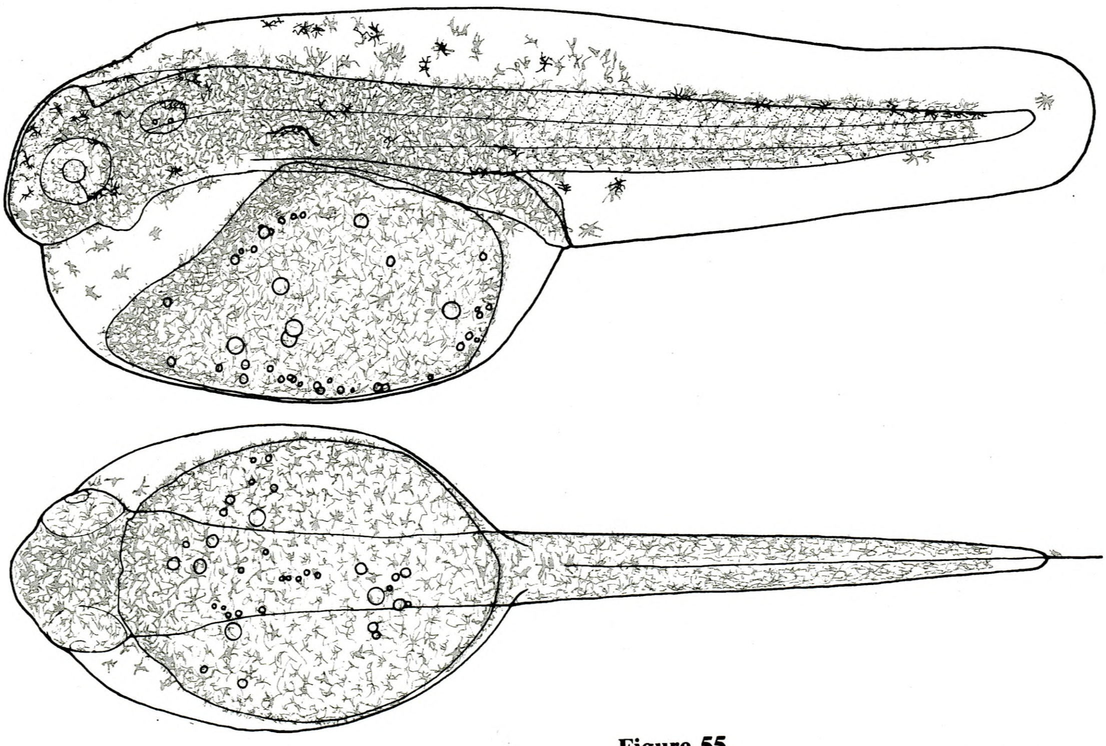


Figure 55
Solea ?fulvomarginata soon after hatching, lateral and ventral views. NL (alive) = 3.5 mm, NL (fixed) = 3.0 mm . Myomeres not seen clearly, estimated to be about 14 + 26 = 40

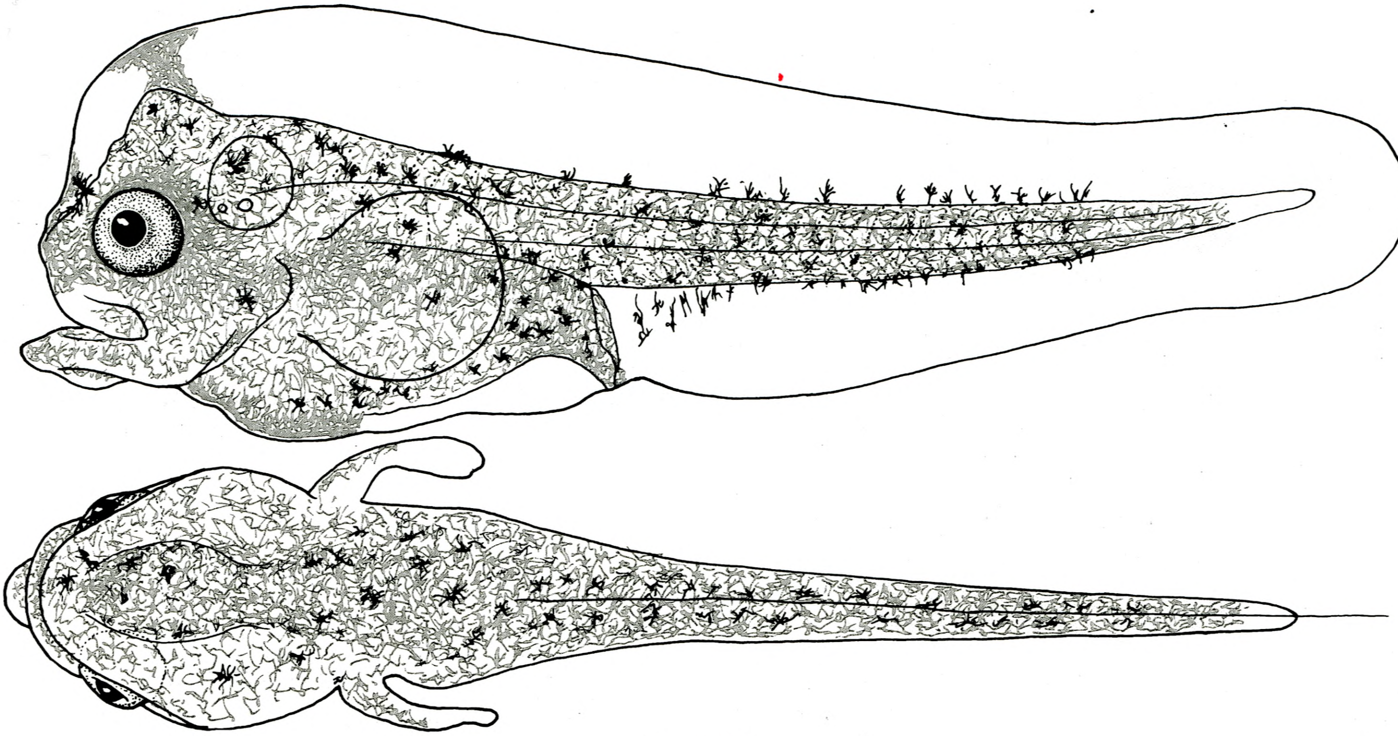


Figure 56

Solea ?fulvomarginata at 16 days (15°C), lateral and dorsal views. NL (alive) = 4.2 mm, NL (fixed) = 3.9 mm . Myomeres not seen clearly, estimated to be about 11 + 27 = 38

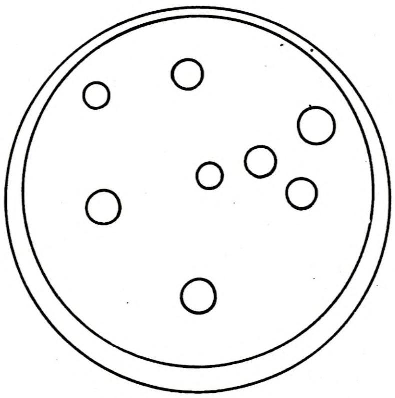


Figure 57

Cynoglossus capensis egg. 0.75 mm in diameter

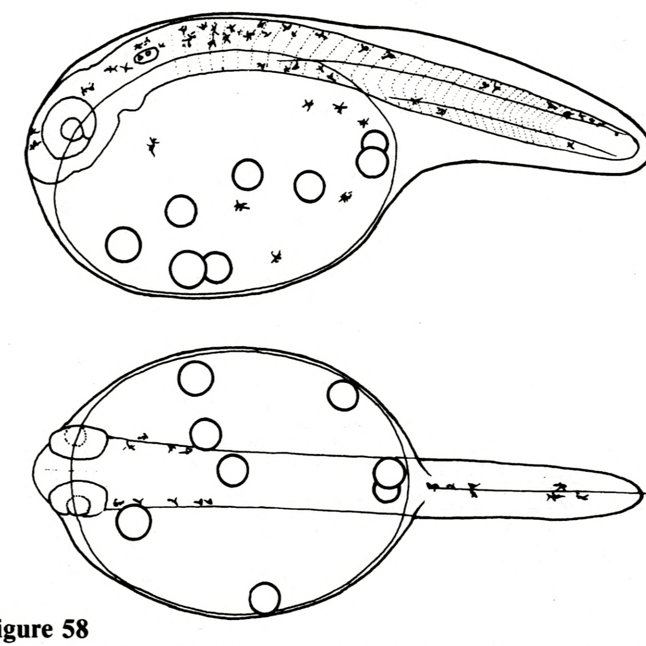


Figure 58

Cynoglossus capensis soon after hatching, lateral and ventral views. NL (alive) = 1.4 mm, NL (fixed) = 1.2 mm . Myomeres: 18 + ca. 20

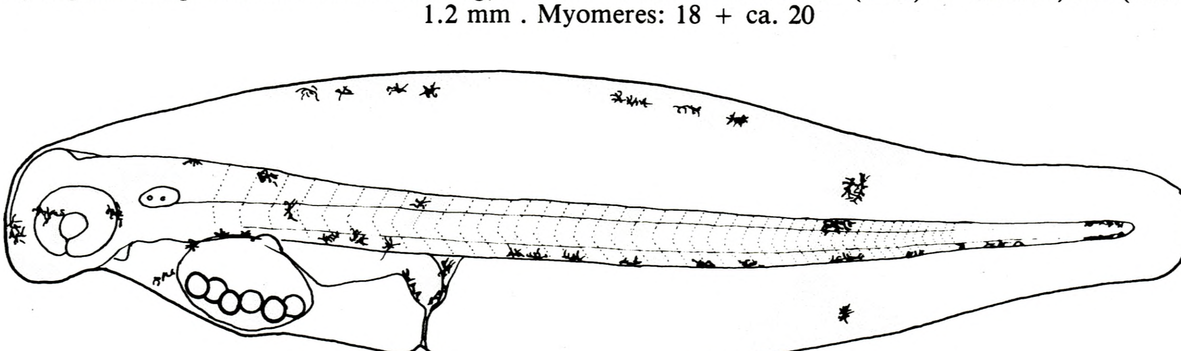


Figure 59

Cynoglossus capensis at 2 days (15°C). NL (alive) = 2.2 mm, NL (fixed) = 2.0 mm . Myomeres: 10 + 36 = 46

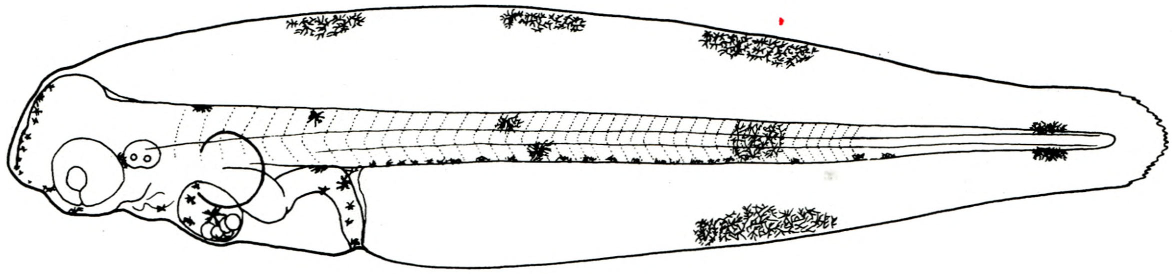


Figure 60
Cynoglossus capensis at 4 days (15°C). NL (alive) = 3.0 mm, NL (fixed) = 2.5 mm. Myomeres: 10 + 36 = 46

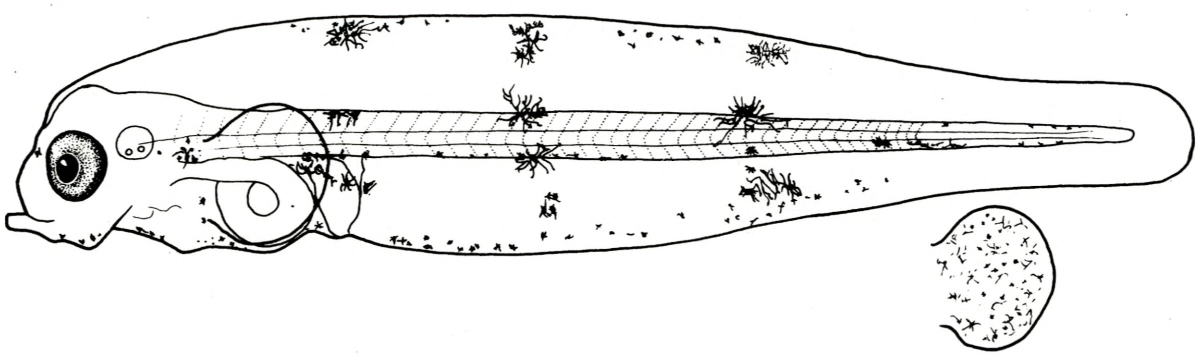


Figure 61
Cynoglossus capensis at 8 days (15°C), lateral view and fin detail. NL (alive) = 3.0 mm, NL (fixed) = 2.7 mm. Myomeres: 9 + 35 = 44

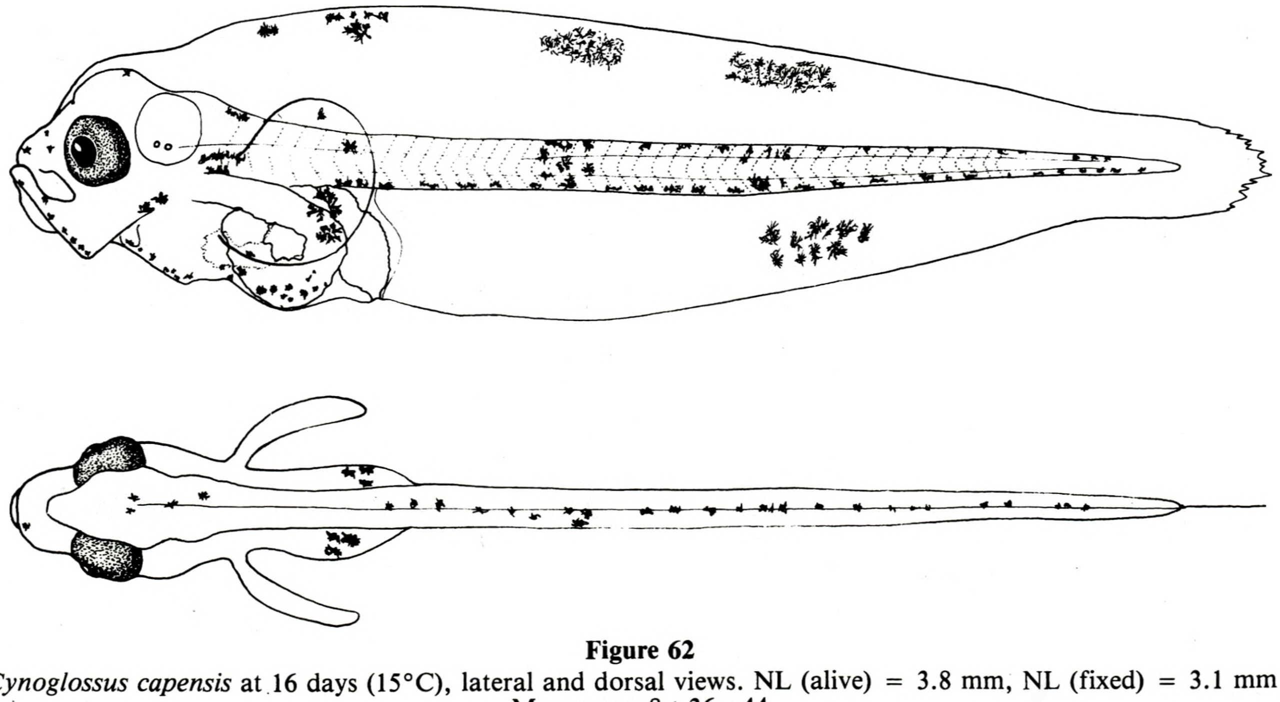


Figure 62
Cynoglossus capensis at 16 days (15°C), lateral and dorsal views. NL (alive) = 3.8 mm, NL (fixed) = 3.1 mm. Myomeres: 8 + 36 = 44

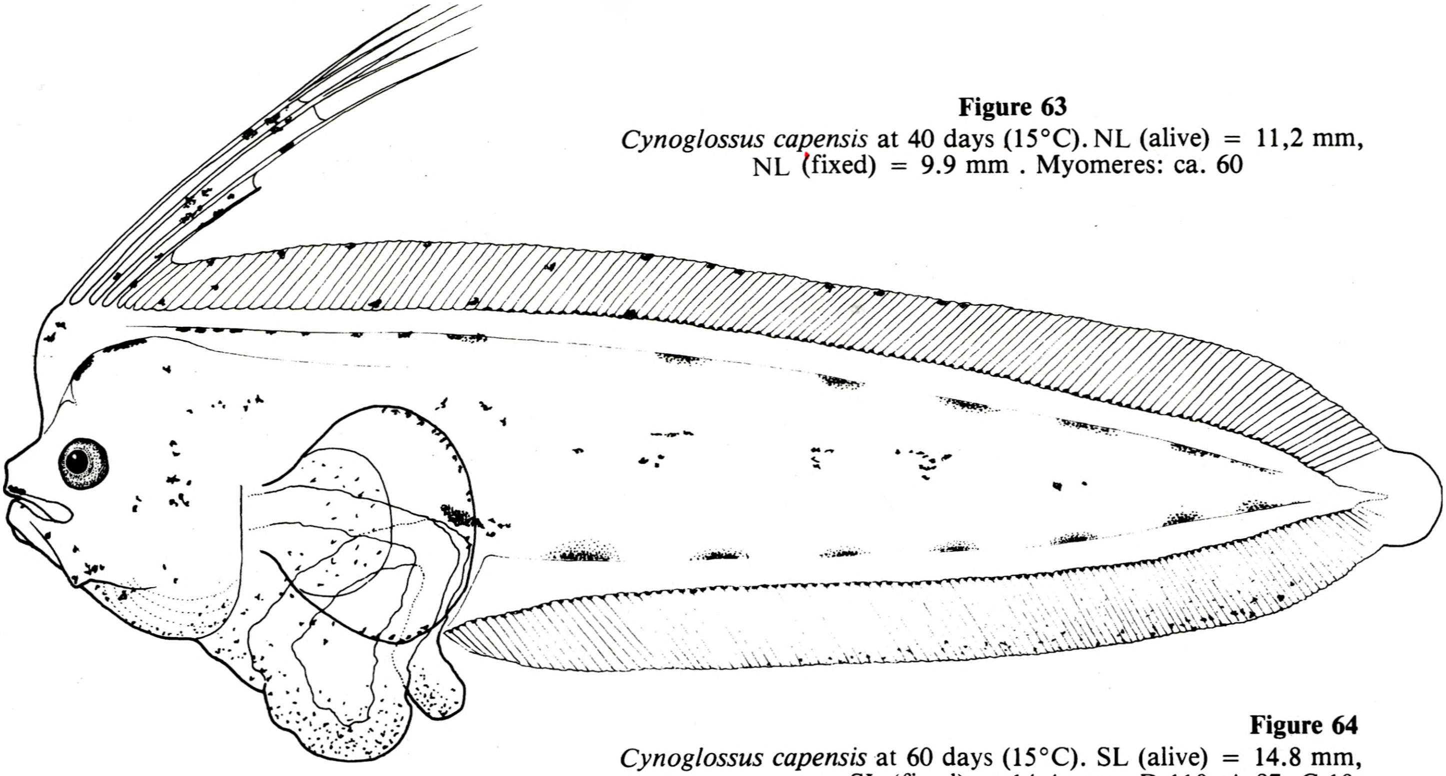
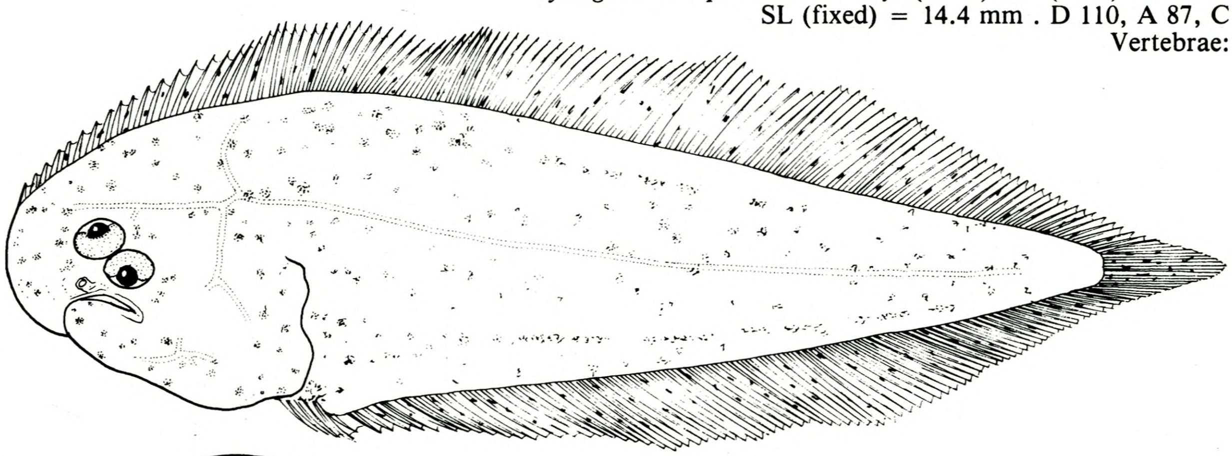


Figure 63
Cynoglossus capensis at 40 days (15°C). NL (alive) = 11,2 mm, NL (fixed) = 9.9 mm . Myomeres: ca. 60

Figure 64
Cynoglossus capensis at 60 days (15°C). SL (alive) = 14.8 mm, SL (fixed) = 14.4 mm . D 110, A 87, C 10, Vertebrae: 51.



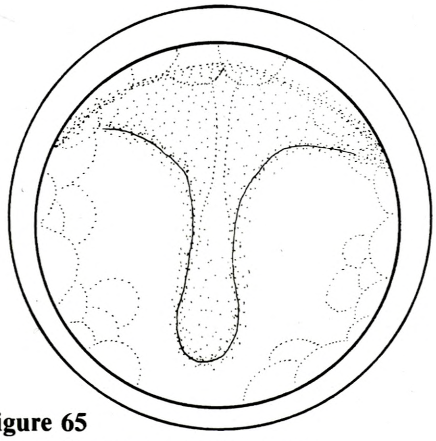


Figure 65
Paracallionymus costatus egg. 0.80 mm in diameter

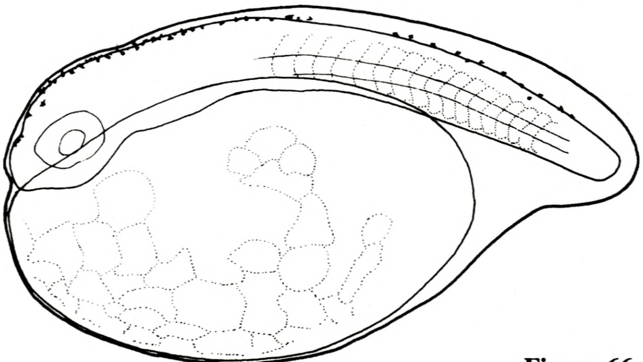


Figure 66
Paracallionymus costatus soon after hatching. NL (alive) = 1.05 mm, NL (fixed) = 0.98 mm . Myomeres: 18

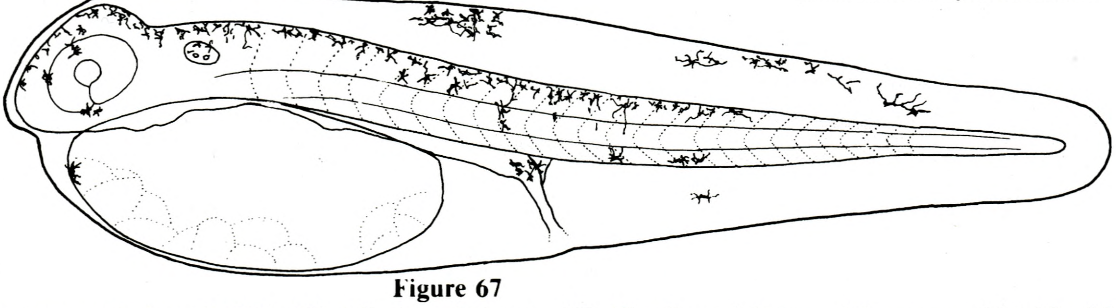


Figure 67
Paracallionymus costatus at 2 days (15°C). NL (alive) = 2.1 mm, NL (fixed) = 1.8 mm . Myomeres: 11 + 15 = 26

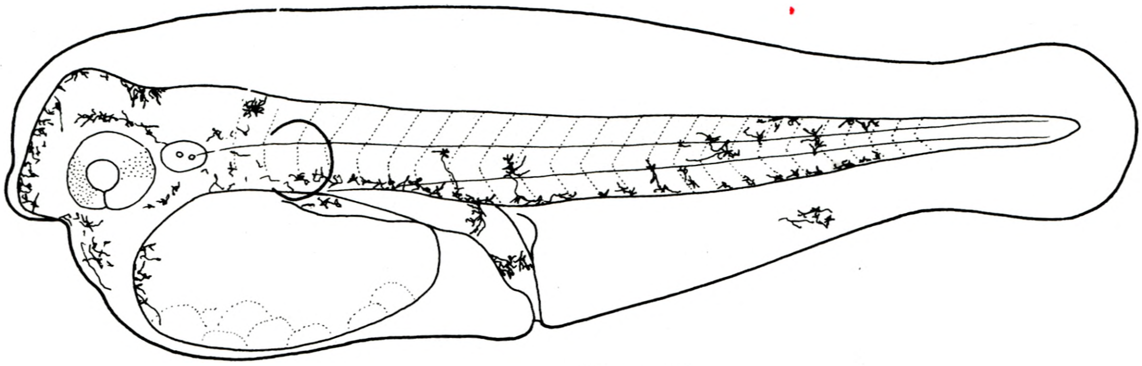


Figure 68

Paracallionymus costatus at 4 days (15°C). NL (alive) = 2.2 mm, NL (fixed) = 1.9 mm . Myomeres: 10 + 15 = 25

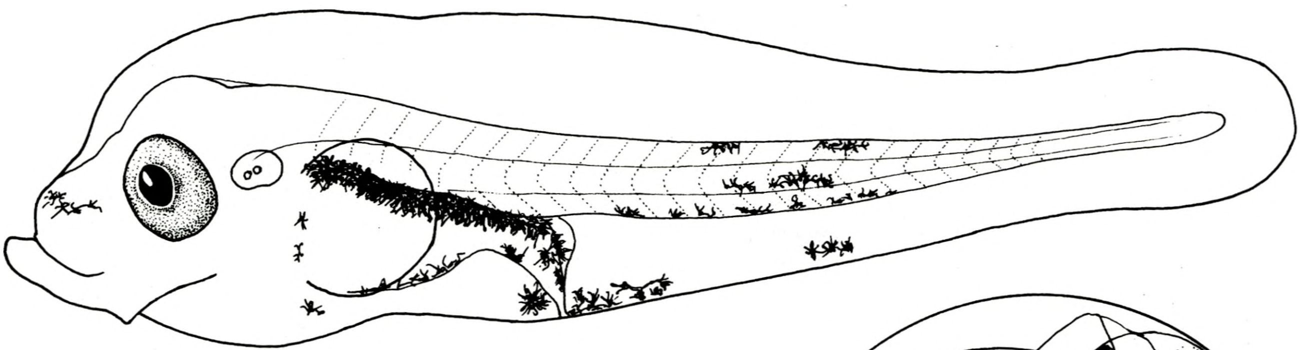


Figure 69

Paracallionymus costatus at 8 days (15°C). NL (alive) = 2.3 mm, NL (fixed) unavailable, specimen damaged prior to fixing. Myomeres: 9 + 16 = 25

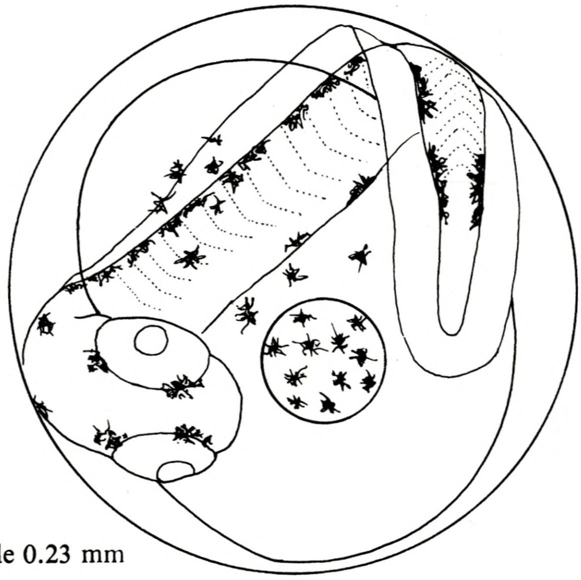


Figure 70

?Cheilodactylus fasciatus egg. 1.02 mm in diameter, oil globule 0.23 mm

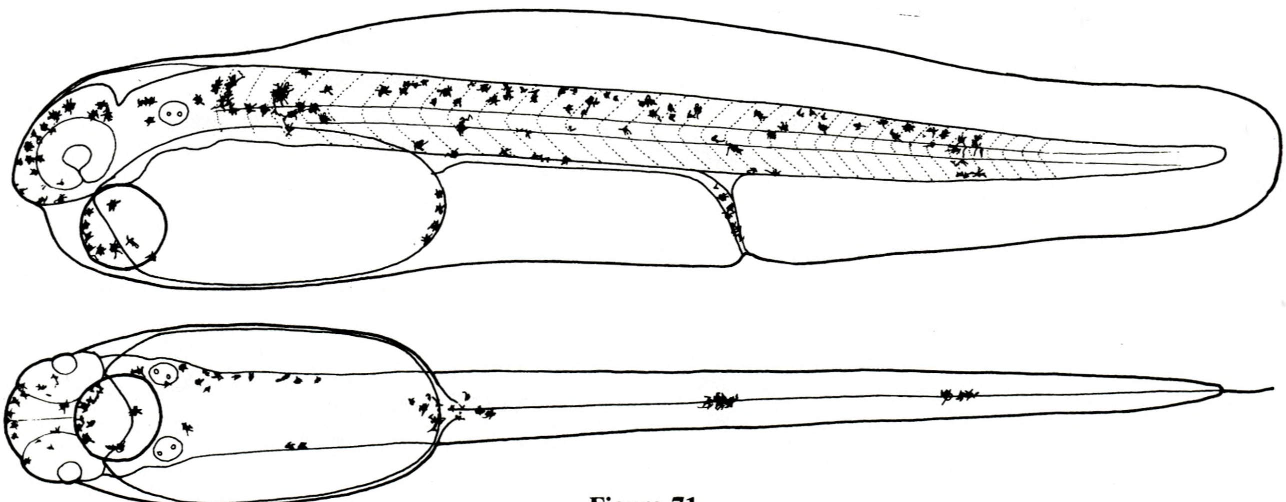


Figure 71

?Cheilodactylus fasciatus soon after hatching, lateral and ventral views. NL (alive) = 3.6 mm, NL (fixed) = 3.3 mm . Myomeres: 19 + 17 = 36

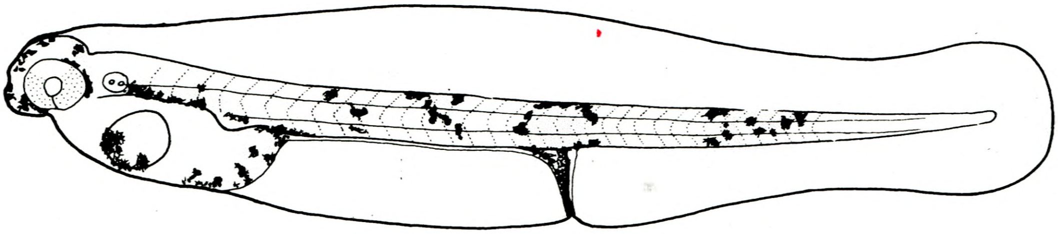


Figure 72

?Cheilodactylus fasciatus at 2 days (15°C). NL (alive) = 3.9 mm, NL (fixed) = 3.8 mm . Myomeres: 19 + 17 = 36

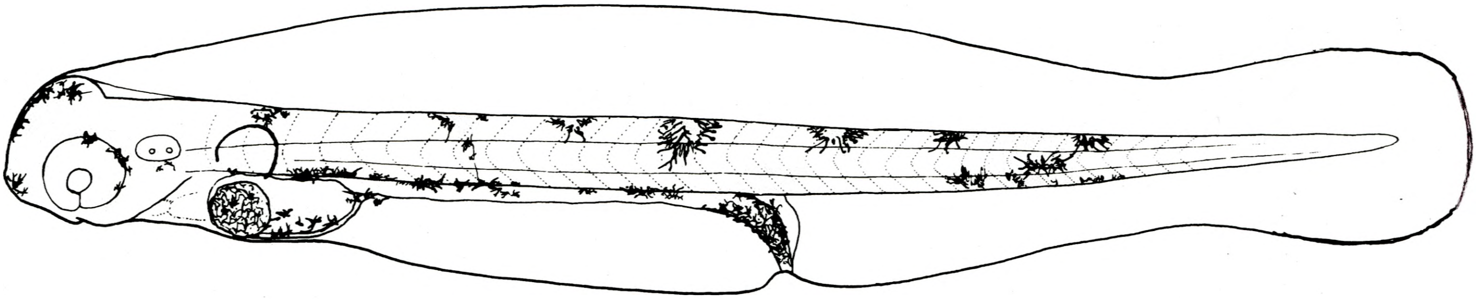


Figure 73

?Cheilodactylus fasciatus at 4 days (15°C). NL (alive) = 4.2 mm, NL (fixed) = 3.9 mm . Myomeres: 19 + 17 = 36

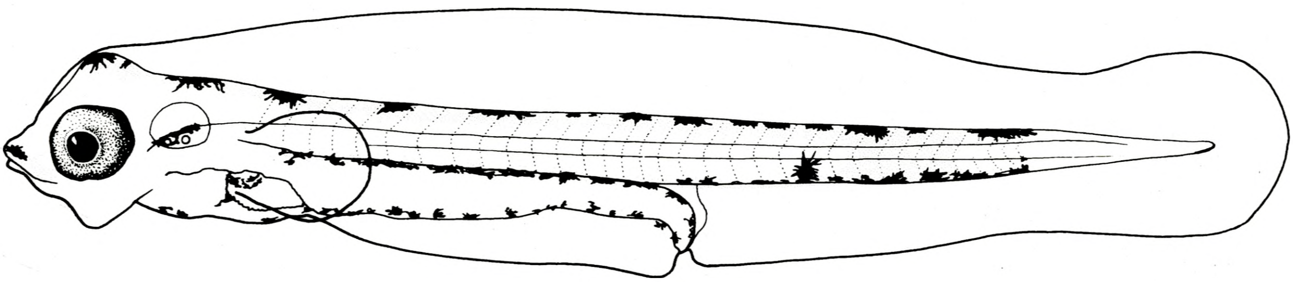


Figure 74

?Cheilodactylus fasciatus at 8 days (15°C). NL (alive) = 4.3 mm, NL (fixed) = 4.0 mm . Myomeres: 18 + 17 = 35

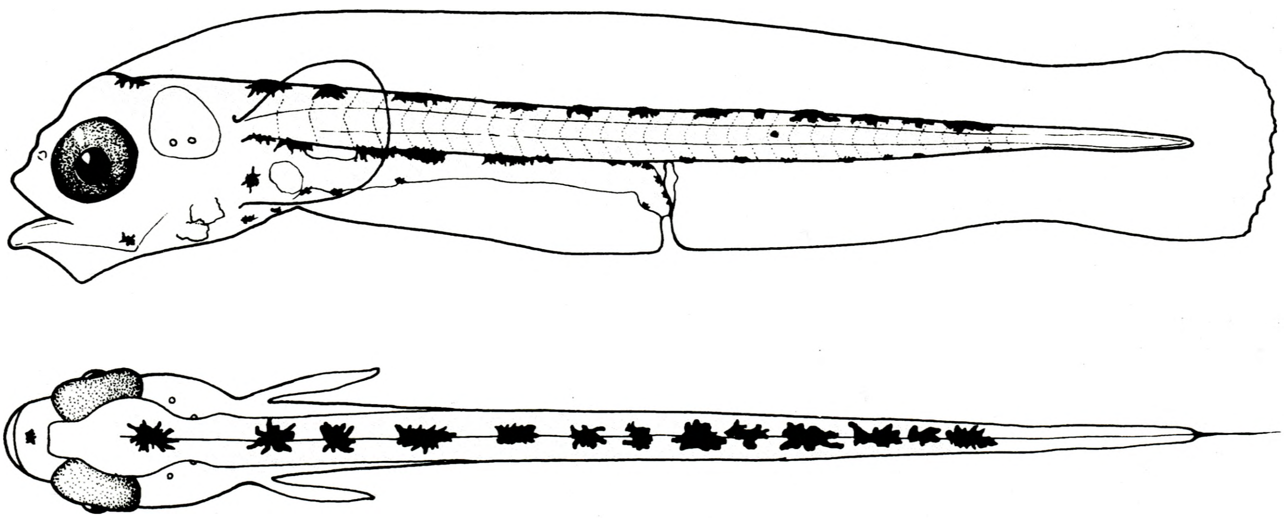


Figure 75

?Cheilodactylus fasciatus at 16 days (15°C), lateral and dorsal views. NL (alive) = 4.4 mm, NL (fixed) = 4.1 mm . Myomeres: 18 + 17 = 35

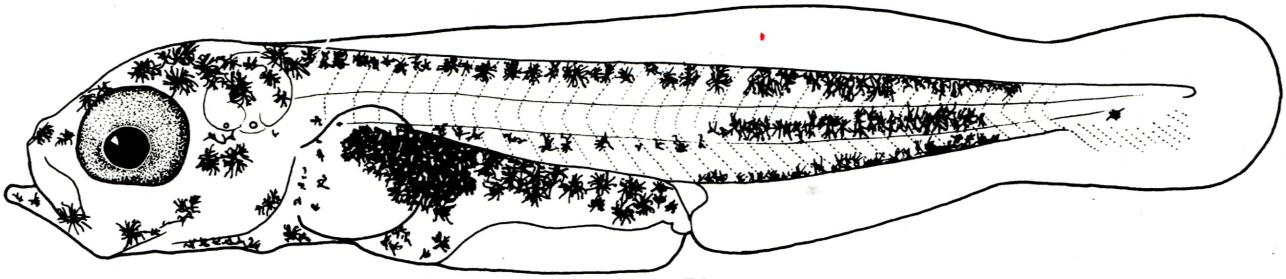


Figure 76

?Cheilodactylus fasciatus at 32 days (15°C). NL (alive) = 6.9 mm, NL (fixed) = 6.4 mm . Myomeres: 17 + 18 = 35

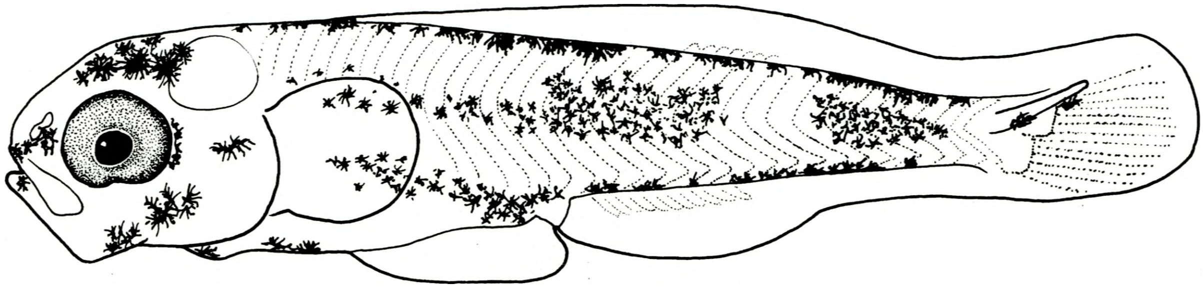


Figure 77

?Cheilodactylus fasciatus at 45 days (15°C). NL (alive) = 8.00 mm, NL (fixed) = 7.5 mm . Myomeres: 18 + 18 = 36

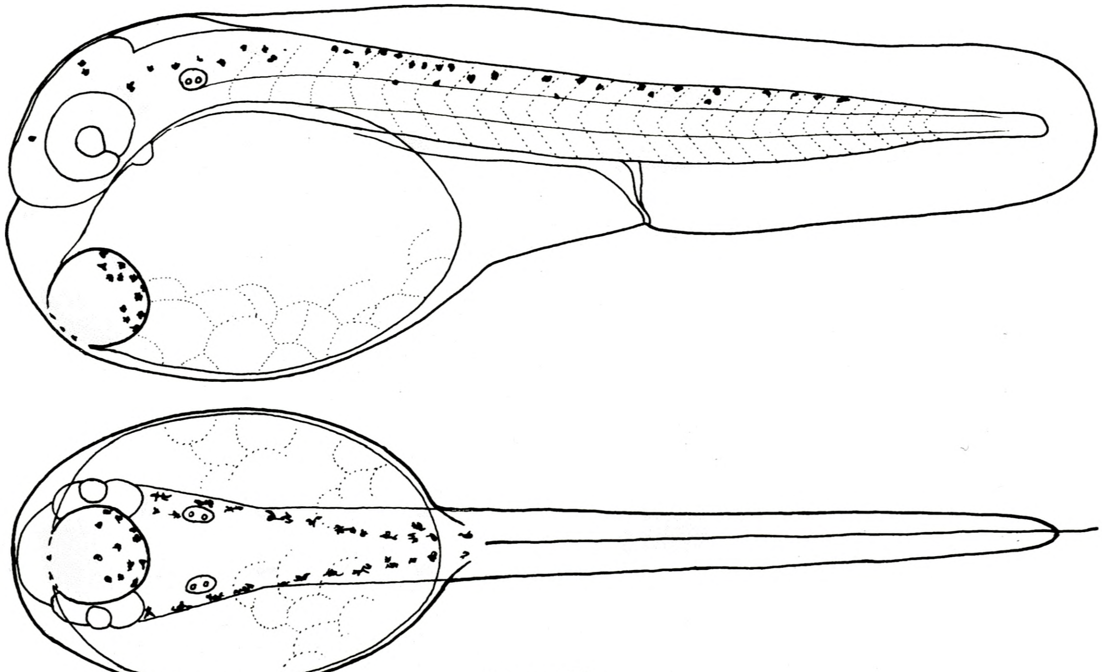


Figure 78

Trachurus t. capensis soon after hatching, lateral and ventral views. NL (alive) = 2.3 mm, NL (fixed) = 2.2 mm . Myomeres: 14 + 14 = 28

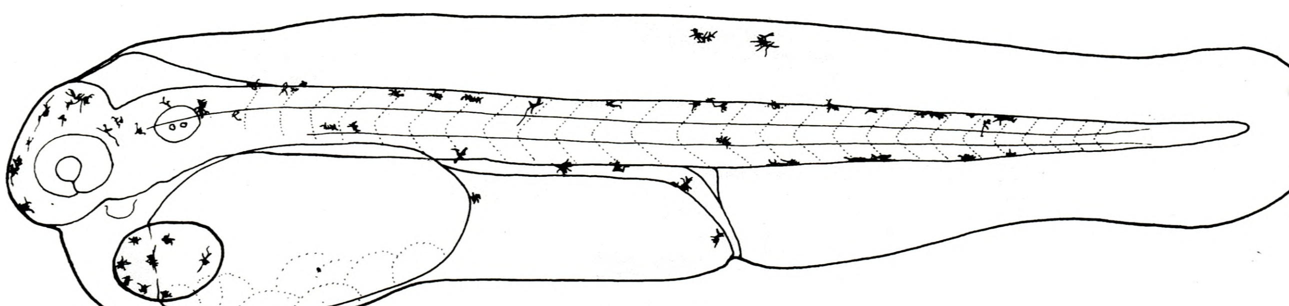


Figure 79

Trachurus t. capensis at 2 days (15°C). NL (alive) = 3.00 mm, NL (fixed) = 2.8 mm . Myomeres: 14 + 13 = 27

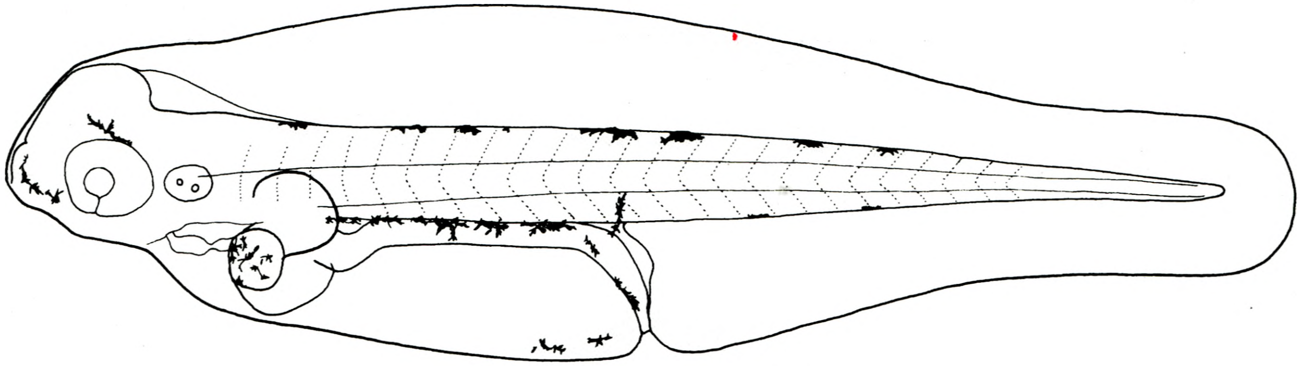


Figure 80

Trachurus t. capensis at 4 days (15°C). NL (alive) = 3.6 mm, NL (fixed) = 2.9 mm . Myomeres: 13 + 12 = 25

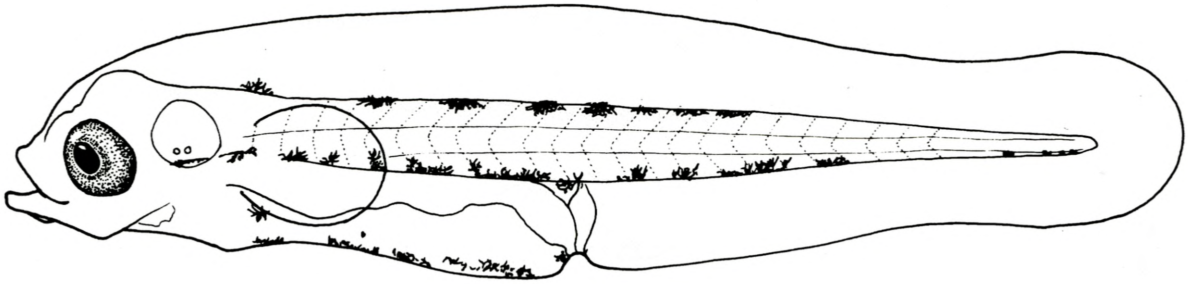


Figure 81

Trachurus t. capensis at 8 days (15°C). NL (alive) = 3.7 mm, NL (fixed) = 3.6 mm . Myomeres: 12 + 12 = 24

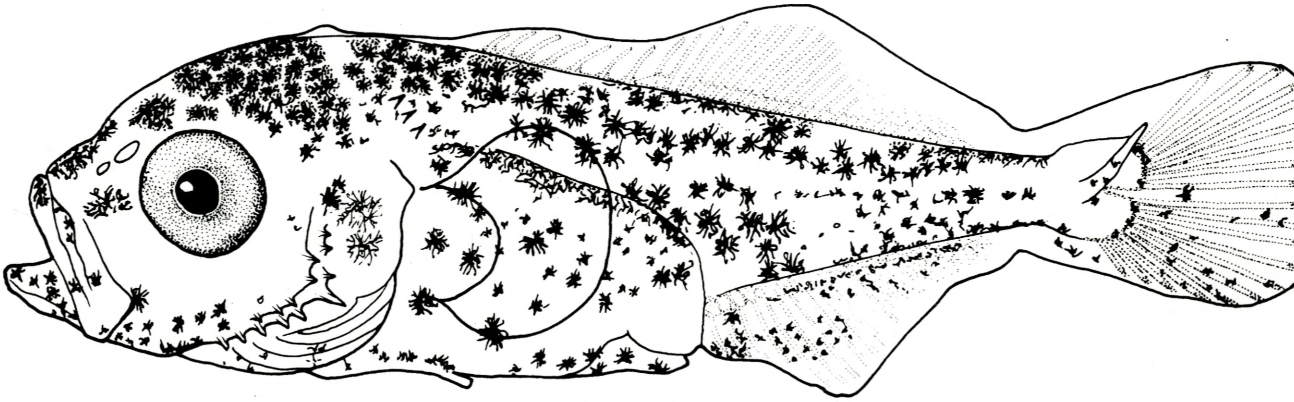


Figure 82

Trachurus t. capensis at 32 days (15°C). SL (alive) = 9.5 mm, SL (fixed) = 8.9 mm . Fin elements have not yet reached definitive counts

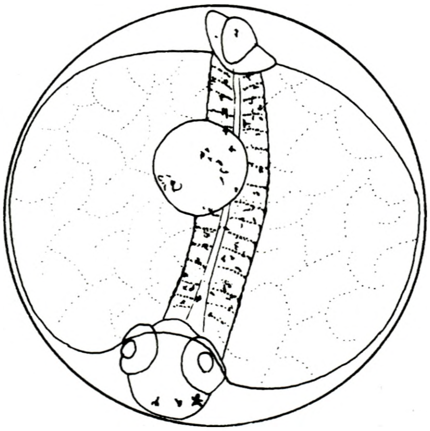


Figure 83

?Seriola lalandi egg. 1.44 mm in diameter, oil globule 0.32 mm

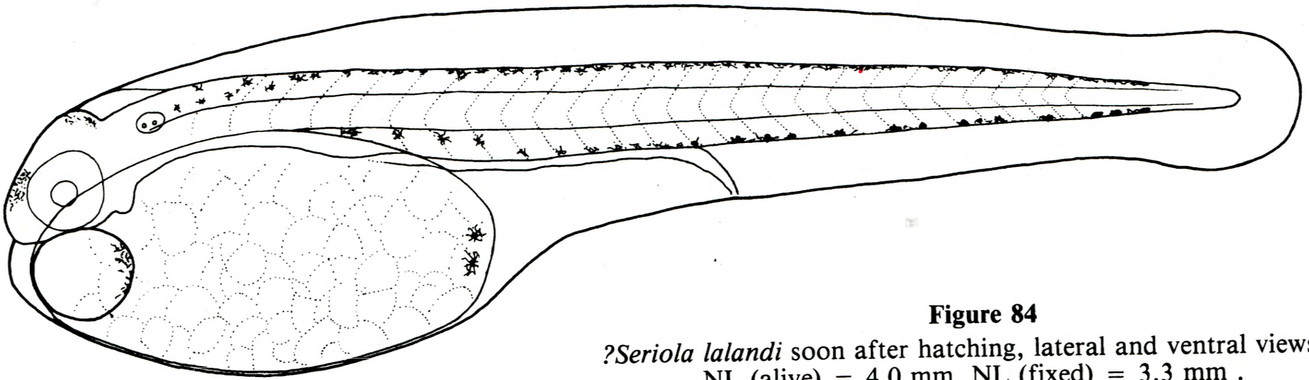
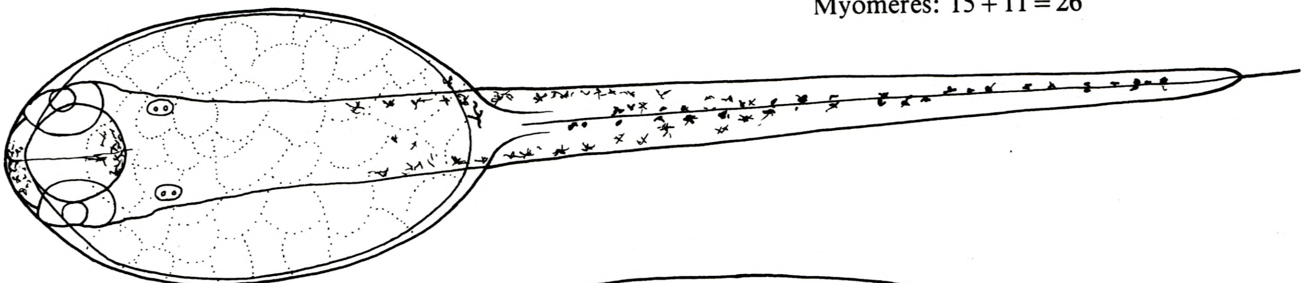


Figure 84

?Seriola lalandi soon after hatching, lateral and ventral views.
NL (alive) = 4.0 mm, NL (fixed) = 3.3 mm .
Myomeres: 15 + 11 = 26



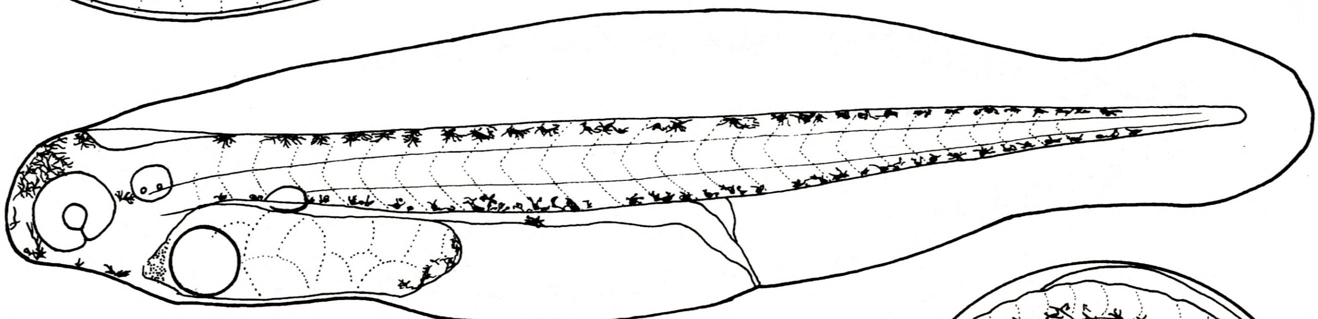


Figure 85

?Seriola lalandi at 2 days. NL (alive) = 4.8 mm,
NL (fixed) = 4,0 mm . Myomeres: 16 + 11 = 27

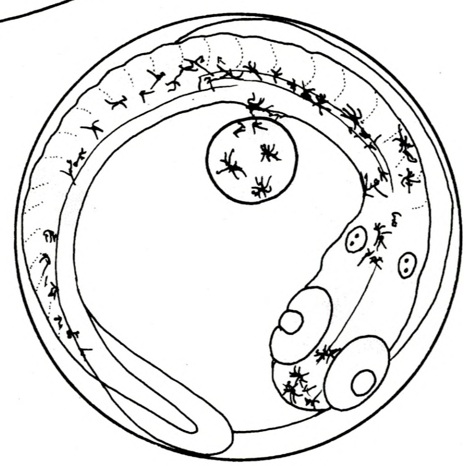


Figure 86

Pterosmaris axillaris egg. 1.28 mm in diameter, oil globule 0.26 mm

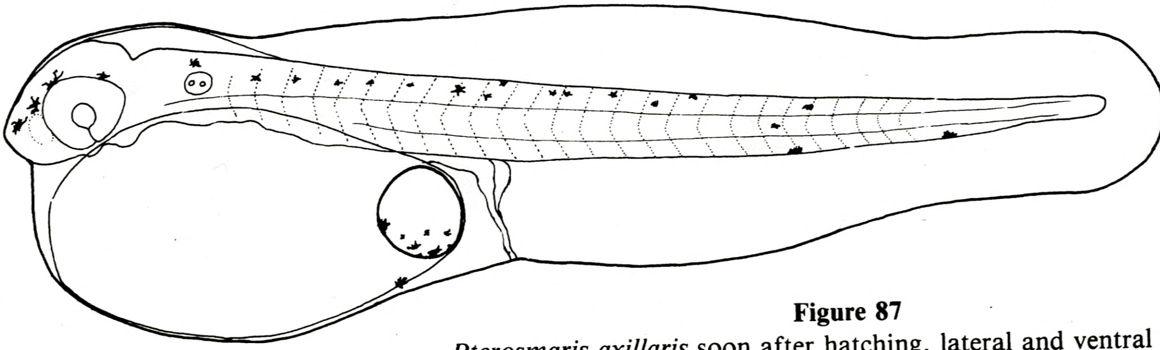
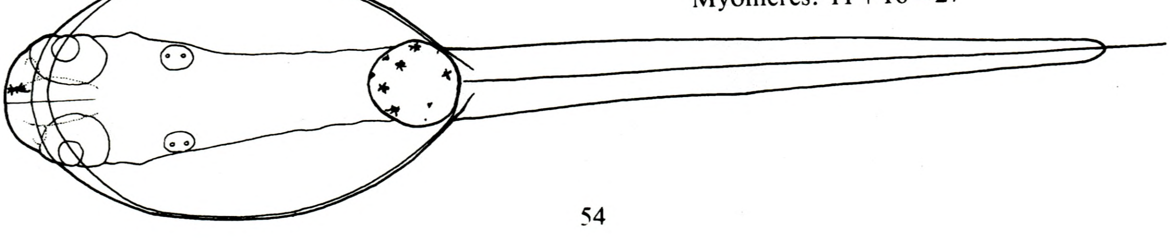


Figure 87

Pterosmaris axillaris soon after hatching, lateral and ventral views.
NL (alive) = 2.5 mm, NL (fixed) = 2.2 mm .
Myomeres: 11 + 16 = 27



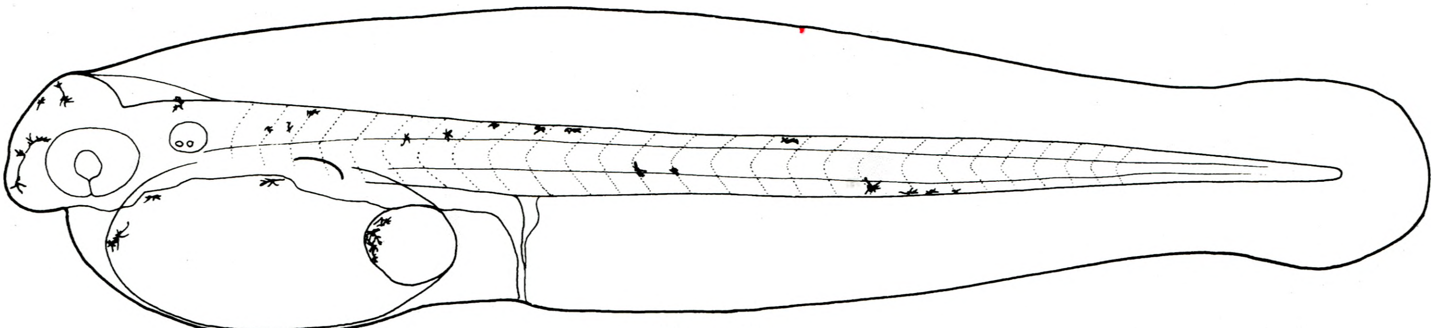


Figure 88

Pterosmaris axillaris at 2 days (15°C). NL (alive) = 3.3 mm, NL (fixed) = 3.0 mm . Myomeres: 10 + 17 = 27

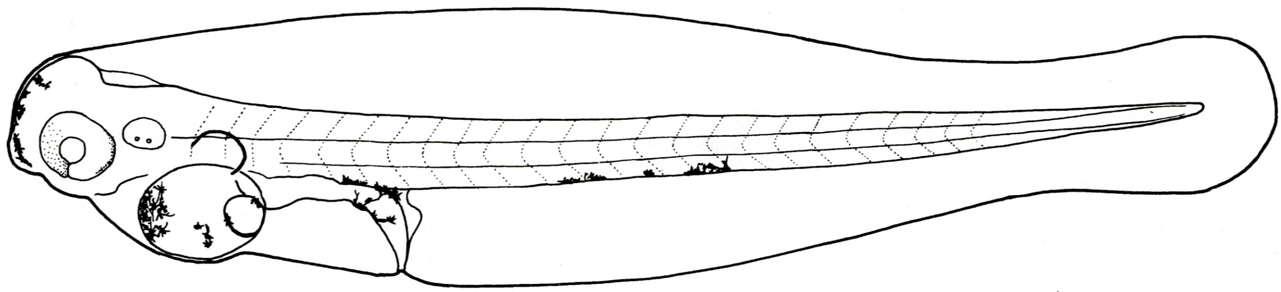


Figure 89

Pterosmaris axillaris at 4 days (15°C). NL (alive) = 3.4 mm, NL (fixed) unavailable (specimen lost). Myomeres: 8 + 17 = 25

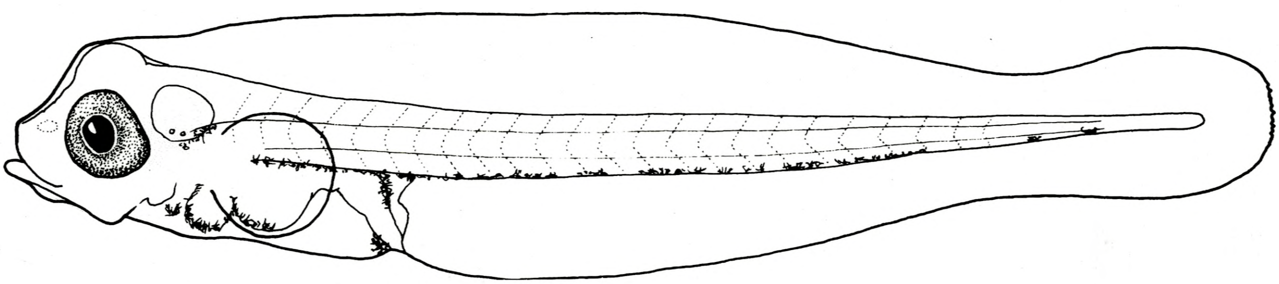


Figure 90

Pterosmaris axillaris at 8 days (15°C). NL (alive) = 3.8 mm, NL (fixed) = 3.4 mm . Myomeres: 7 + 18 = 25

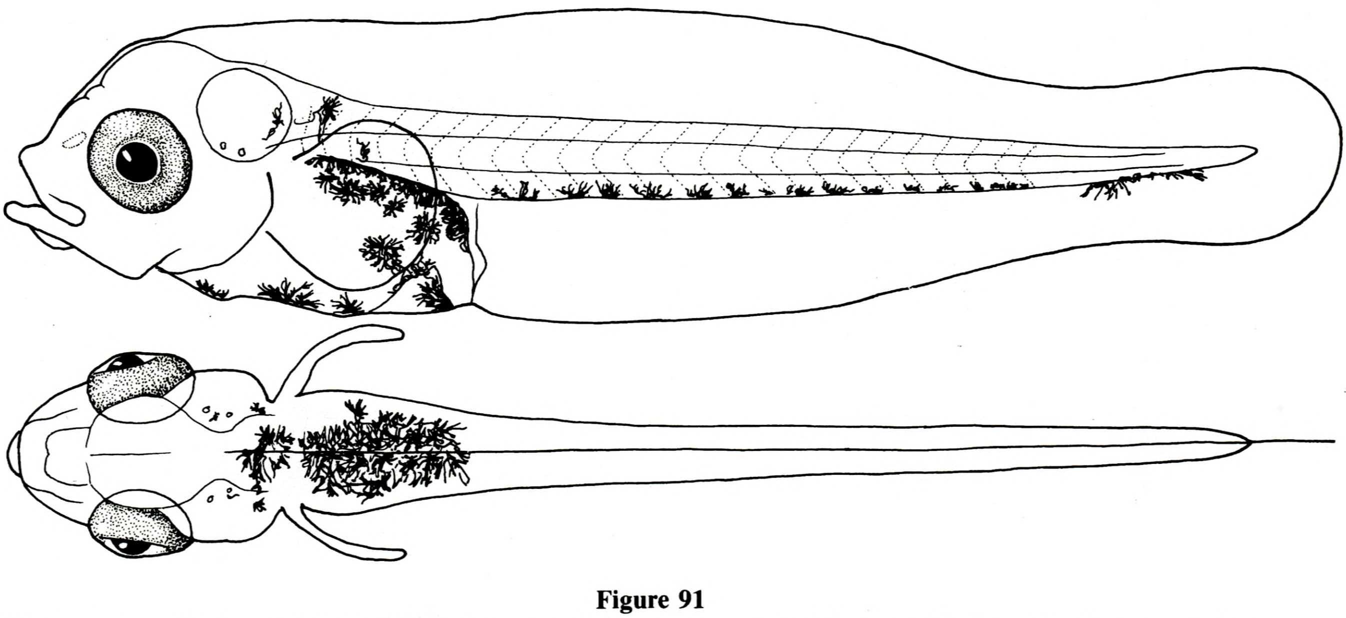


Figure 91

Pterosmaris axillaris at 16 days (15°C), lateral and dorsal views. NL (alive) = 5.2 mm, NL (fixed) = 4.8 mm . Myomeres: 7 + 18 = 25

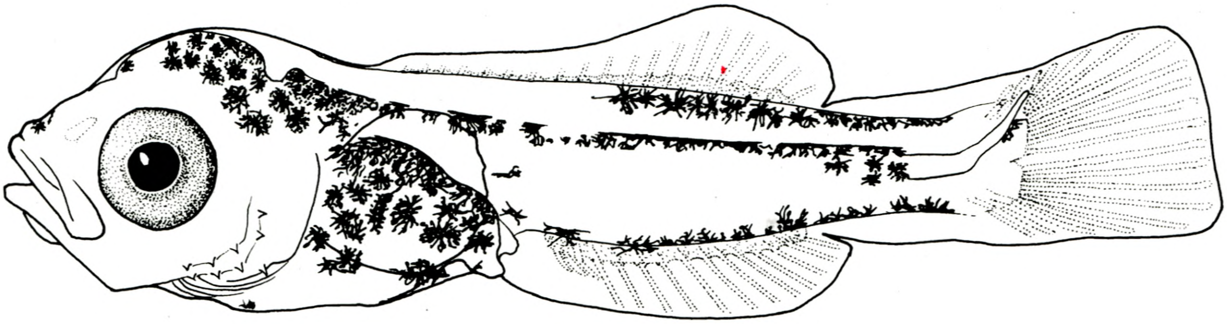


Figure 92

Pterosmaris axillaris at 32 days (15°C). SL (alive) = 7.7 mm, SL (fixed) = 7.2 mm . Fin elements have not yet reached definitive counts

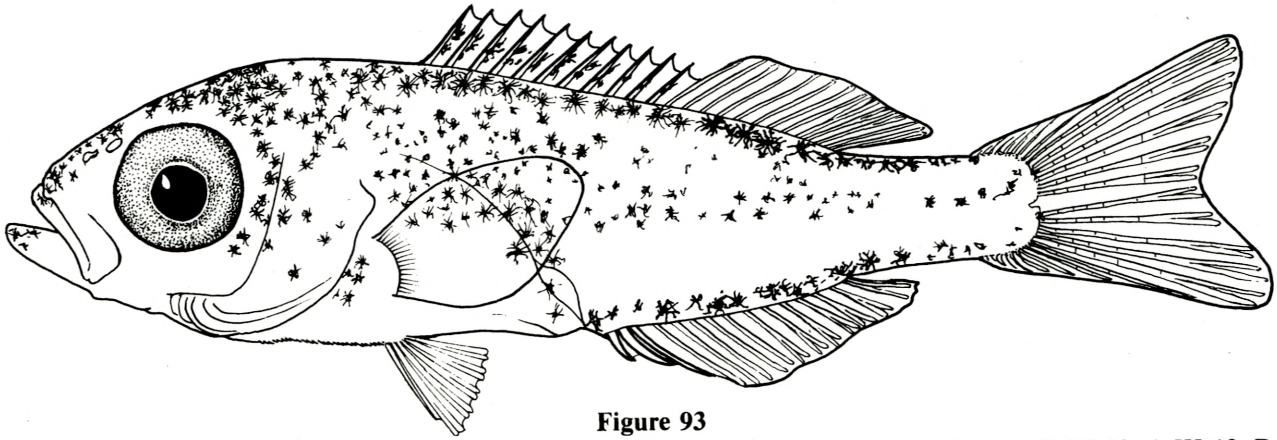


Figure 93

Pterosmaris axillaris at 3 months (15°C). SL (alive) = 18.2 mm, SL (fixed) = 16.5 mm . D XI,13; A III,12; P 17, Vertebrae: 10 + 14 = 24

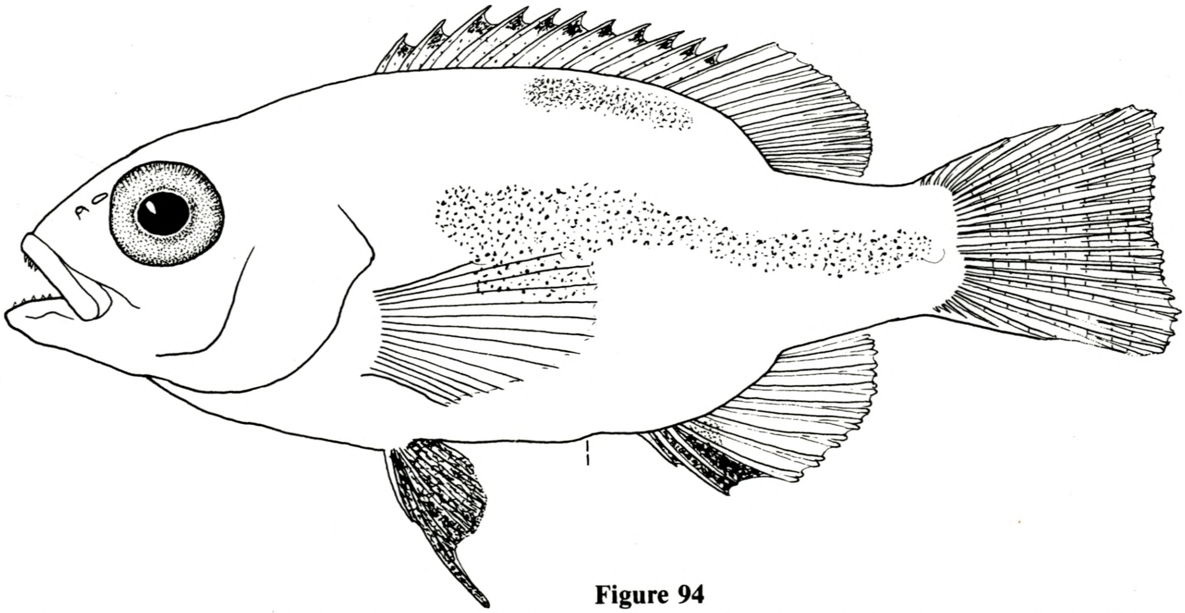


Figure 94

Chrysoblephus laticeps at 4 months (15°C). This specimen died in the rearing tank and was illustrated after preservation. SL (fixed) = 36 mm. D XI,10; A III,8; P 16

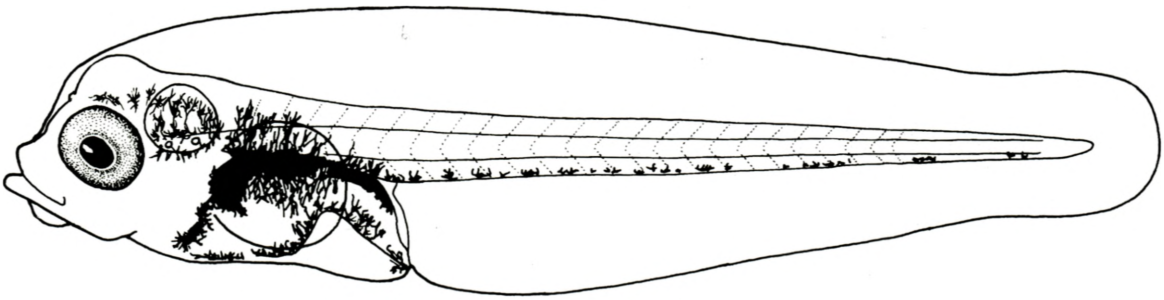


Figure 95

Diplodus cervinus at 8 days (15°C). NL (alive) = 3.8 mm, NL (fixed) = 3.3 mm . Myomeres: 7 + 18 = 25

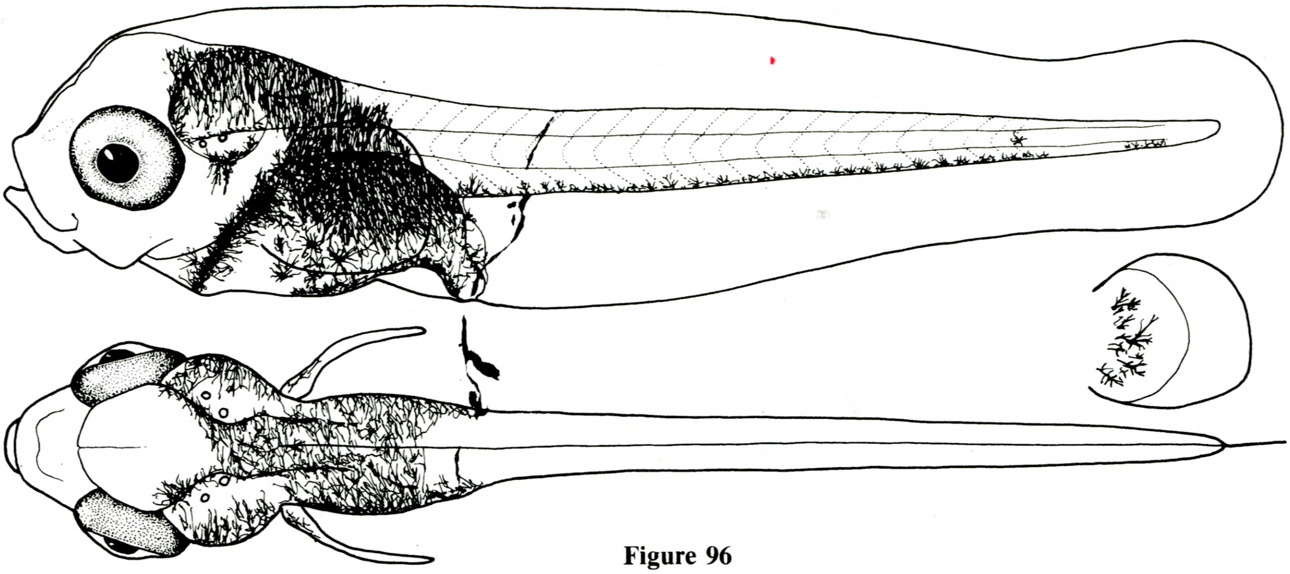


Figure 96
Diplodus cervinus at 16 days (15°C). NL (alive) = 4.3 mm, NL (fixed) = 3.9 mm . Myomeres: 7 + 18 = 25

Figure 97
Diplodus cervinus at 32 days (15°C). SL (alive) = 7.9 mm, SL (fixed) = 7.4 mm . Fin elements have not yet reached definitive counts

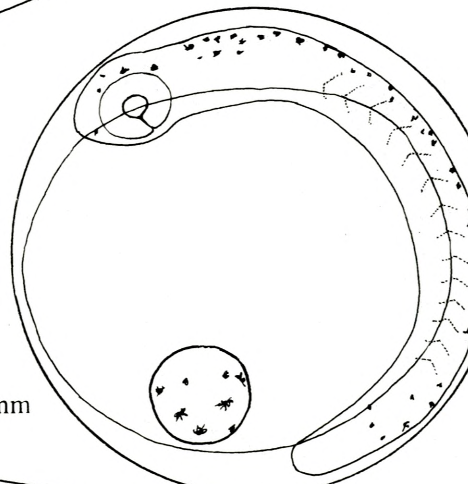


Figure 98
Diplodus sargus egg. 0.94 mm in diameter, oil globule 0.20 mm

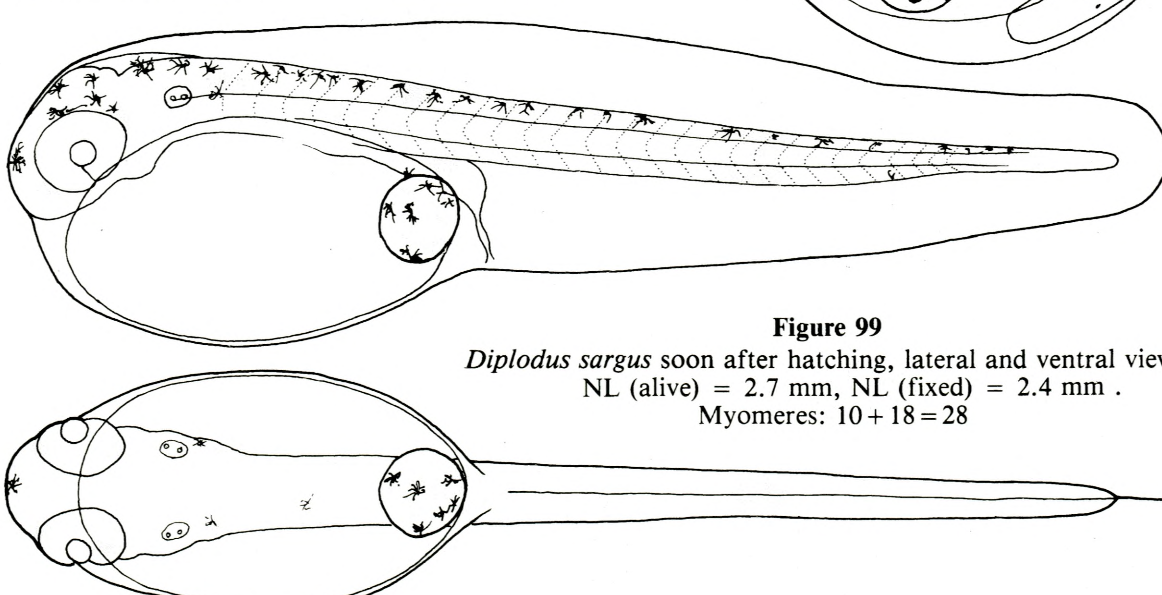


Figure 99
Diplodus sargus soon after hatching, lateral and ventral views. NL (alive) = 2.7 mm, NL (fixed) = 2.4 mm . Myomeres: 10 + 18 = 28

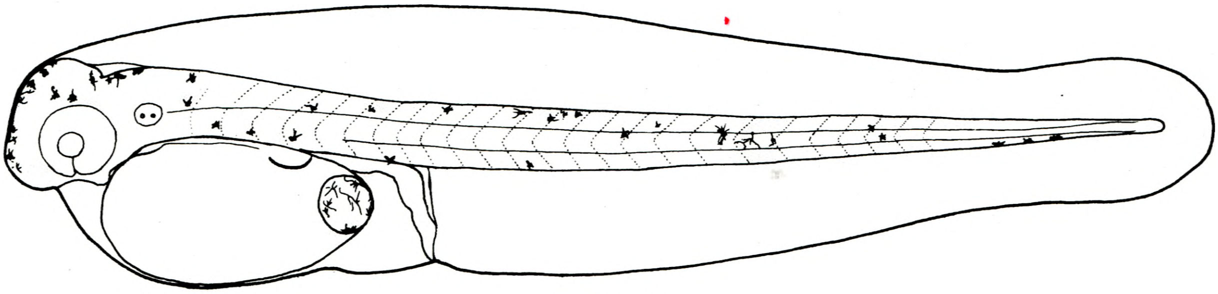


Figure 100

Diplodus sargus at 2 days (15°C). NL (alive) = 3.4 mm, NL (fixed) = 2.9 mm . Myomeres: 9 + 17 = 26

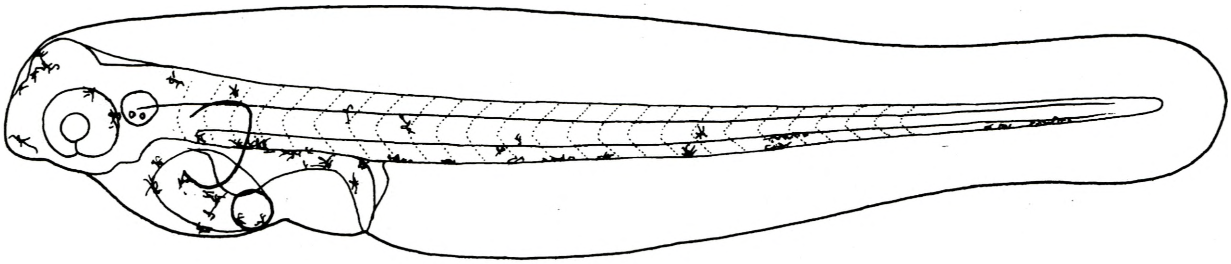


Figure 101

Diplodus sargus at 4 days (15°C). NL (alive) = 3.4 mm, NL (fixed) = 3.1 mm . Myomeres: 8 + 18 = 26

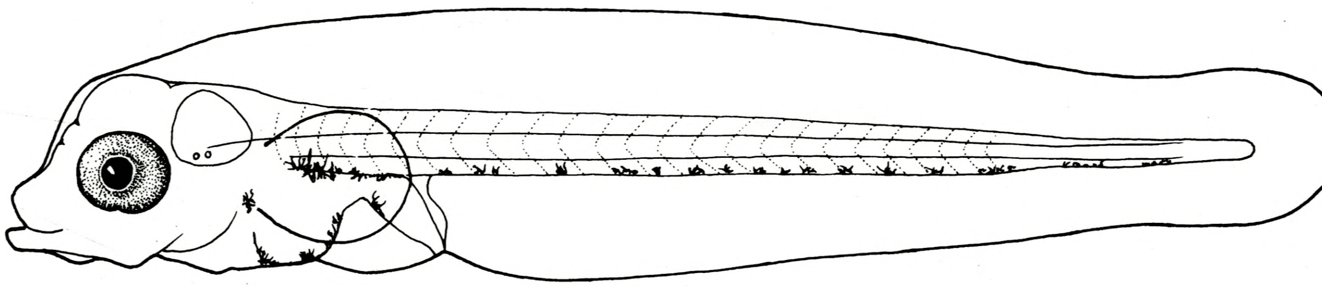


Figure 102

Diplodus sargus at 8 days (15°C). NL (alive) = 3.3 mm, NL (fixed) = 2.9 mm . Myomeres: 8 + 18 = 26

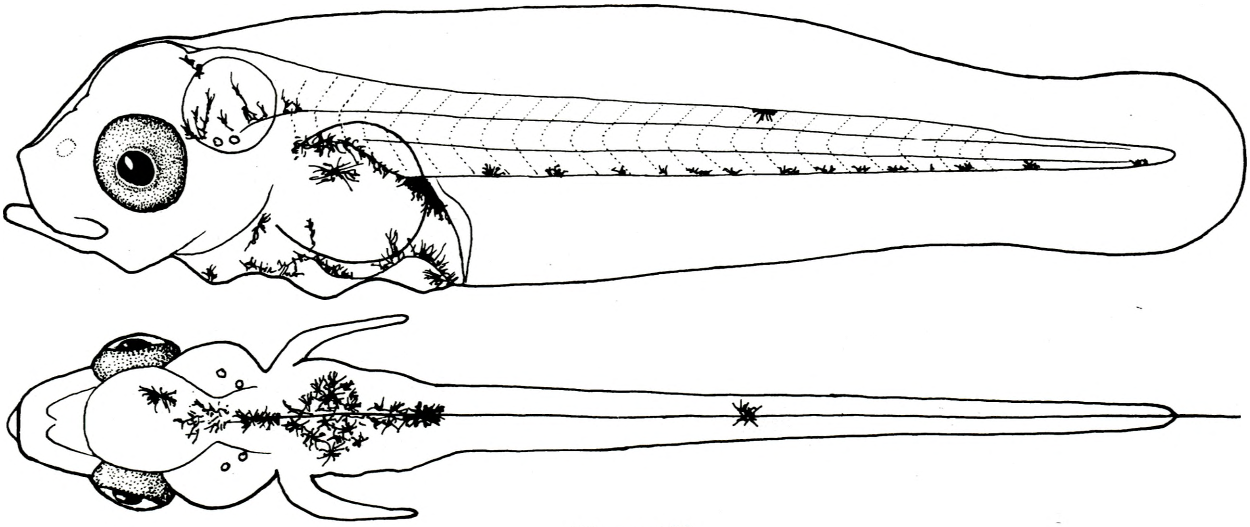


Figure 103

Diplodus sargus at 16 days (15°C), lateral and dorsal views. NL (alive) = 4.5 mm, NL (fixed) = 4.1 mm . Myomeres: 8 + 17 = 25

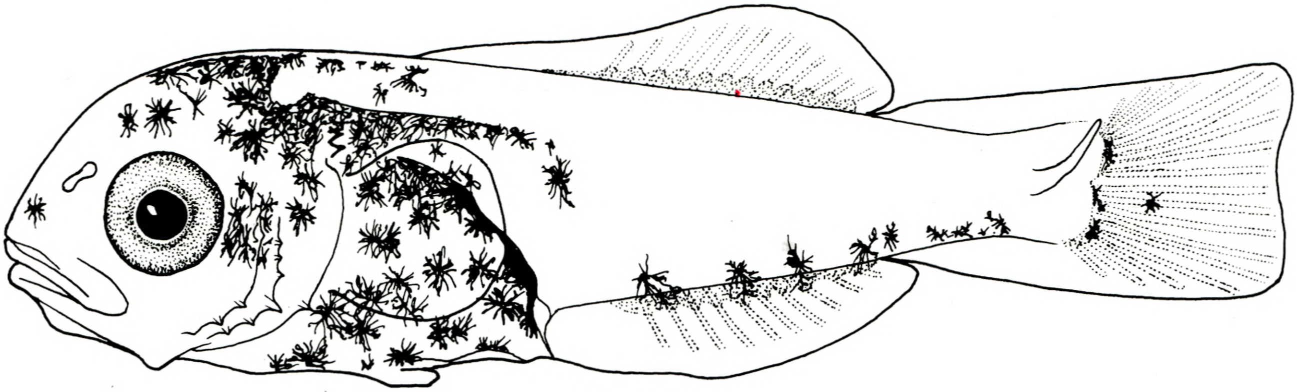


Figure 104
Diplodus sargus at 32 days (15°C). SL (alive) = 8.3 mm, SL (fixed) = 8.0 mm . Fin elements have not yet reached definitive counts

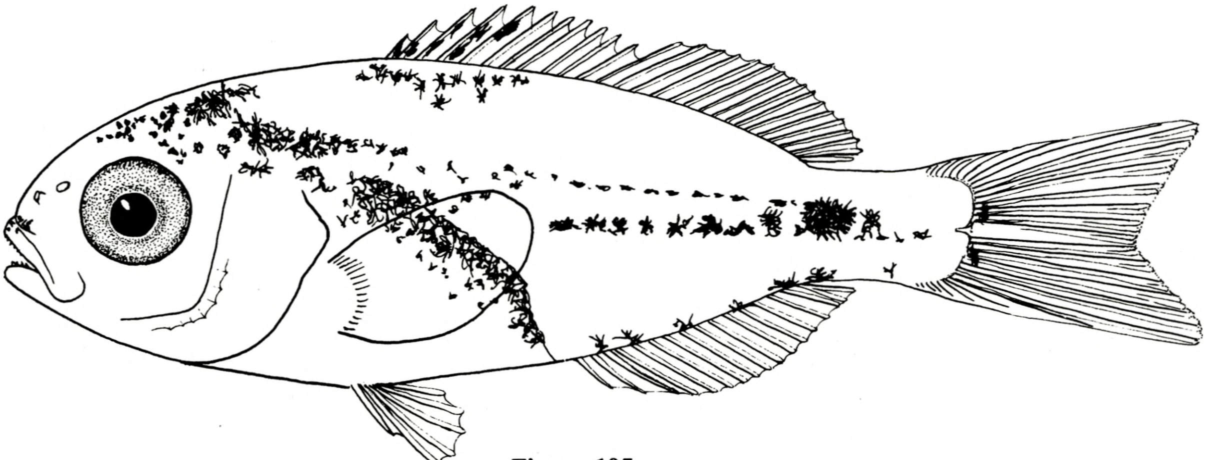


Figure 105
Diplodus sargus at 50 days (15°C). SL (alive) = 14.4 mm, SL (fixed) = 13.3 mm . D XI,15; A III,13; P 16

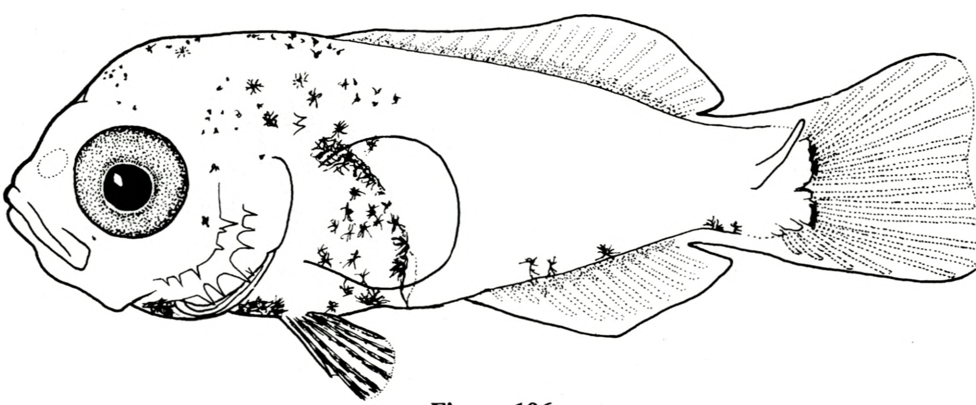


Figure 106
Gymnocrotaphus curvidens at 43 days (15°C). This specimen died in the rearing tank and was illustrated after preservation. SL (fixed) = 5.4 mm . Fin elements have not yet reached definitive counts

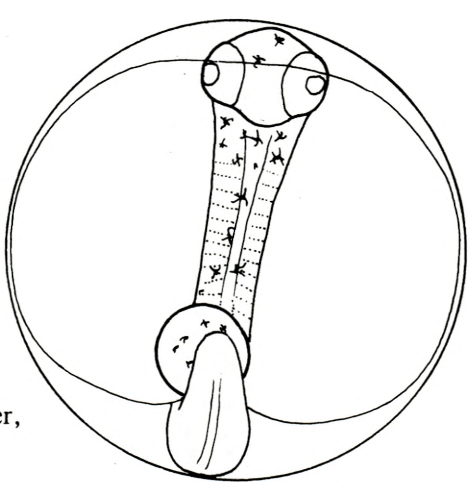


Figure 107
Lithognathus mormyrus egg. 0.85 mm in diameter, oil globule 0.18 mm

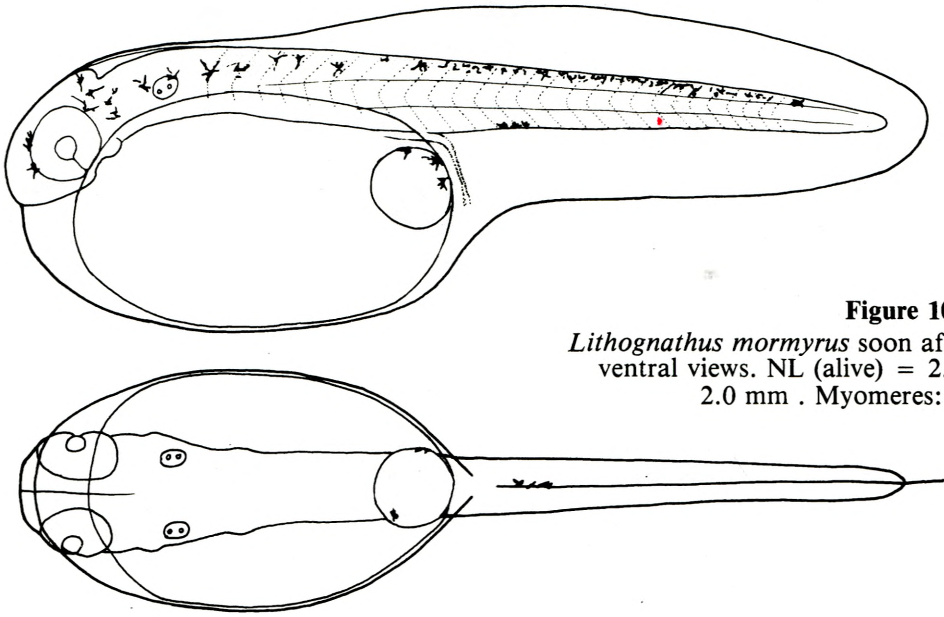


Figure 108

Lithognathus mormyrus soon after hatching, lateral and ventral views. NL (alive) = 2.1 mm, NL (fixed) = 2.0 mm . Myomeres: 11 + 17 = 28

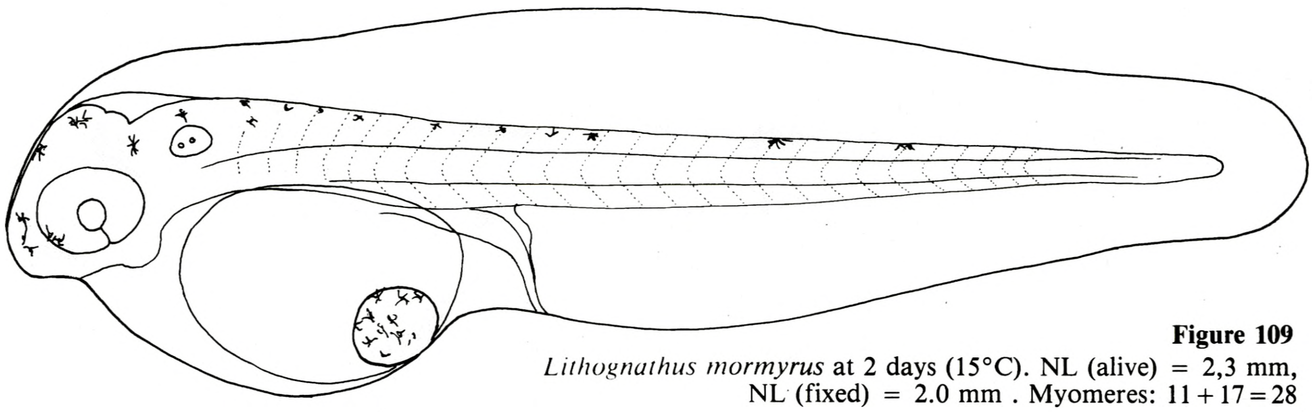


Figure 109

Lithognathus mormyrus at 2 days (15°C). NL (alive) = 2,3 mm, NL (fixed) = 2.0 mm . Myomeres: 11 + 17 = 28

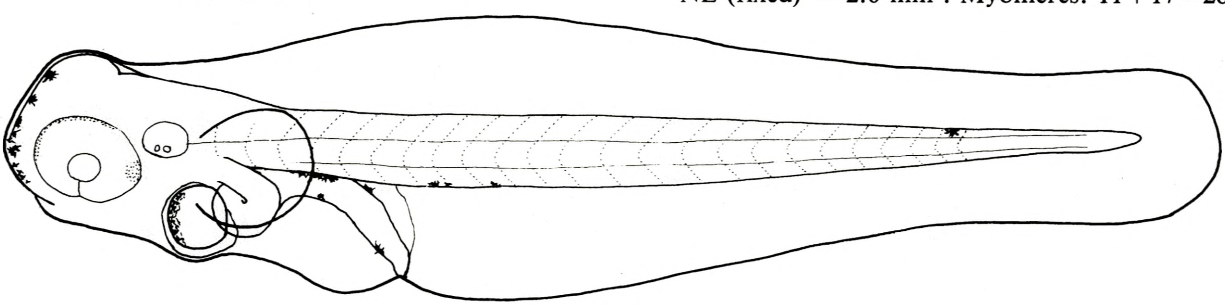


Figure 110

Lithognathus mormyrus at 4 days (15°C). NL (alive) = 2.9 mm, NL (fixed) = 2.5 mm . Myomeres: 7 + 18 = 25

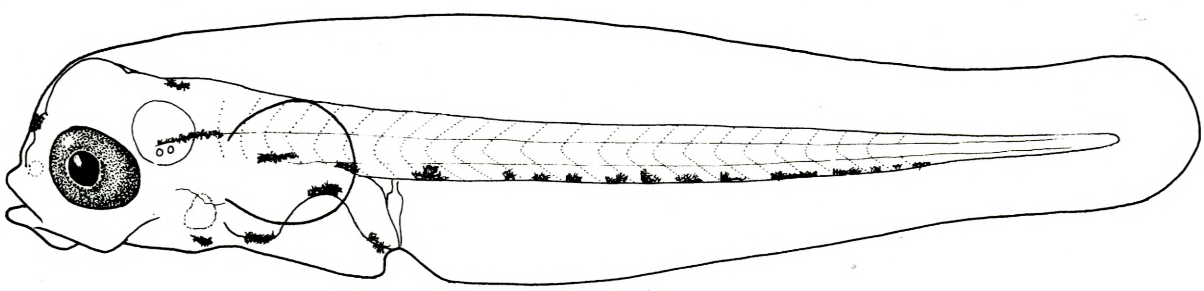


Figure 111

Lithognathus mormyrus at 8 days (15°C). Specimen with poorly developed yellow pigmentation. NL (alive) = 2.9 mm, NL (fixed) = 2.9 mm . Myomeres: 8 + 17 = 25

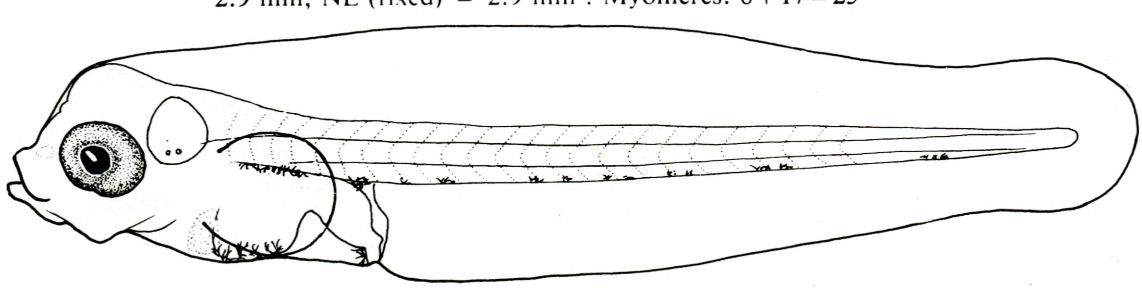


Figure 112

Lithognathus mormyrus at 8 days (15°C). Specimen with well-developed yellow pigmentation. NL (alive) = 3.0 mm, NL (fixed) = 2.8 mm . Myomeres: 8 + 17 = 25

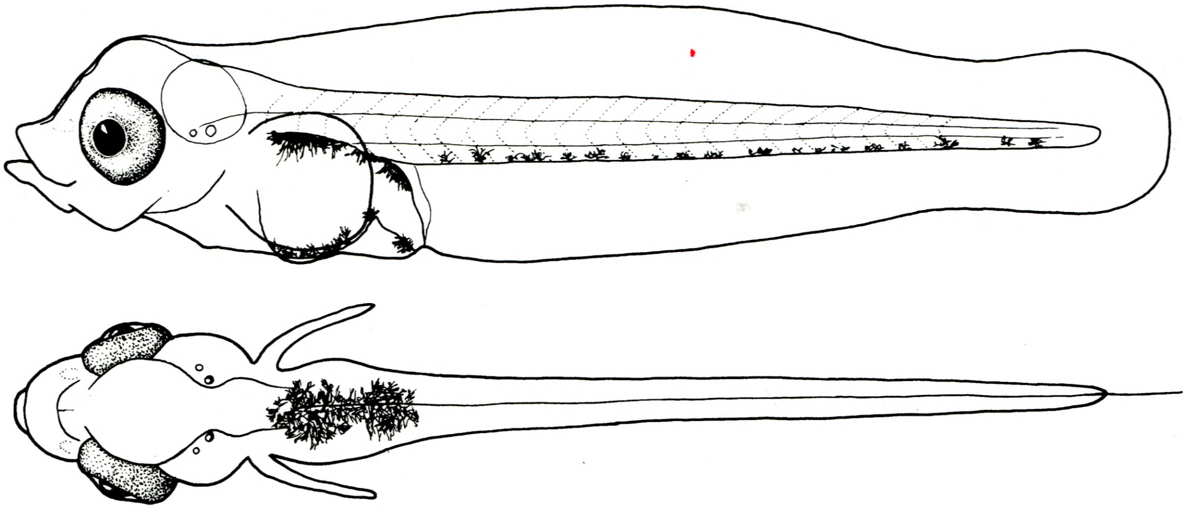


Figure 113

Lithognathus mormyrus at 16 days (15°C), lateral and dorsal views. NL (alive) = 3.7 mm, NL (fixed) = 3.4 mm . Myomeres: 7 + 18 = 25

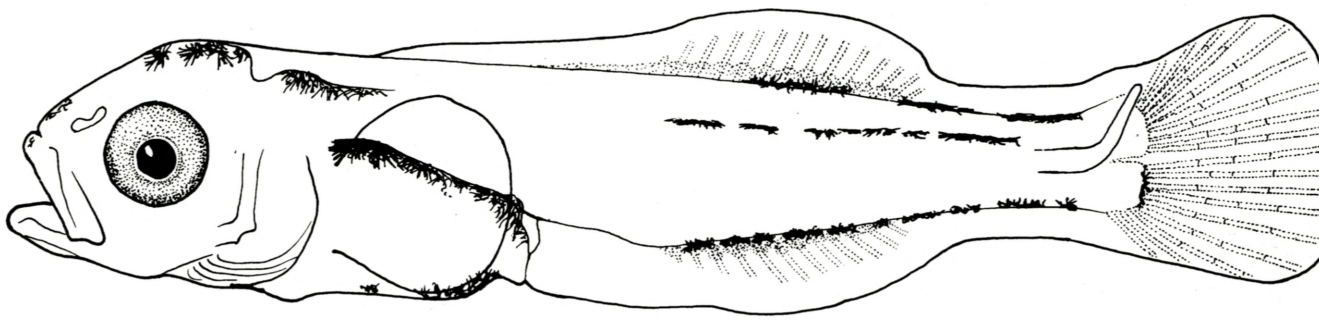


Figure 114

Lithognathus mormyrus at 32 days (15°C). SL (alive) = 7.5 mm, SL (fixed) = 7.0 mm . Fin elements have not yet reached definitive counts

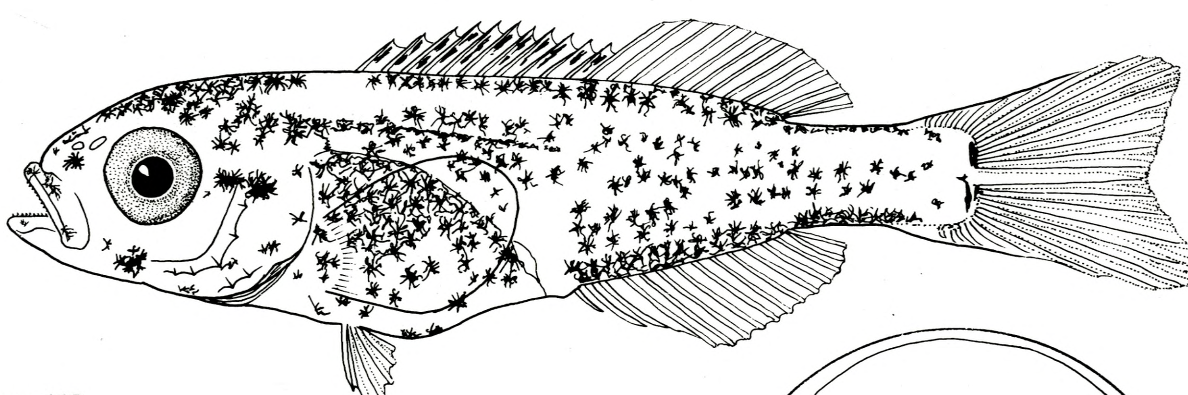


Figure 115

Lithognathus mormyrus at 56 days (15°C). SL (alive) = 13.1 mm, SL (fixed) = 11.7 mm . D XI,12; A III,11; P 16

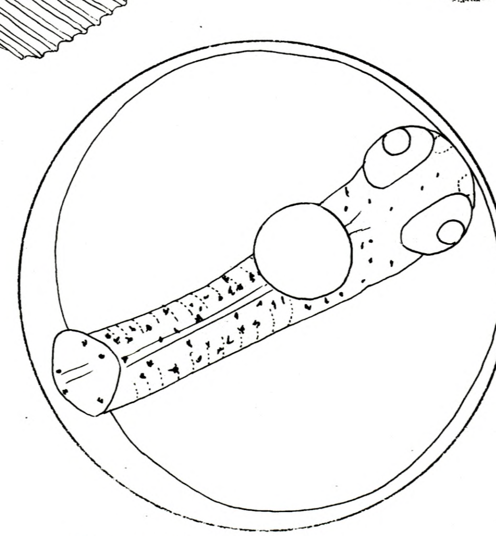


Figure 116

Pachymetopon blochi egg. 1.28 mm in diameter, oil globule 0.24 mm

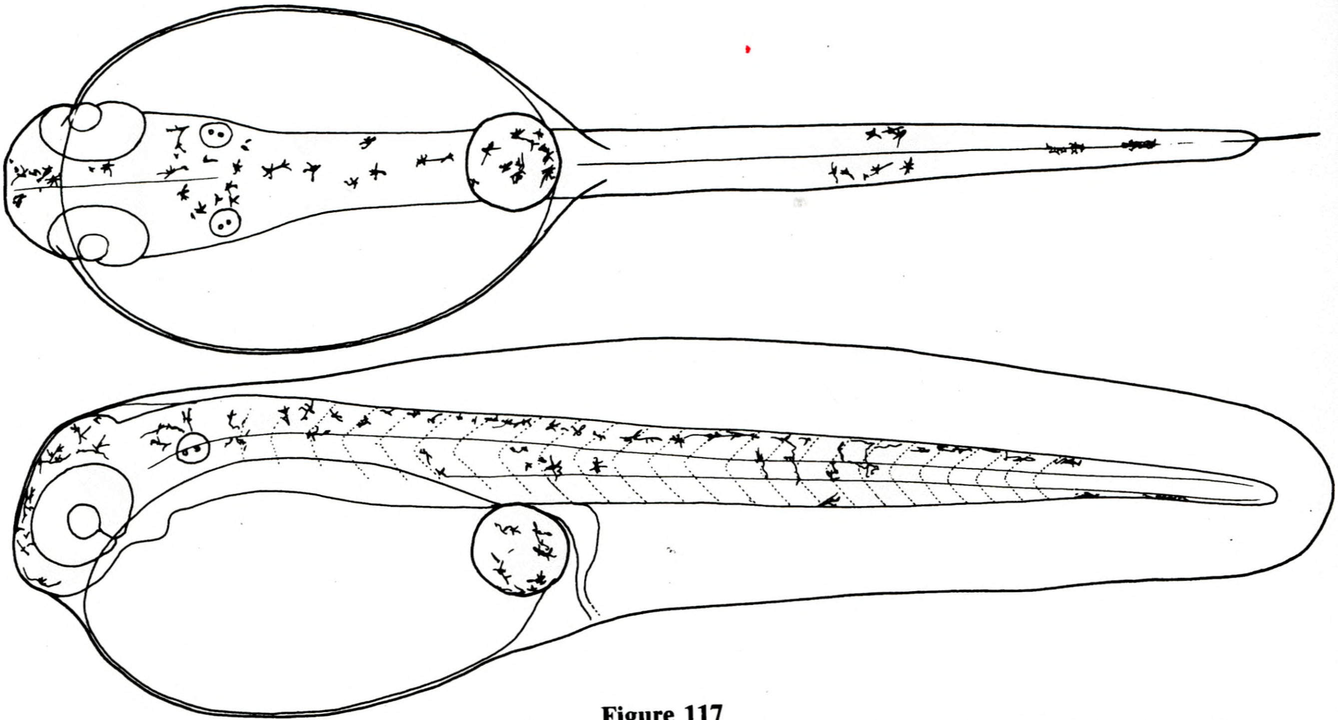


Figure 117

Pachymetopon blochi soon after hatching, lateral and ventral views. NL (alive) = 3.0 mm, NL (fixed) = 2.6 mm . Myomeres: 10 + ca. 15

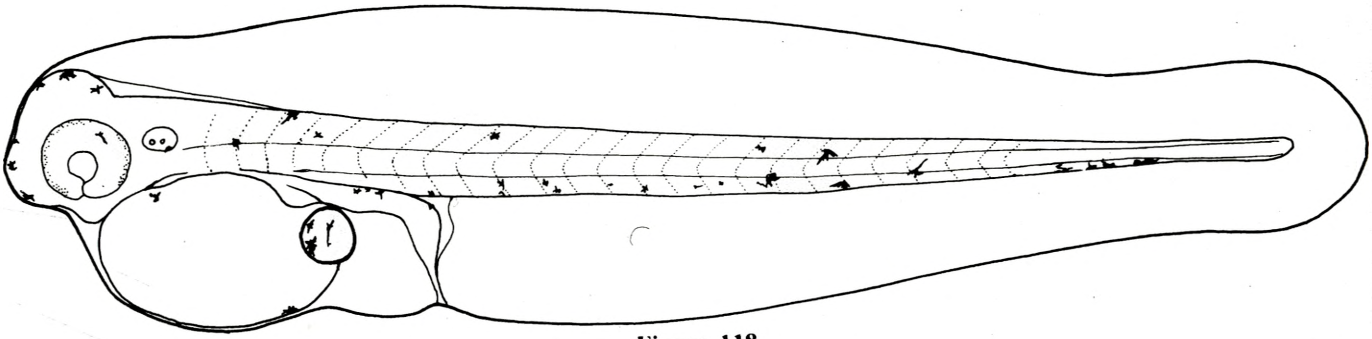


Figure 118

Pachymetopon blochi at 2 days (15°C). NL (alive) = 3.8 mm, NL (fixed) = 3.4 mm . Myomeres: 9 + 18 = 27

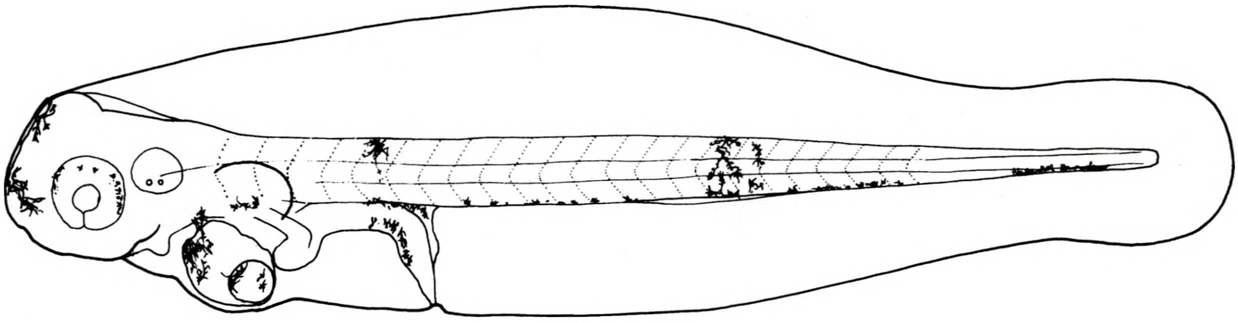


Figure 119

Pachymetopon blochi at 4 days (15°C). NL (alive) = 3.6 mm, NL (fixed) = 3.1 mm . Myomeres: 8 + 18 = 26

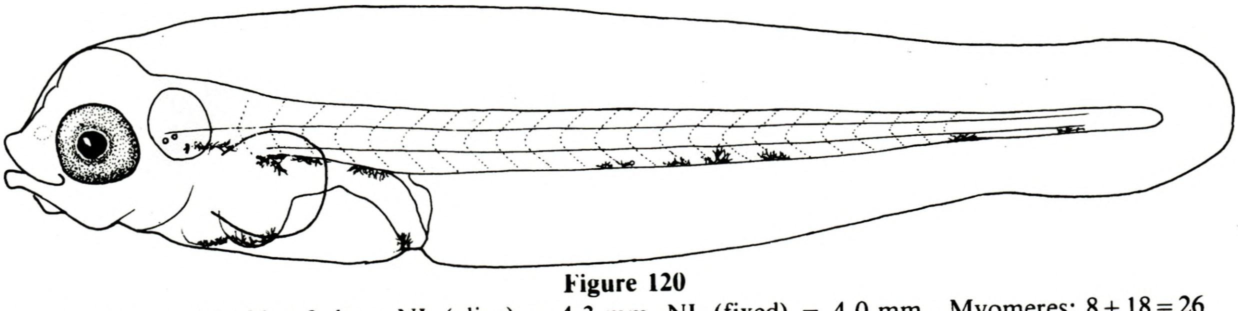
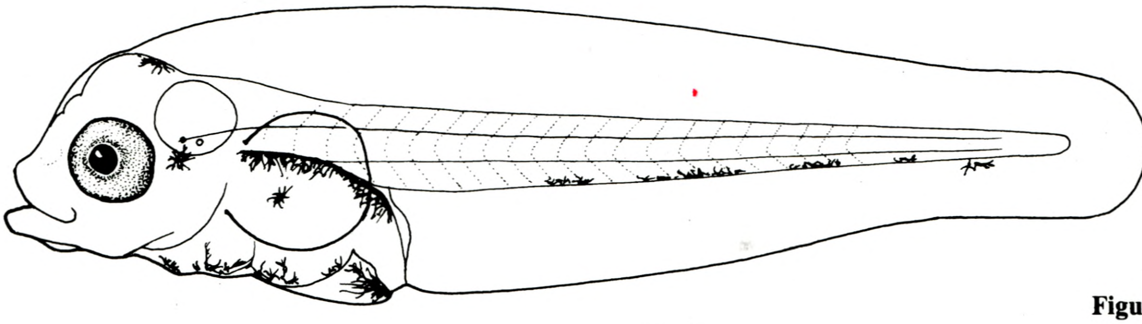


Figure 120

Pachymetopon blochi at 8 days. NL (alive) = 4.3 mm, NL (fixed) = 4.0 mm . Myomeres: 8 + 18 = 26



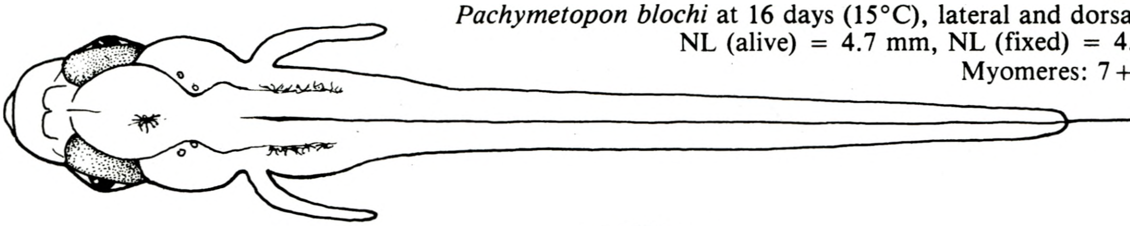


Figure 121
Pachymetopon blochi at 16 days (15°C), lateral and dorsal views.
NL (alive) = 4.7 mm, NL (fixed) = 4.4 mm .
Myomeres: 7 + 18 = 25

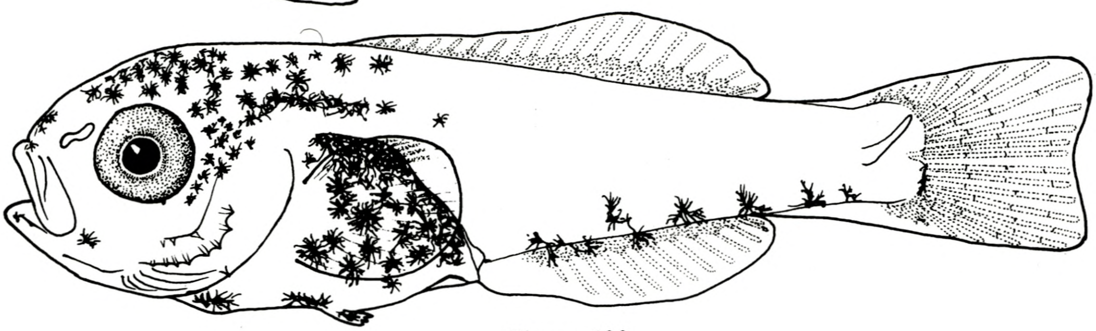


Figure 122
Pachymetopon blochi at 32 days (15°C). SL (alive) = 10.3 mm, SL (fixed) = 9.6 mm . Fin elements have not yet reached definitive counts

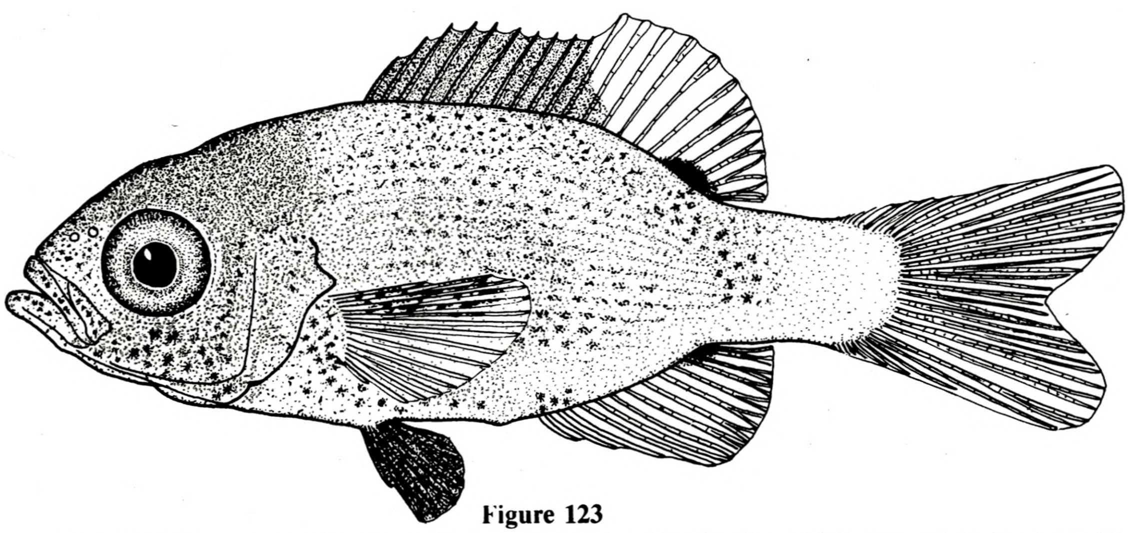


Figure 123
Pachymetopon blochi at 81 days (15°C). SL (alive) = 22.2 mm, SL (fixed) = 20.7 mm . D X,12; A III,10; P 16

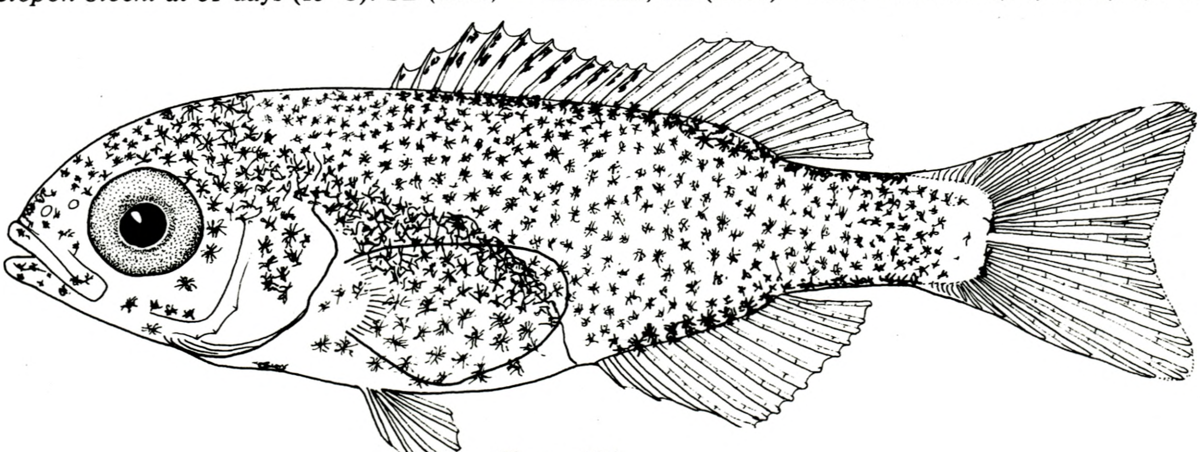
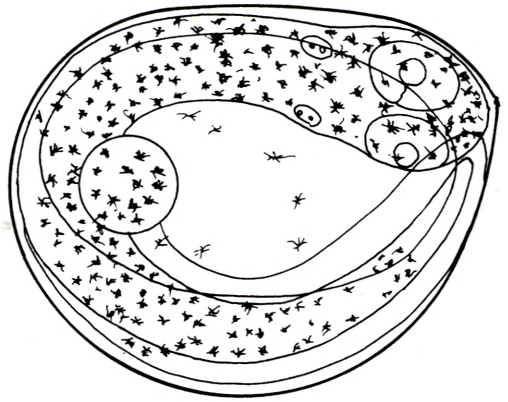
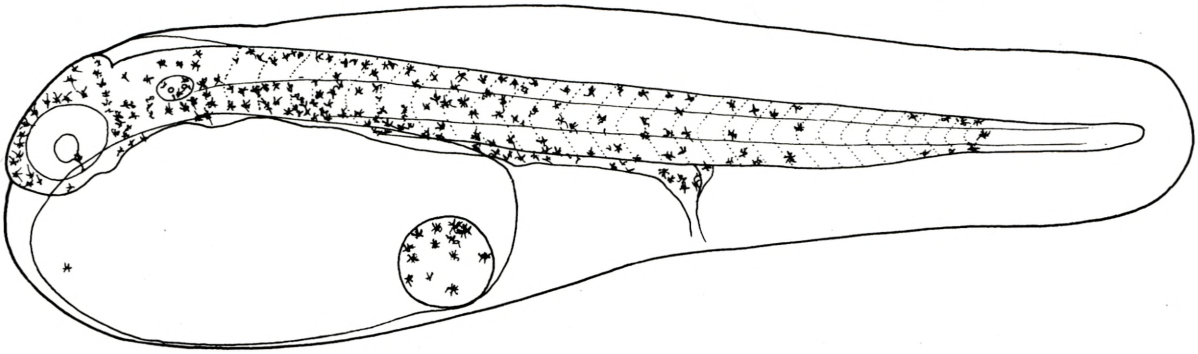


Figure 124
Sparodon durbanensis collected in a False Bay (St. James) tide pool on 6 March 1978. SL (alive) = 13.3 mm, SL (fixed) = 12.4 mm . D XI,12; A III,10; P 15

Figure 125

Liza richardsoni egg in process of hatching. Diameter when spherical was 1.28 mm, oil globule 0.28 mm





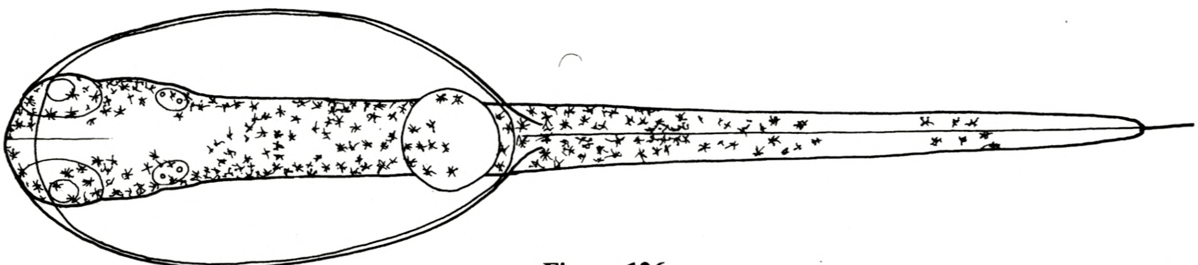


Figure 126

Liza richardsoni soon after hatching, lateral and ventral views. NL (alive) = 3.2 mm, NL (fixed) = 2.7 mm . Myomeres: 17 + 13 = 30

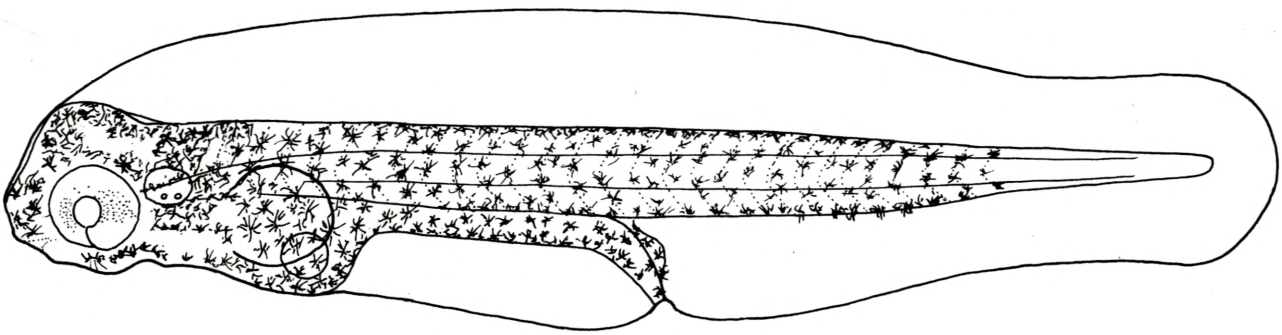


Figure 127

Liza richardsoni at 4 days (15°C). NL (alive) = 4.2 mm, NL (fixed) = 3.8 mm . Myomeres: 16 + 13 = 29

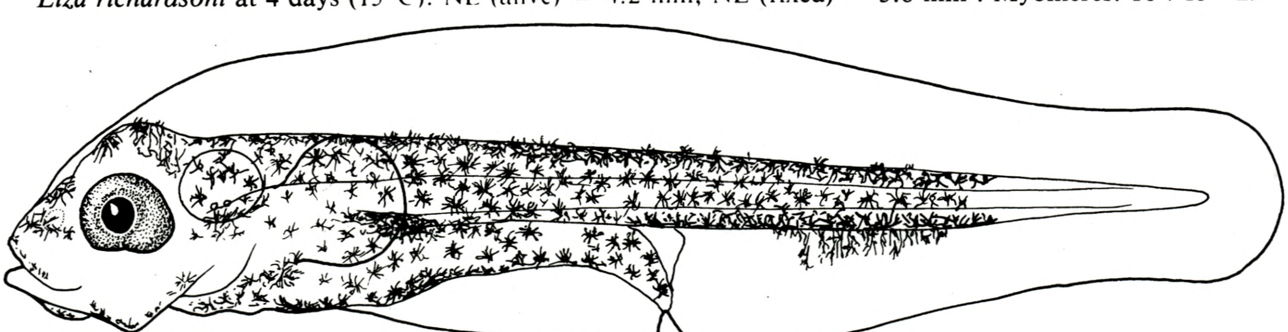


Figure 128

Liza richardsoni at 8 days (15°C). NL (alive) = 4.5 mm, NL (fixed) unavailable, specimen damaged prior to fixing. Myomeres: not visible in live specimen, masked by pigment

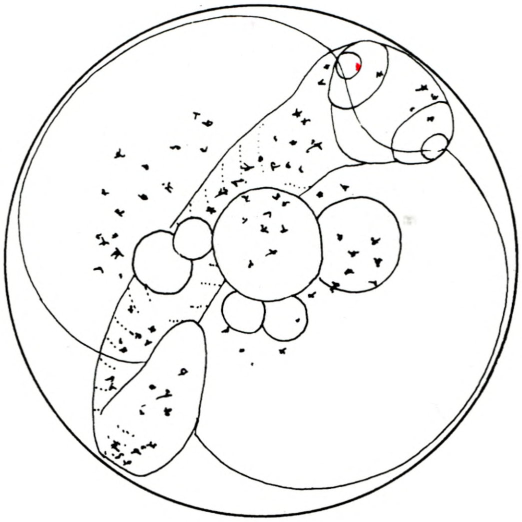


Figure 129
Mugil cephalus egg. 0.98 mm in diameter. The largest oil globule in this egg at time of drawing was 0.22 mm . Coalescence of all the globules would yield a globule of ca. 0.36 mm

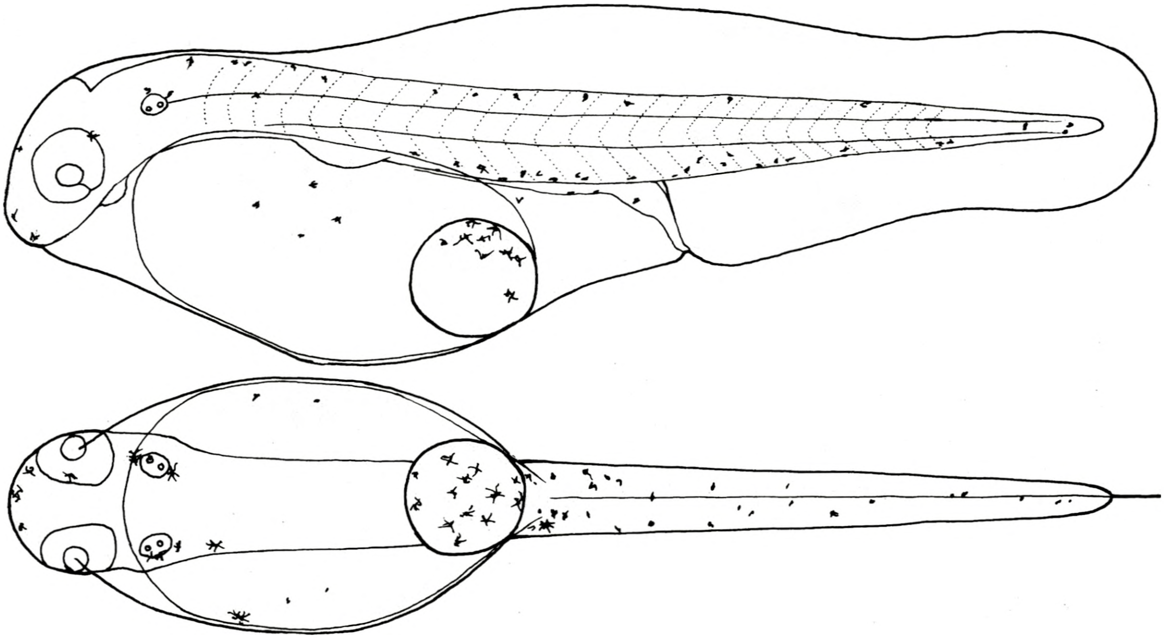


Figure 130
Mugil cephalus soon after hatching, lateral and ventral views. NL (alive) = 2.7 mm, NL (fixed) = 2.3 mm . Myomeres: 16 + 12 = 28

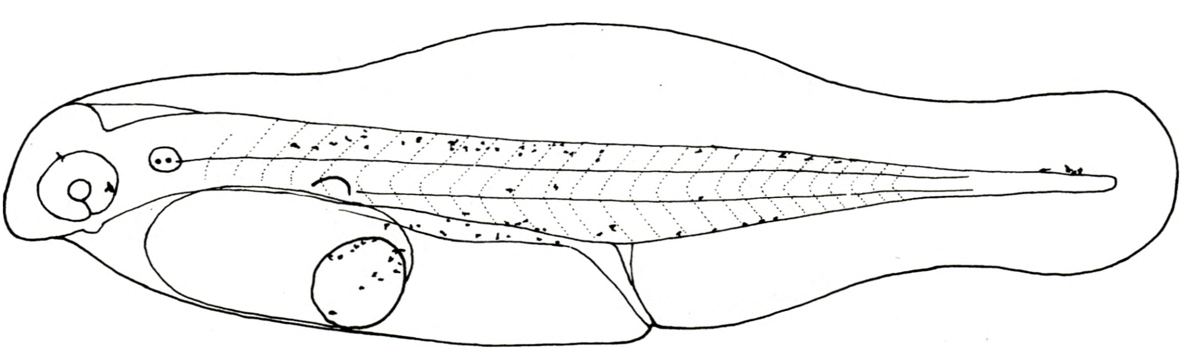


Figure 131
Mugil cephalus at 2 days (15°C). NL (alive) = 3.3 mm, NL (fixed) = 2.8 mm . Myomeres: 16 + 11 = 27

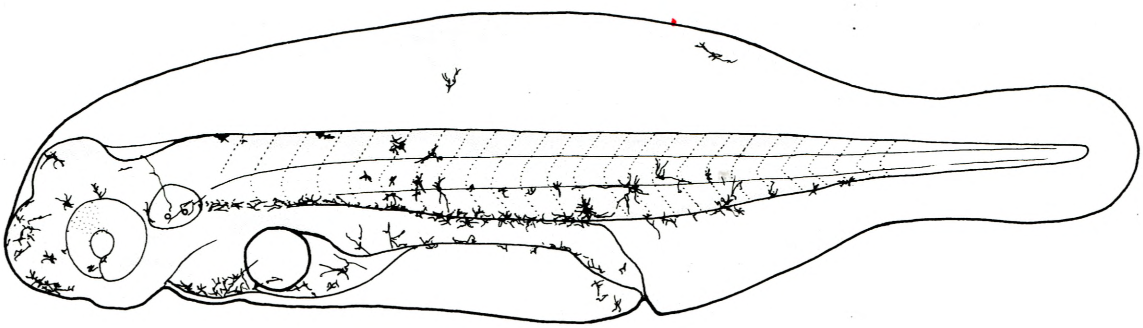


Figure 132
Mugil cephalus at 4 days (15°C). NL (alive) = 3.5 mm, NL (fixed) = 3.2 mm . Myomeres: 15 + 11 = 26

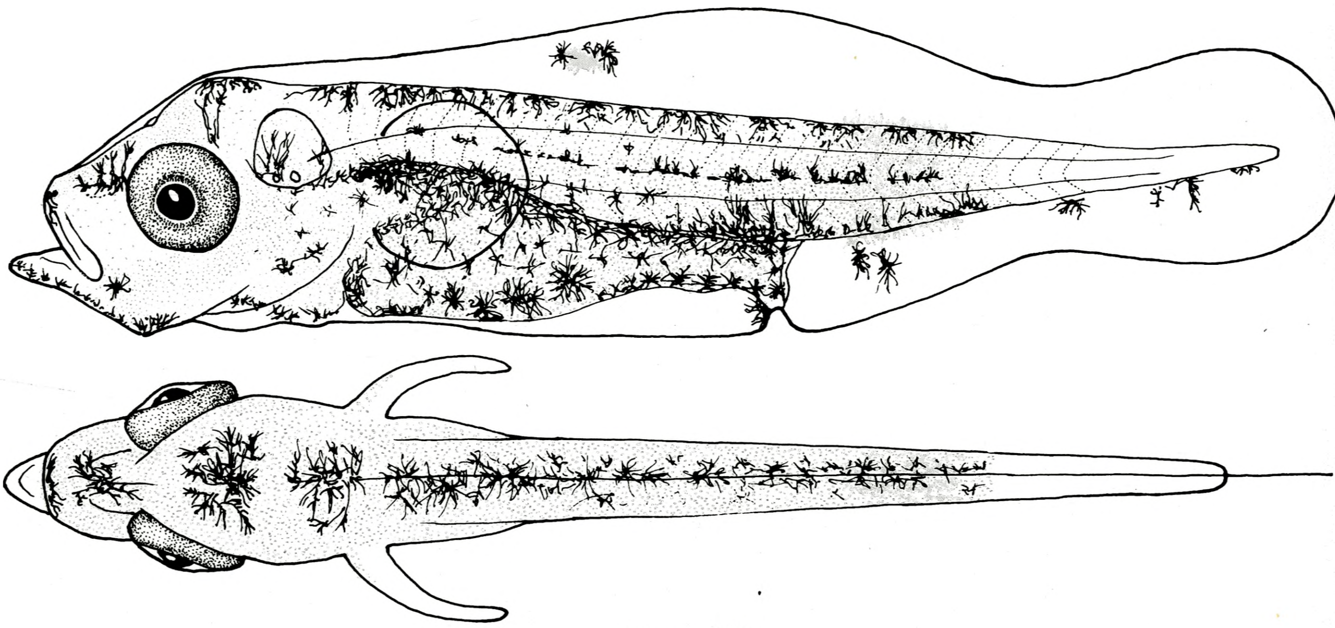


Figure 133
Mugil cephalus at 16 days (15°C), lateral and dorsal views. NL (alive) = 4.6 mm, NL (fixed) = 3.8 mm . Myomeres: 15 + 11 = 26

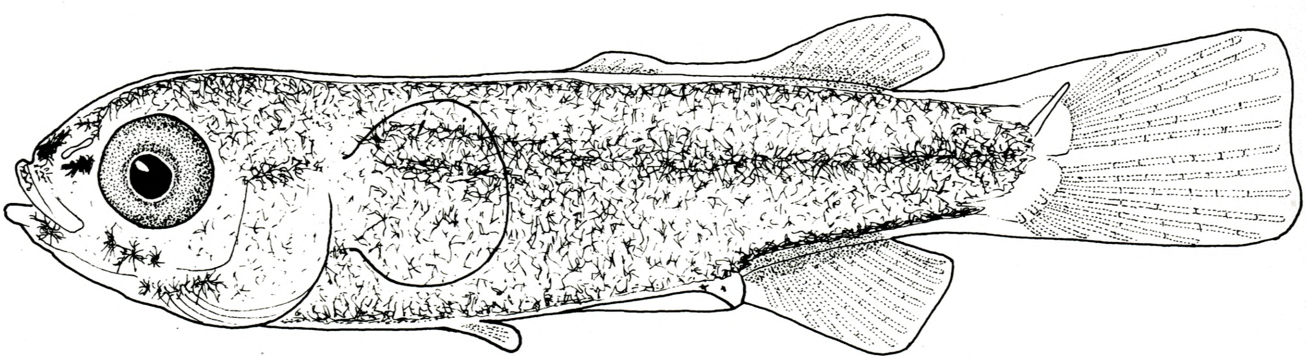
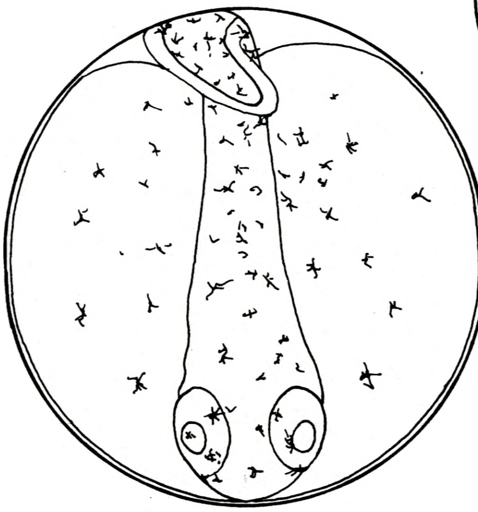


Figure 134
Mugil cephalus at 32 days (15°C). SL (alive) = 8.2 mm, SL (fixed) = 7.6 mm .

Figure 135
Coccotropsis gymnoderma egg.
1.14 mm in diameter



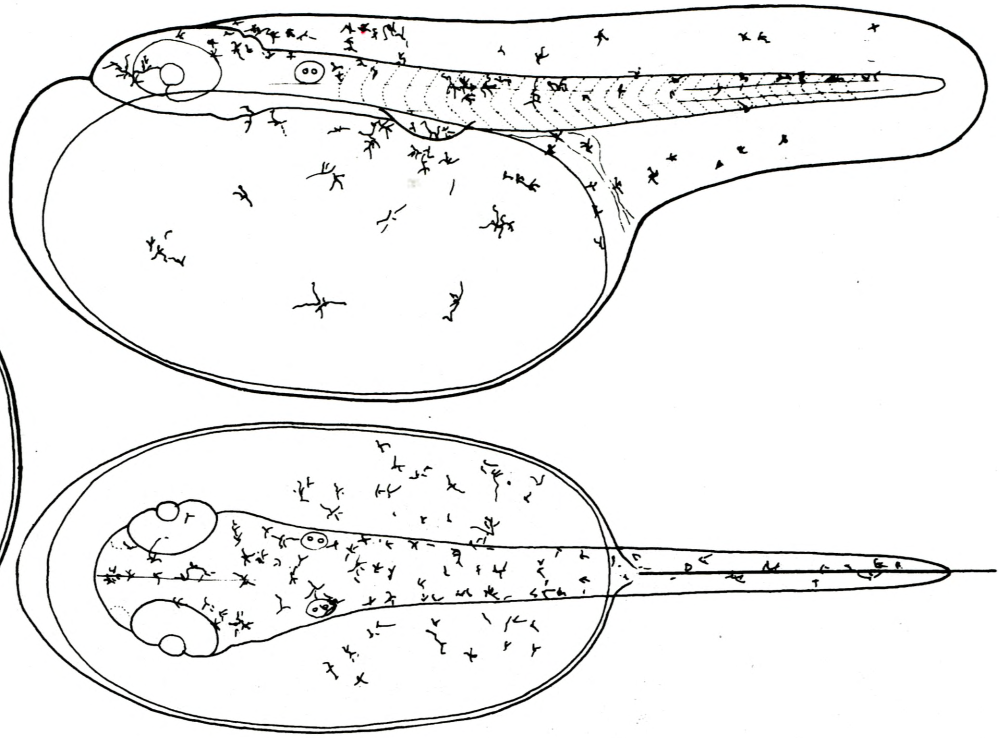


Figure 136
Coccotropsis gymnoderma soon after hatching, lateral and ventral views. NL (alive) = 2.3 mm, NL (fixed) = 2.0 mm . Myomeres: 15 + 15 = 30

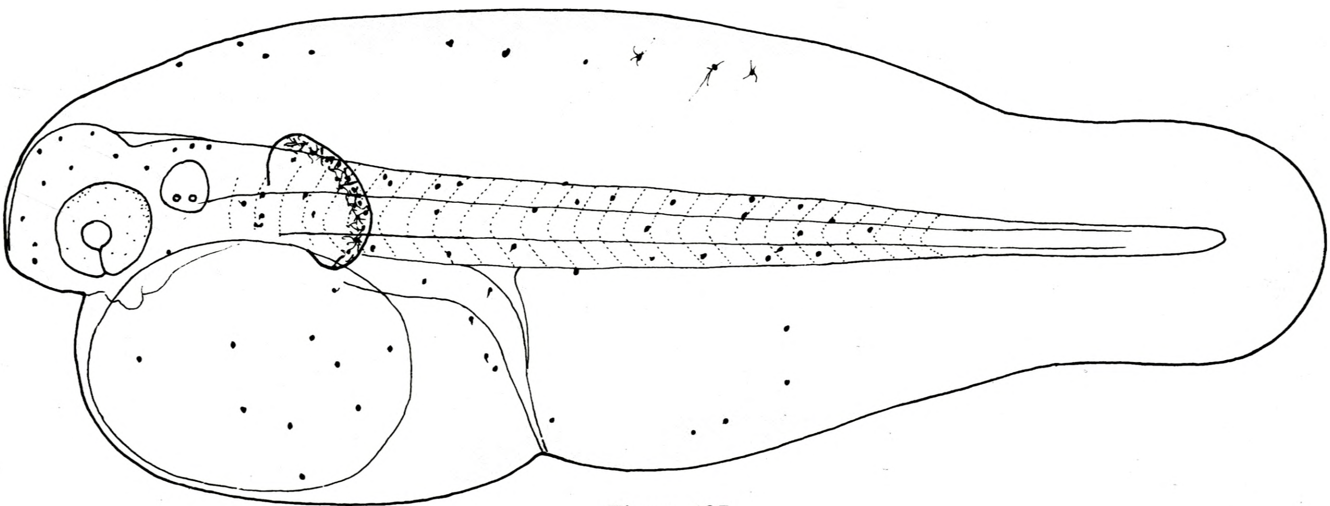


Figure 137
Coccotropsis gymnoderma at 2 days (15°C). NL (alive) = 2.9 mm, NL (fixed) = 2.6 mm . Myomeres: 13 + 16 = 29

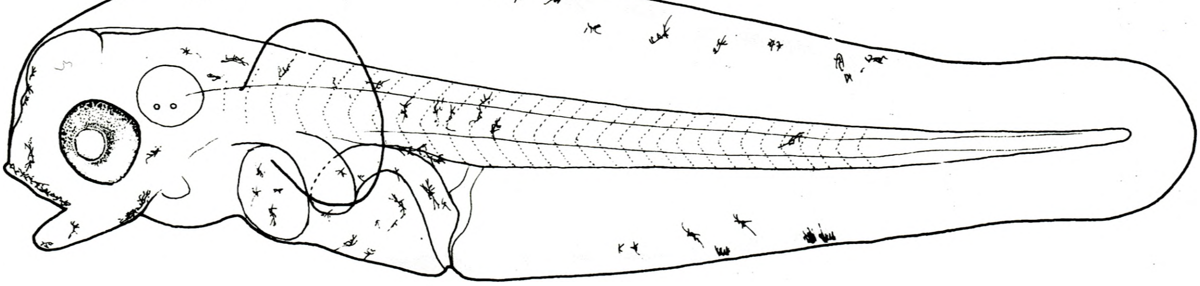


Figure 138
Coccotropsis gymnoderma at 4 days (15°C). NL (alive) = 3.3 mm, NL (fixed) = 3.0 mm . Myomeres: 11 + 20 = 31

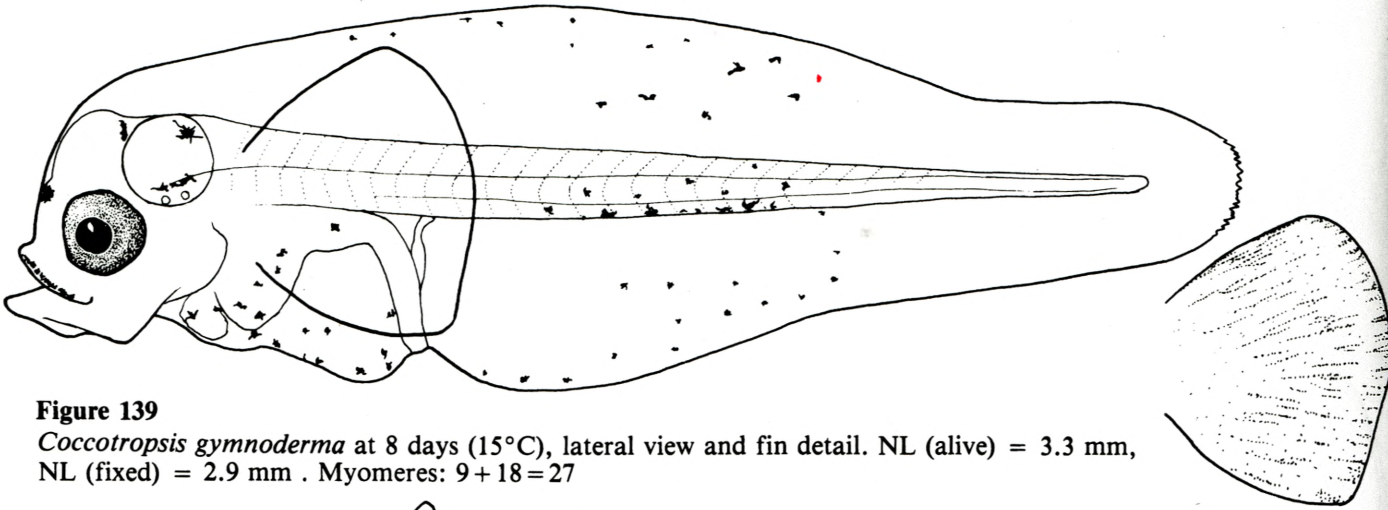


Figure 139
Coccotropsis gymnoderma at 8 days (15°C), lateral view and fin detail. NL (alive) = 3.3 mm, NL (fixed) = 2.9 mm . Myomeres: 9 + 18 = 27

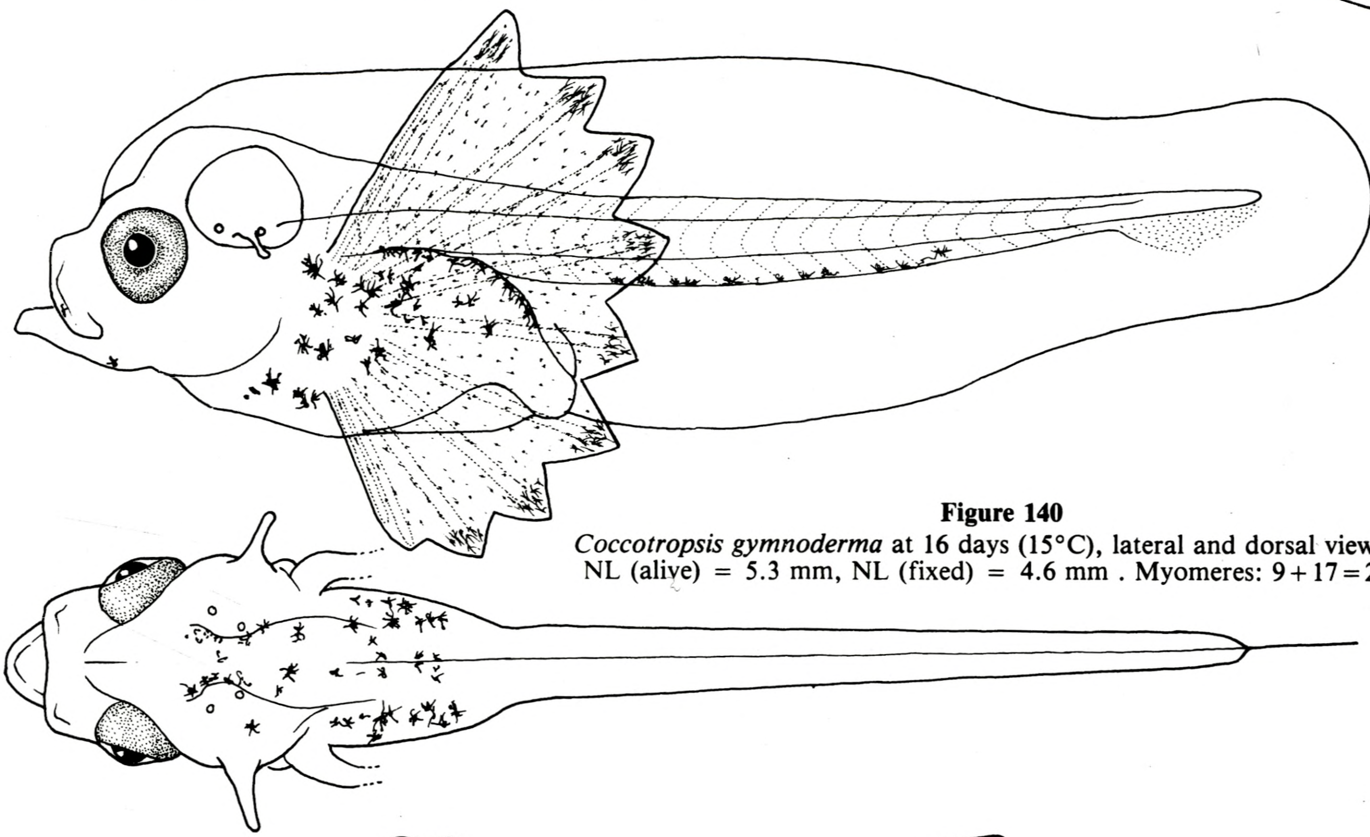


Figure 140
Coccotropsis gymnoderma at 16 days (15°C), lateral and dorsal views. NL (alive) = 5.3 mm, NL (fixed) = 4.6 mm . Myomeres: 9 + 17 = 26

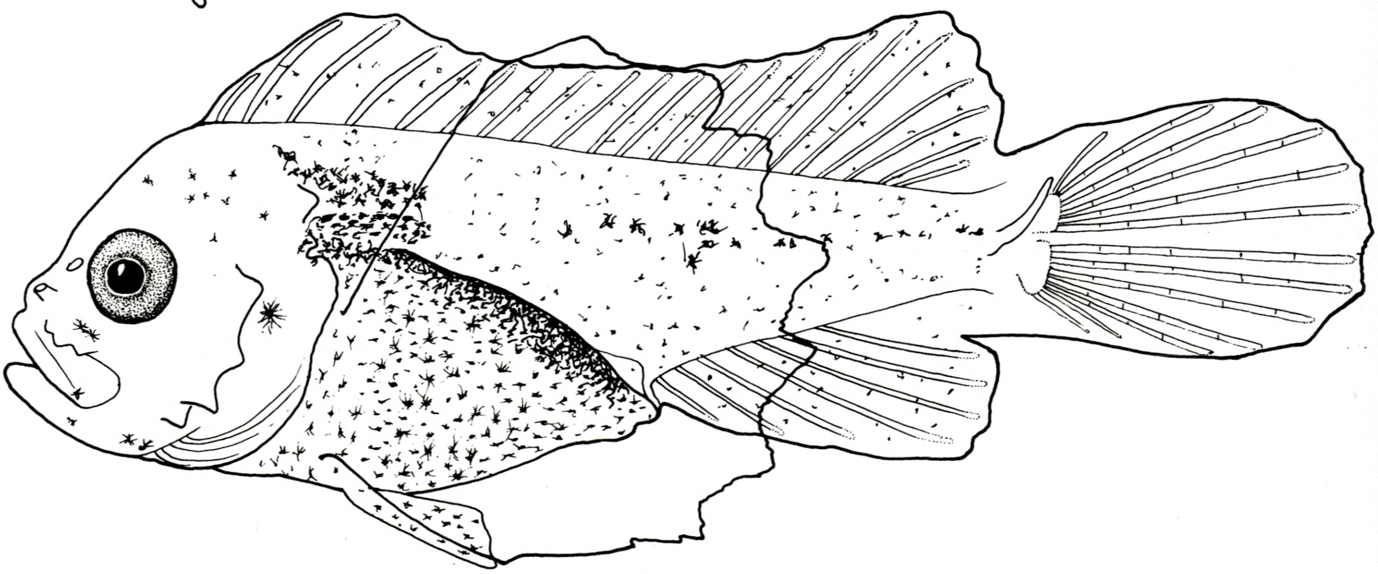
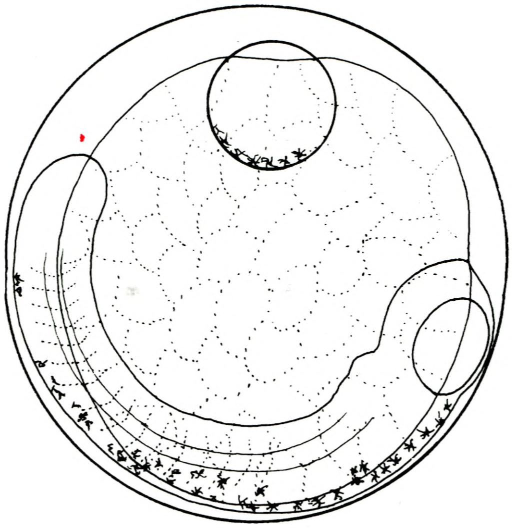


Figure 141
Coccotropsis gymnoderma at 32 days (15°C). SL (alive) = 7.2 mm, SL (fixed) = 6.7 mm . D XV,6; A III,4; P 11

Figure 142
Helicolenus dactylopterus egg. Major axis 0.94 mm, minor axis 0.90 mm, oil globule 0.24 mm



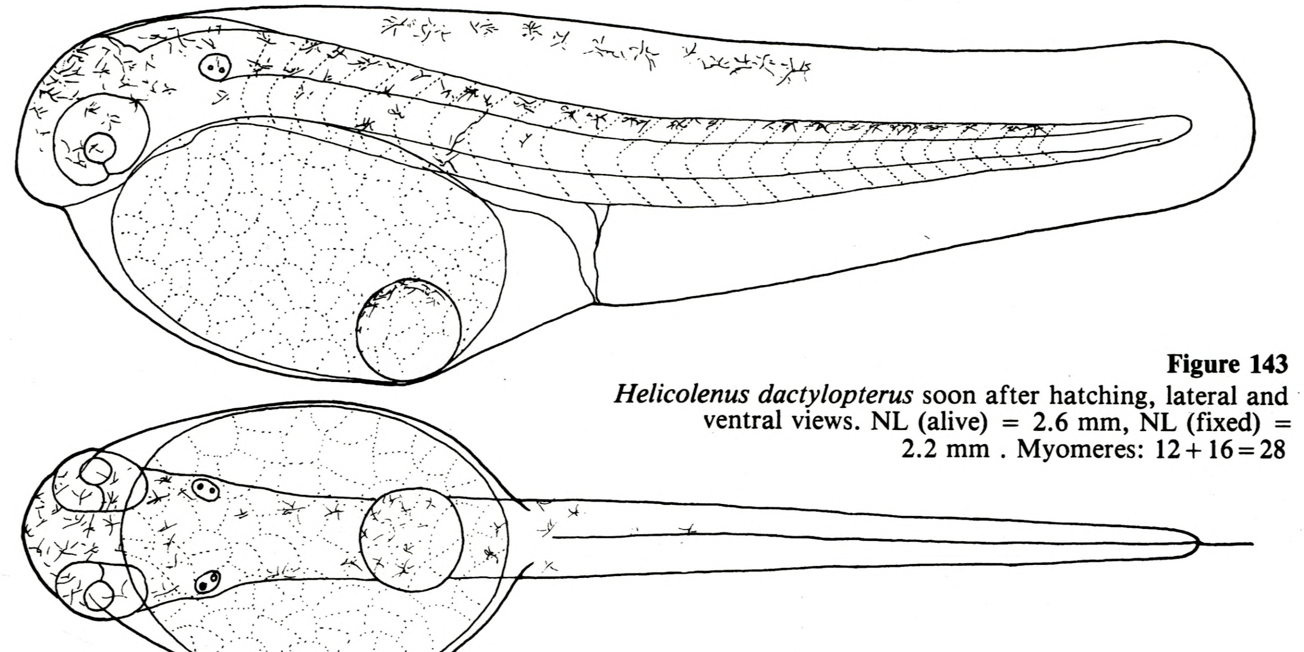


Figure 143
Helicolenus dactylopterus soon after hatching, lateral and ventral views. NL (alive) = 2.6 mm, NL (fixed) = 2.2 mm . Myomeres: 12 + 16 = 28

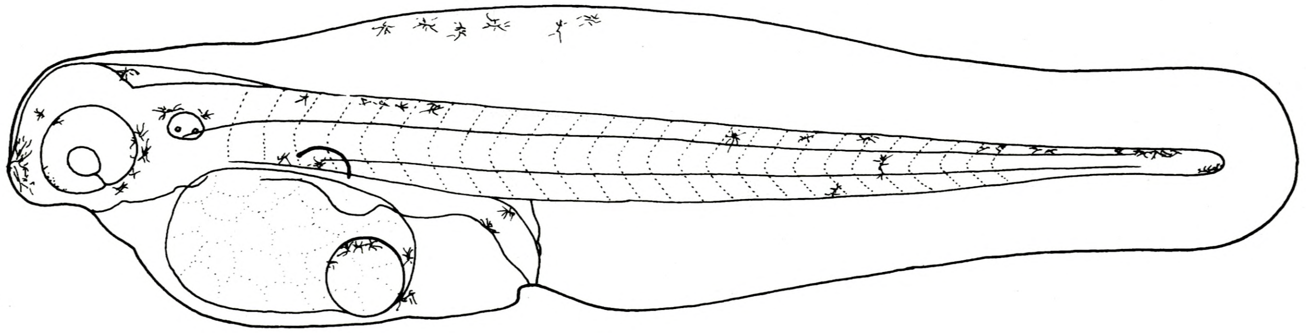


Figure 144
Helicolenus dactylopterus at 2 days (15°C). NL (alive) = 3.2 mm, NL (fixed) = 2.9 mm . Myomeres: 10 + 18 = 28

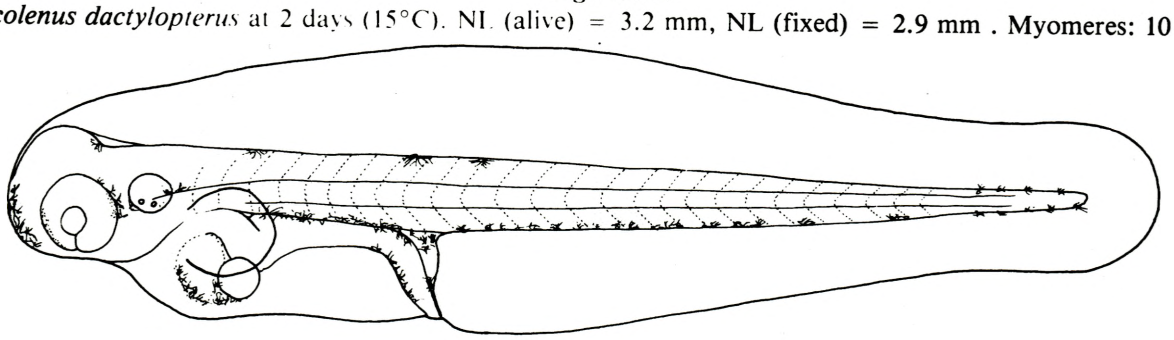


Figure 145
Helicolenus dactylopterus at 4 days (15°C). NL (alive) = 3.5 mm, NL (fixed) = 3.2 mm . Myomeres: 10 + 17 = 27

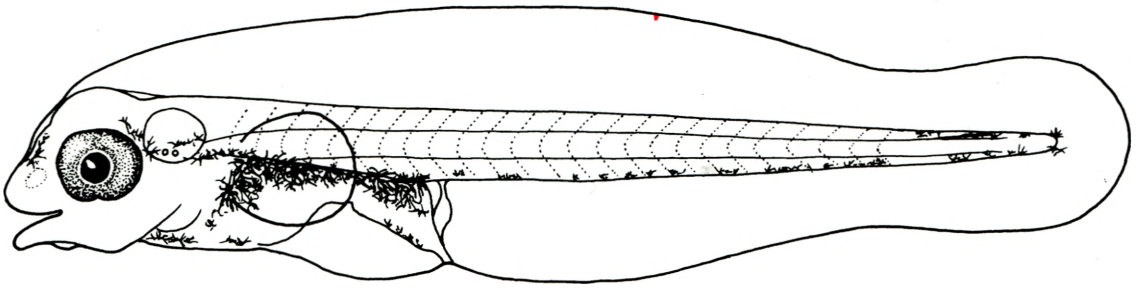


Figure 146
Helicolenus dactylopterus at 8 days (15°C). NL (alive) = 3.8 mm, NL (fixed) = 3.3 mm . Myomeres: 9 + 17 = 26

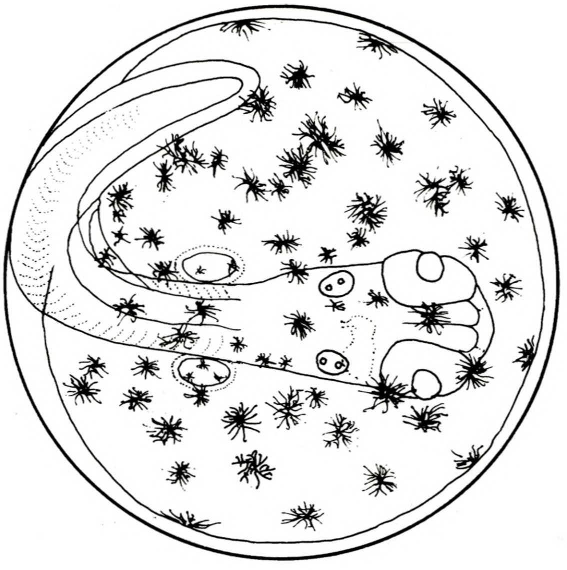


Figure 147
Congiopodus spinifer egg. 1.82 mm in diameter

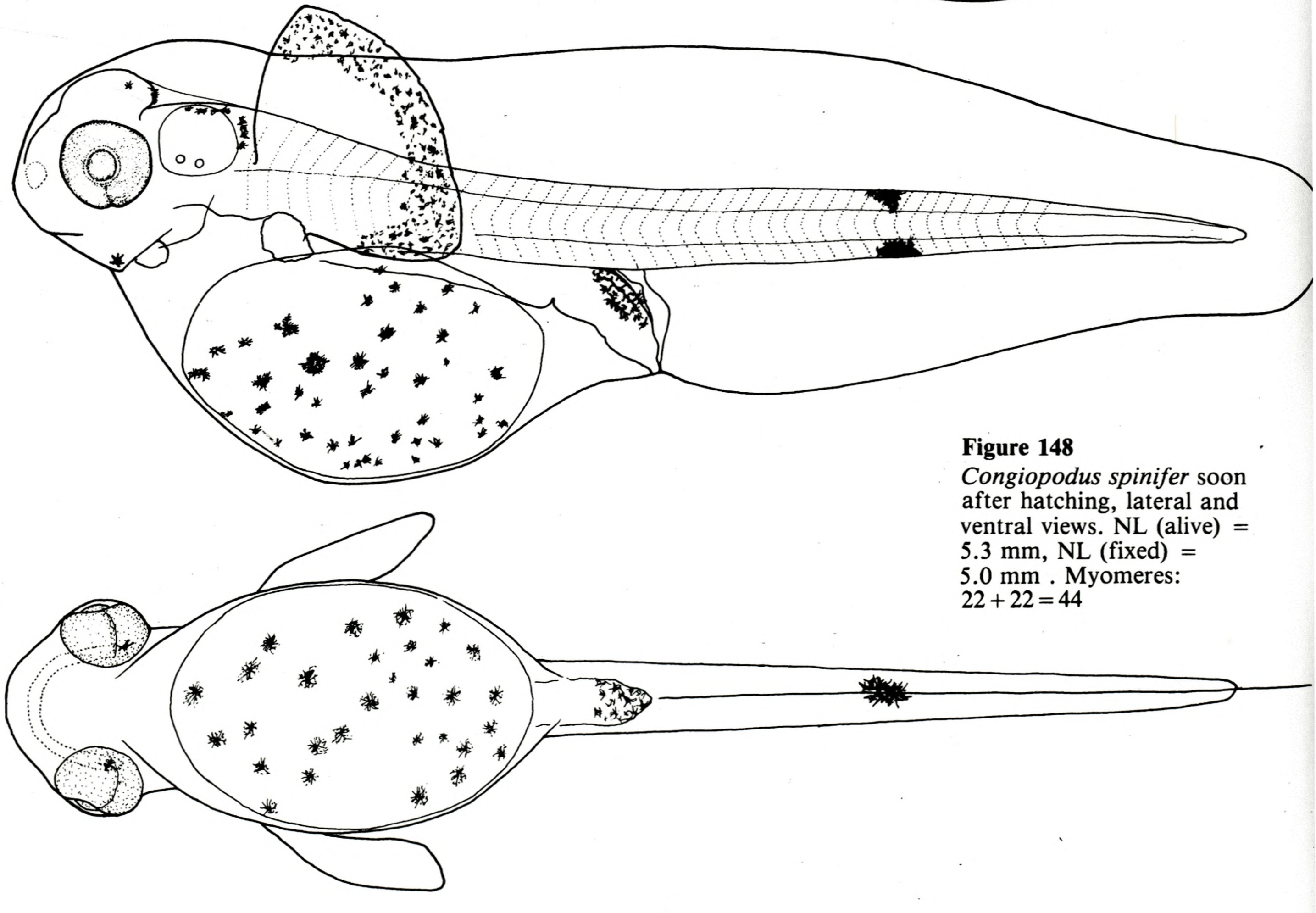
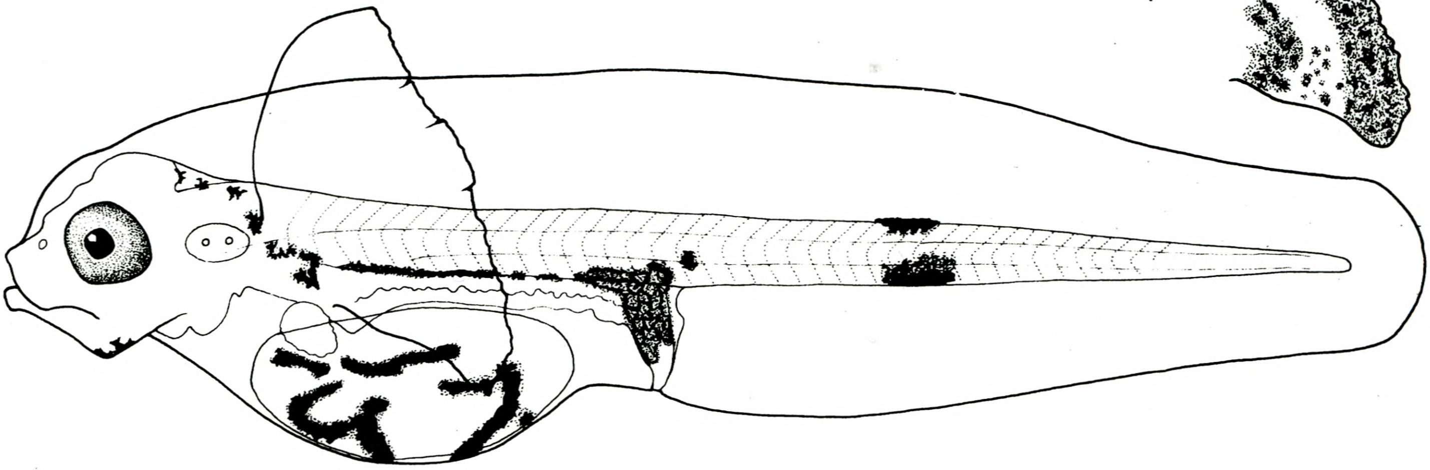


Figure 148
Congiopodus spinifer soon after hatching, lateral and ventral views. NL (alive) = 5.3 mm, NL (fixed) = 5.0 mm . Myomeres: 22 + 22 = 44

Figure 149
Congiopodus spinifer at 24 hours, lateral view and fin detail.
NL (alive) = 5.2 mm, NL (fixed) = 4.9 mm .
Myomeres: 18 + 24 = 42



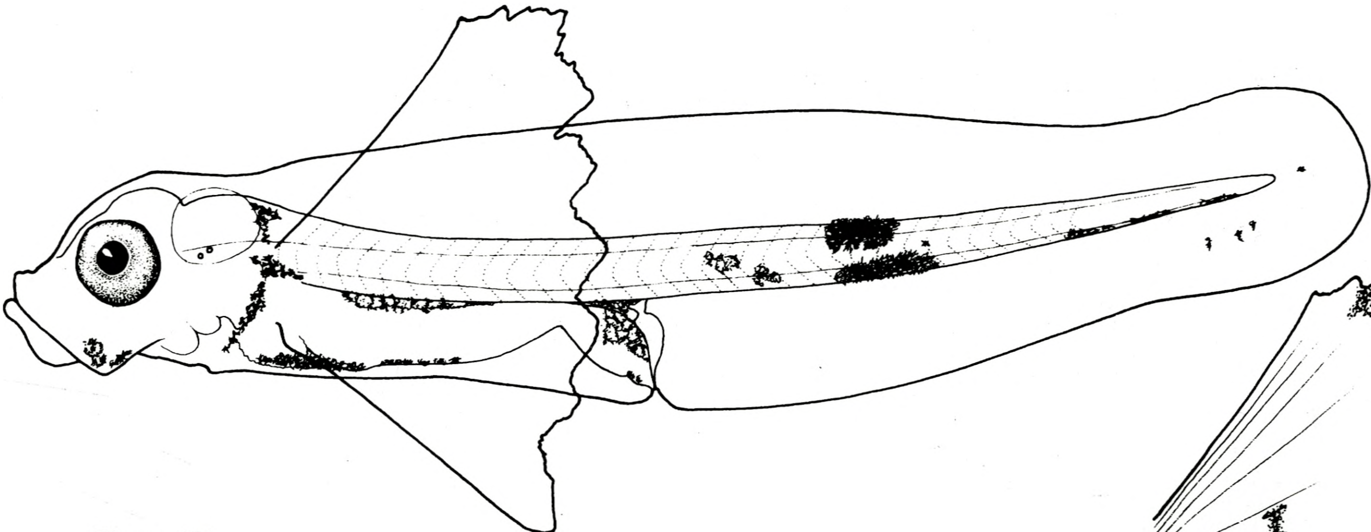
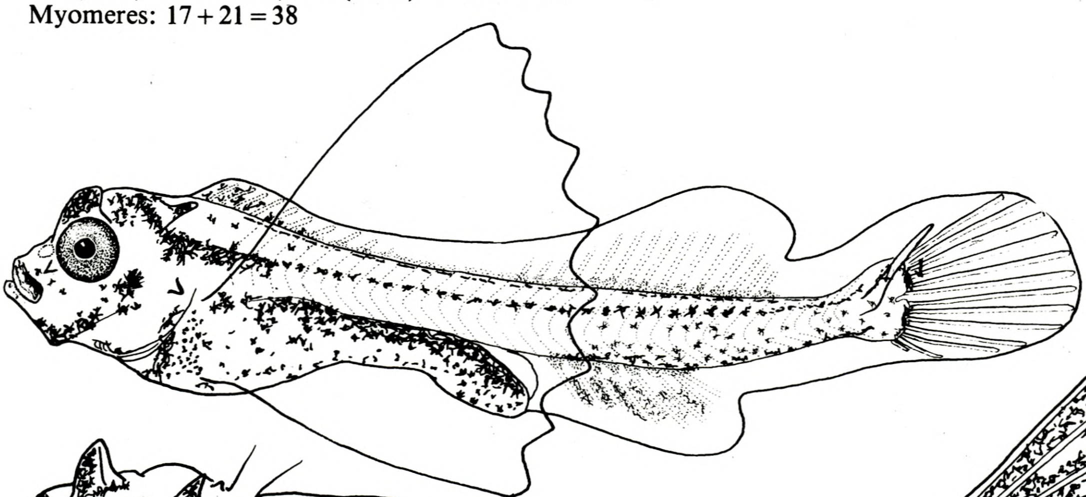


Figure 150
Congiopodus spinifer at 8 days (15°C), lateral view and fin detail.
NL (alive) = 6.1 mm, NL (fixed) = 5.8 mm .
Myomeres: 17 + 21 = 38



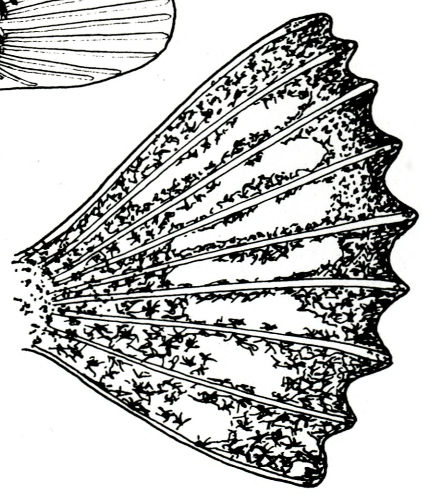


Figure 151
Congiopodus spinifer at 32 days (15°C), lateral view of larva, dorsal view of head, and pectoral fin detail. SL (alive) = 12.4 mm, SL (fixed) = 10.8 mm . Myomeres: 18 + 18 = 36

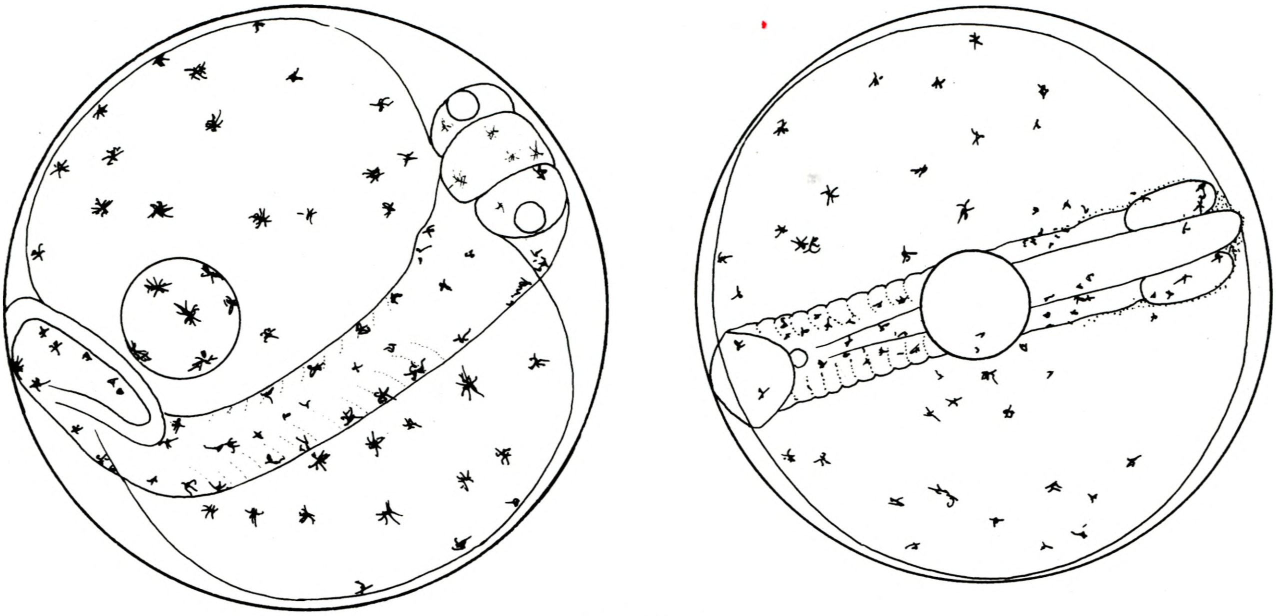


Figure 152

Two eggs of *Trigla ?capensis*. More advanced egg (left): 1.25 mm in diameter, oil globule 0.25 mm . Less developed egg (right): 1.33 mm in diameter, oil globule 0.25 mm

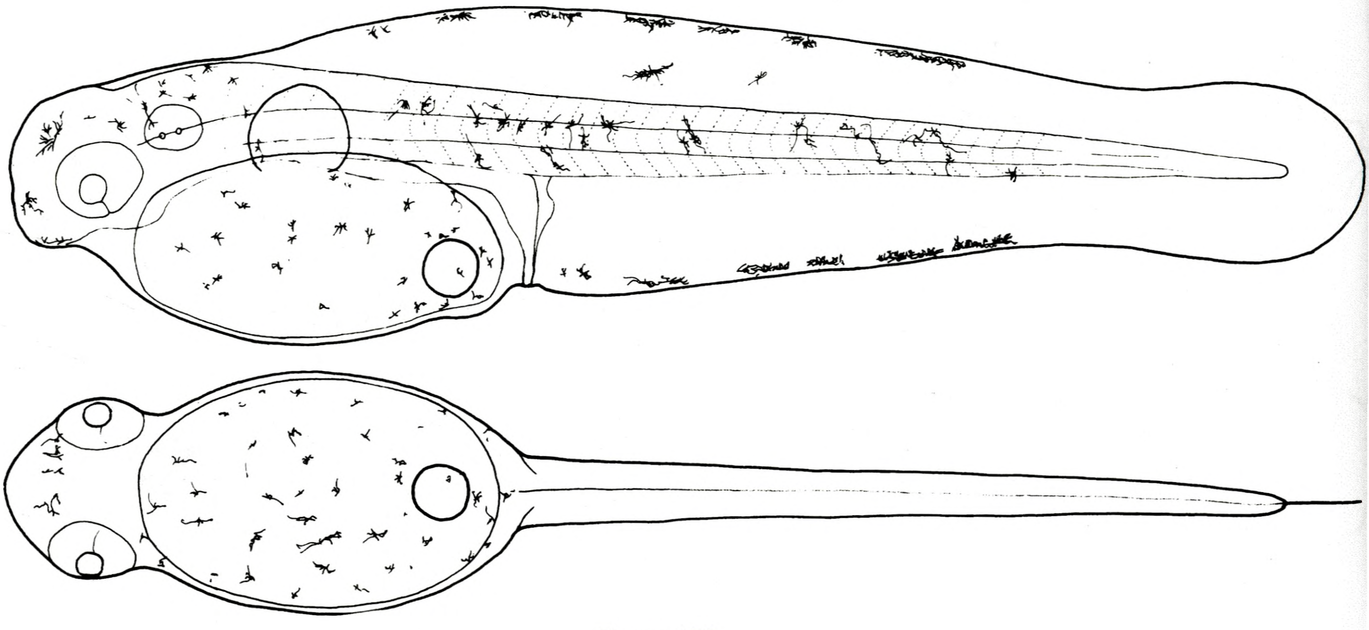


Figure 153

Trigla ?capensis soon after hatching, lateral and ventral views. NL (alive) = 3.7 mm, NL (fixed) = 3.6 mm . Myomeres: 13 + 23 = 36

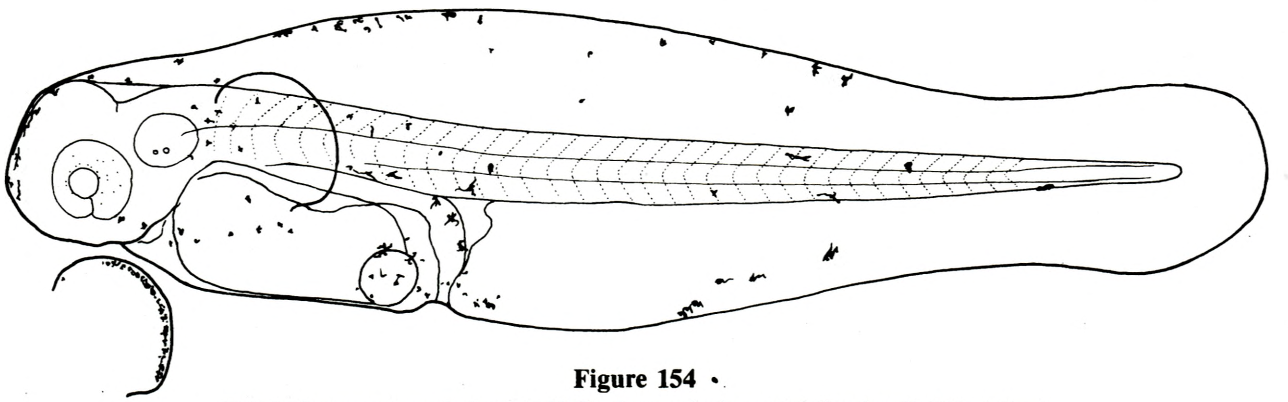


Figure 154

Trigla ?capensis at 2 days (15°C). Lateral view and fin detail. NL (alive) = 4.0 mm, NL (fixed) = 3.5 mm . Myomeres: 11 + 25 = 36

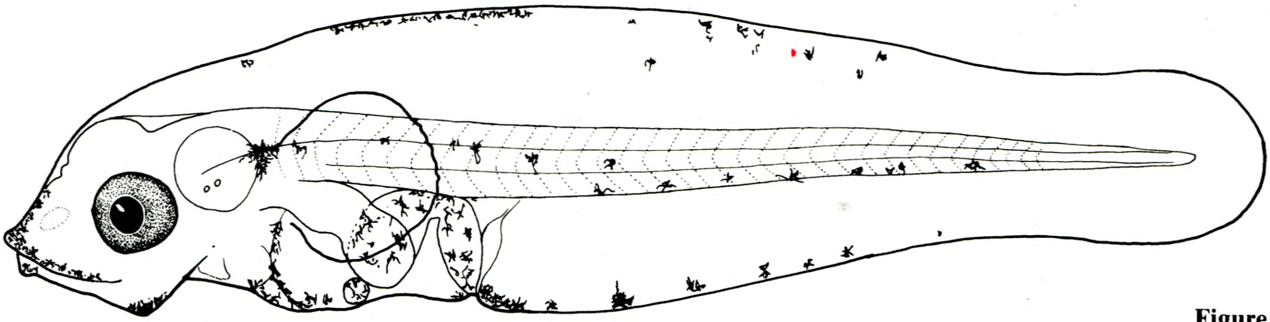
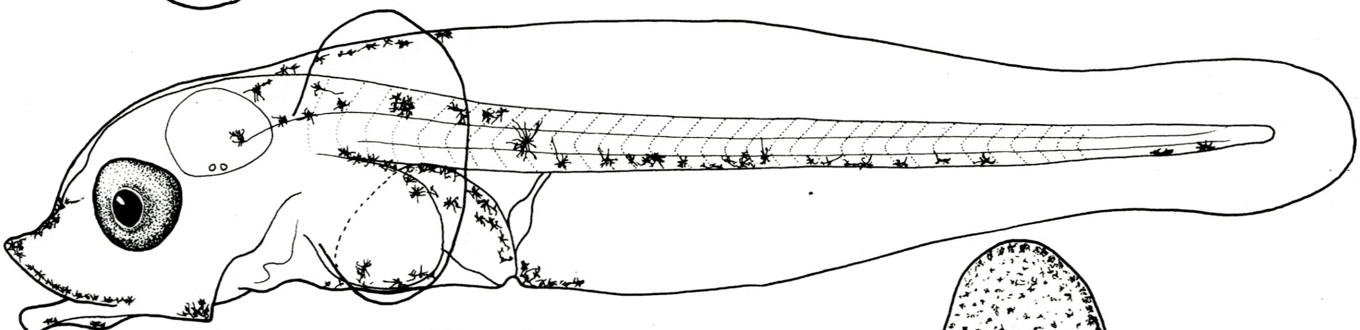


Figure 155
Trigla ?capensis at 4 days (15°C), lateral view and fin detail.
NL (alive) = 4.3 mm, NL (fixed) = 4.1 mm .
Myomeres: 9 + 26 = 35



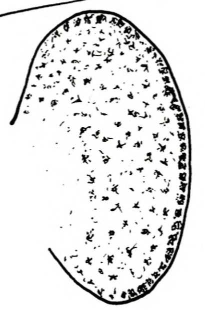
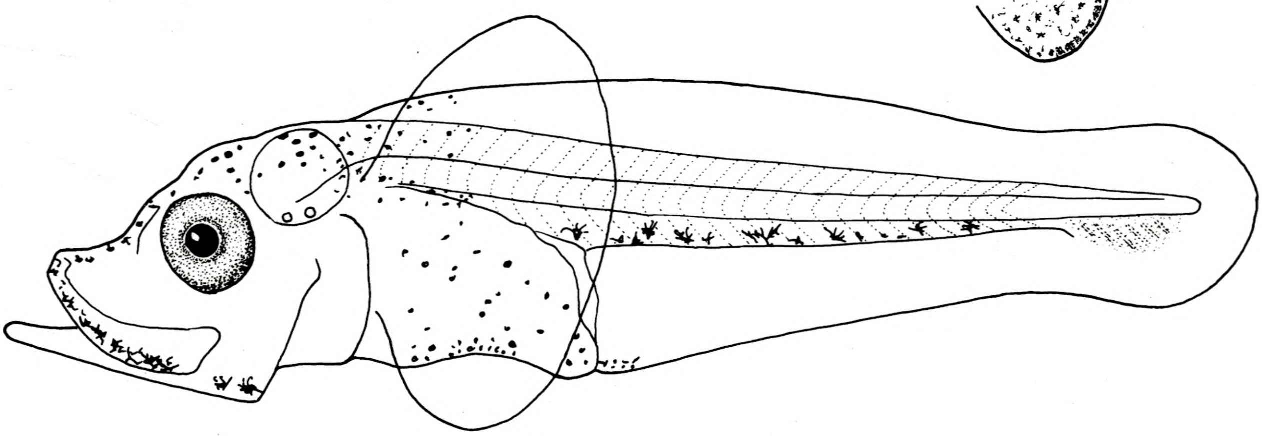
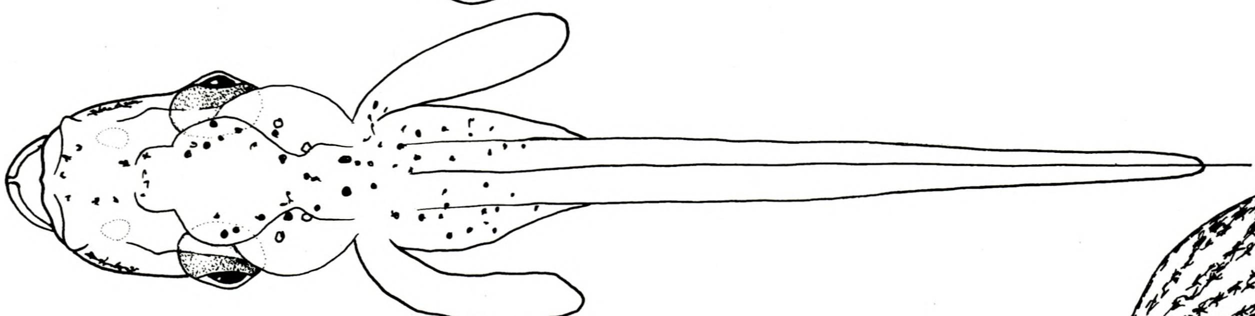


Figure 156
Trigla ?capensis at 8 days (15°C), lateral view and fin detail.
NL (alive) = 4.4 mm, NL (fixed) = 4.2 mm .
Myomeres: 9 + 24 = 33





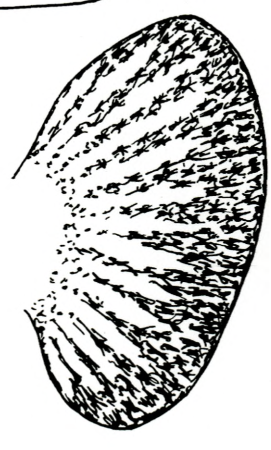


Figure 157
Trigla ?capensis at 16 days (15°C), lateral and dorsal views and fin detail. NL (alive) = 7.1 mm, NL (fixed) = 6.2 mm .
Myomeres: 11 + 21 = 32

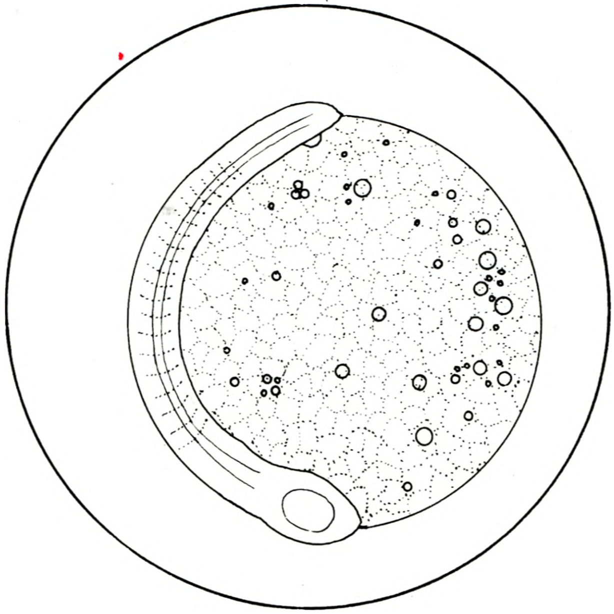
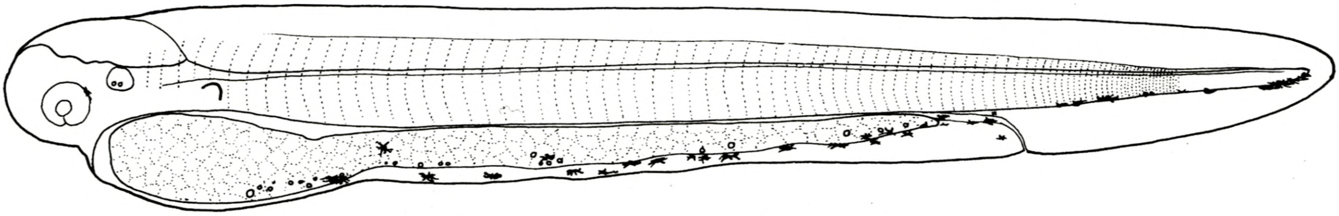


Figure 158
Leptocephalus Species 1 egg. 2.63 mm in diameter, yolk diameter 1.80 mm

Figure 159
Leptocephalus Species 1 soon after hatching. NL (alive) = 8.4 mm, NL (fixed) = 7.6 mm . Myomeres: 60 + ca. 50



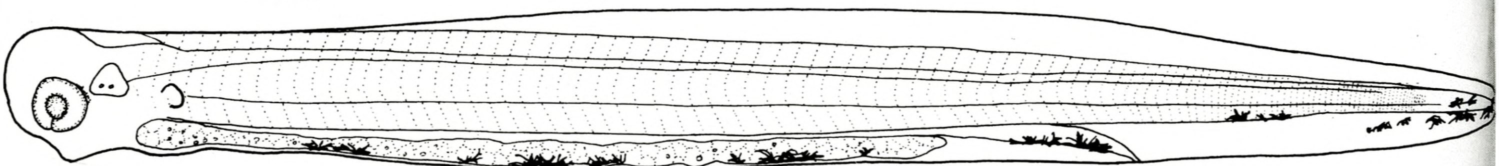


Figure 160
Leptocephalus Species 1 at 4 days (15°C). NL (alive) = 9.4 mm, NL (fixed) = 8.5 mm . Myomeres: 59 + ca. 50

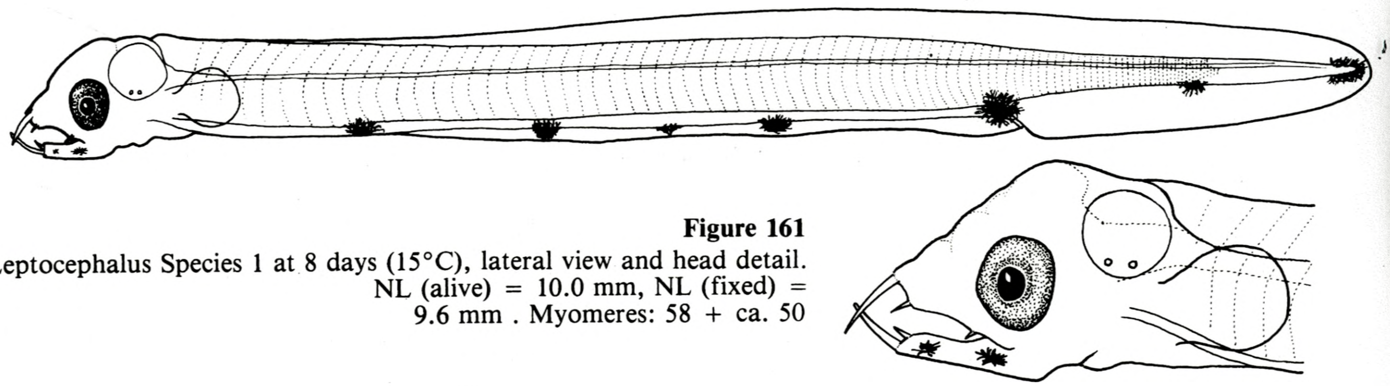


Figure 161
Leptocephalus Species 1 at 8 days (15°C), lateral view and head detail. NL (alive) = 10.0 mm, NL (fixed) = 9.6 mm . Myomeres: 58 + ca. 50

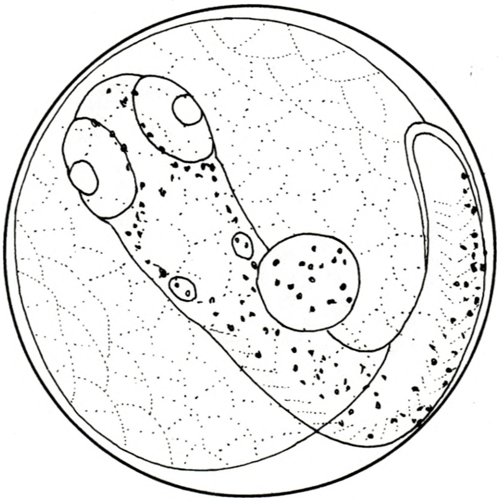


Figure 162
Perciform Species 1 egg. Major axis 0.91 mm, minor axis 0.90 mm, oil globule 0.20 mm

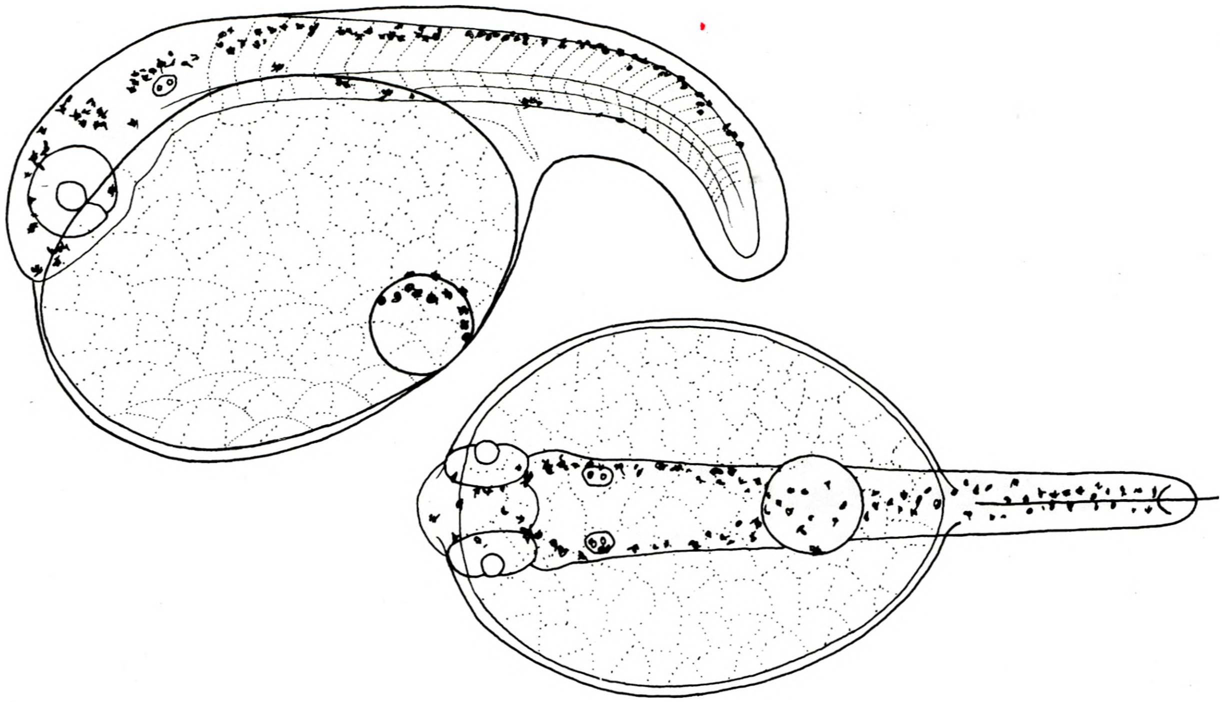


Figure 163
Perciform Species 1 soon after hatching, lateral and ventral views. NL (alive) = 1.4 mm, NL (fixed) = 1.3 mm . Myomeres: 14 + 17 = 31

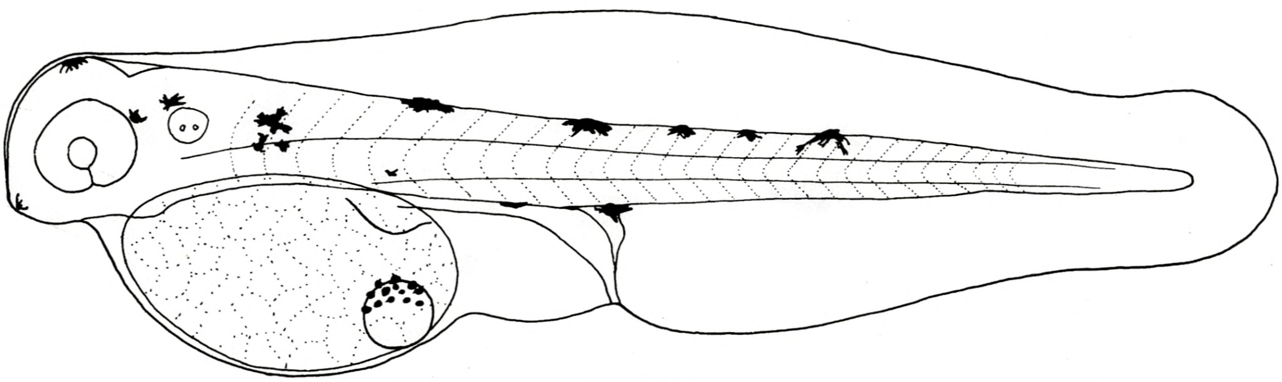


Figure 164
Perciform Species 1 at 2 days (15°C). NL (alive) = 2.8 mm, NL (fixed) = 2.4 mm . Myomeres: 13 + 16 = 29

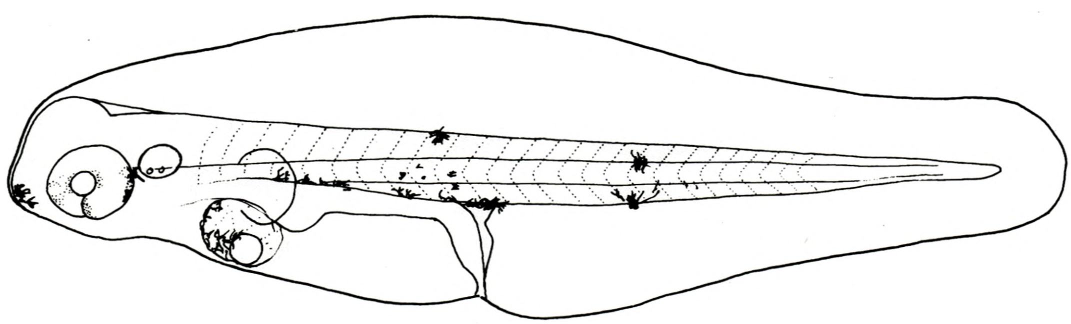


Figure 165
Perciform Species 1 at 4 days (15°C). NL (alive) = 3.1 mm, NL (fixed) = 2.7 mm . Myomeres: 12 + 15 = 27

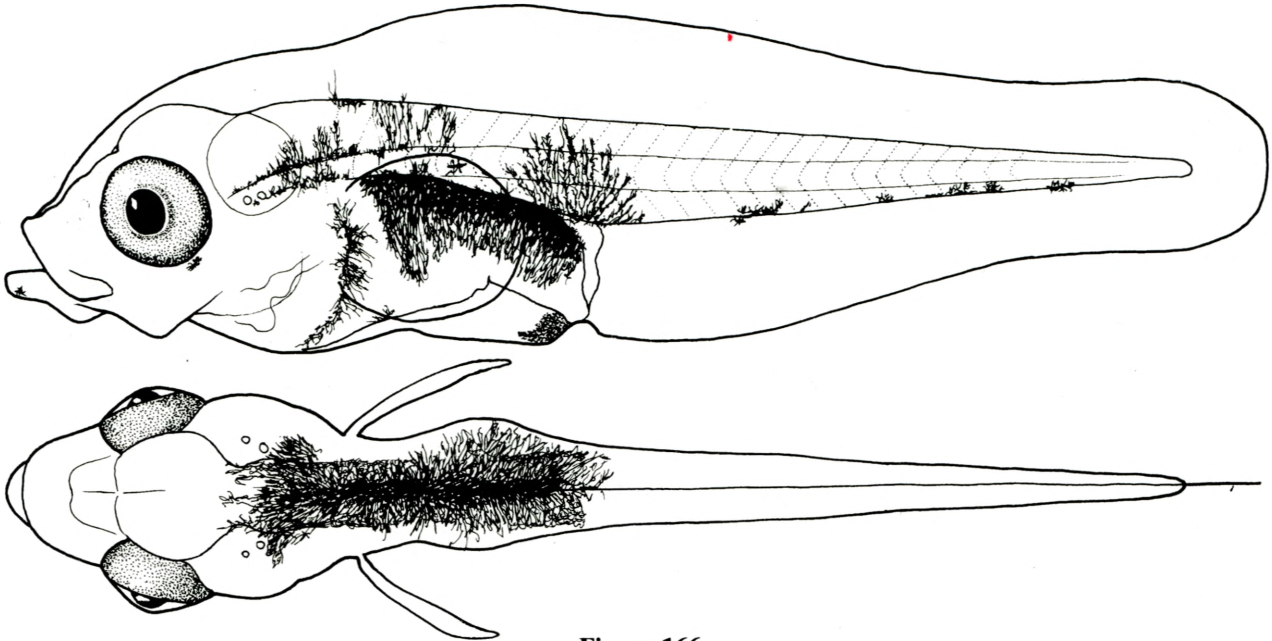


Figure 166
Perciform Species 1 at 16 days (15°C), lateral and dorsal views. NL (alive) = 3.7 mm, NL (fixed) = 3.2 mm .
Myomeres: 11 + 16 = 27

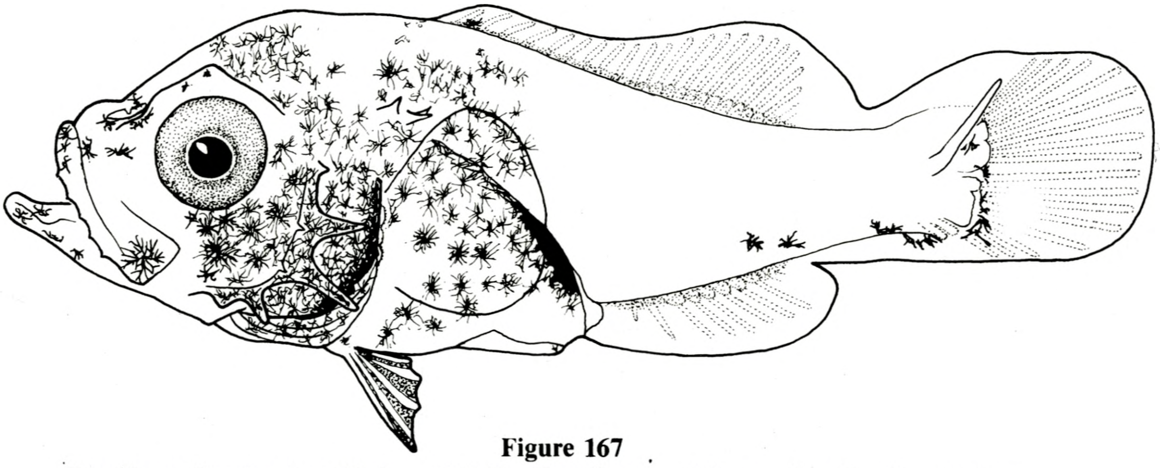


Figure 167
Perciform Species 1 at 32 days (15°C). SL (alive) = 6.9 mm, SL (fixed) = 6.4 mm .

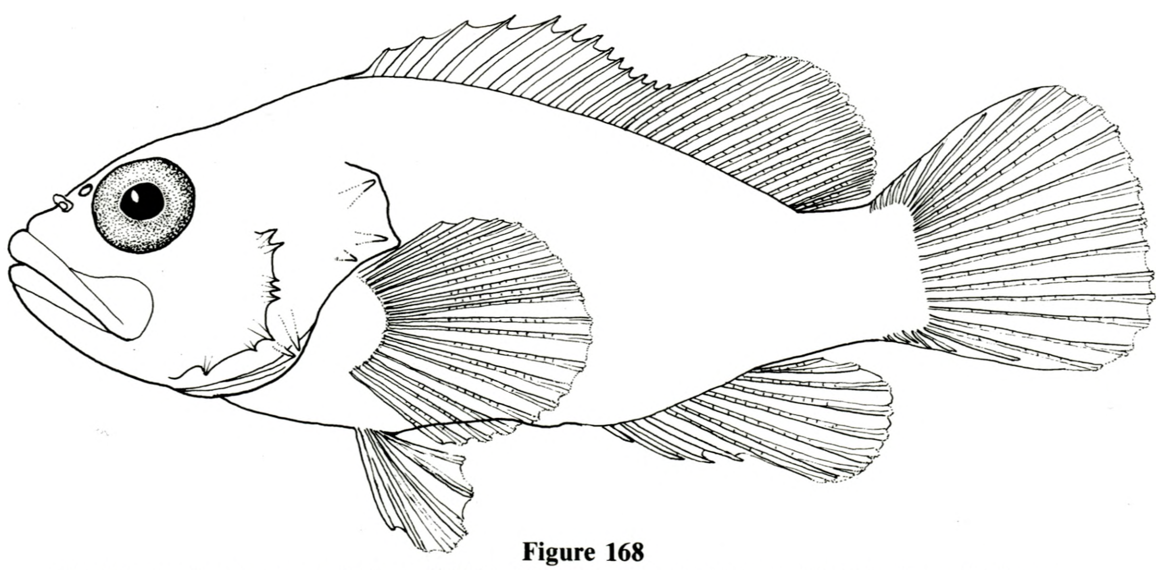


Figure 168
Perciform Species 1 at 93 days (15°C). SL (alive) = 25.1 mm, SL (fixed) = 24.5 mm .
D XIII, 15; A IV, 7; P 20

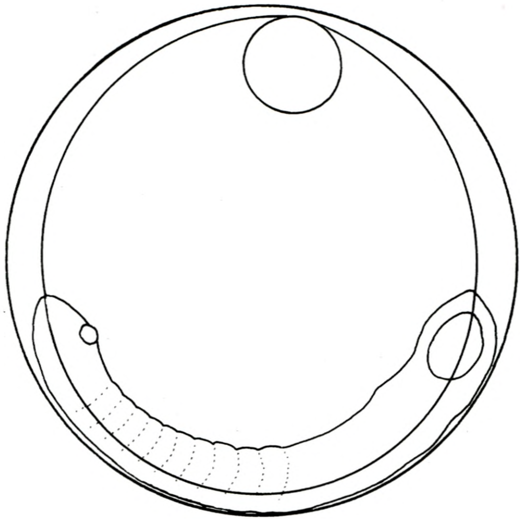


Figure 169
Species 2 egg. 0.90 mm in diameter, oil globule 0.17 mm

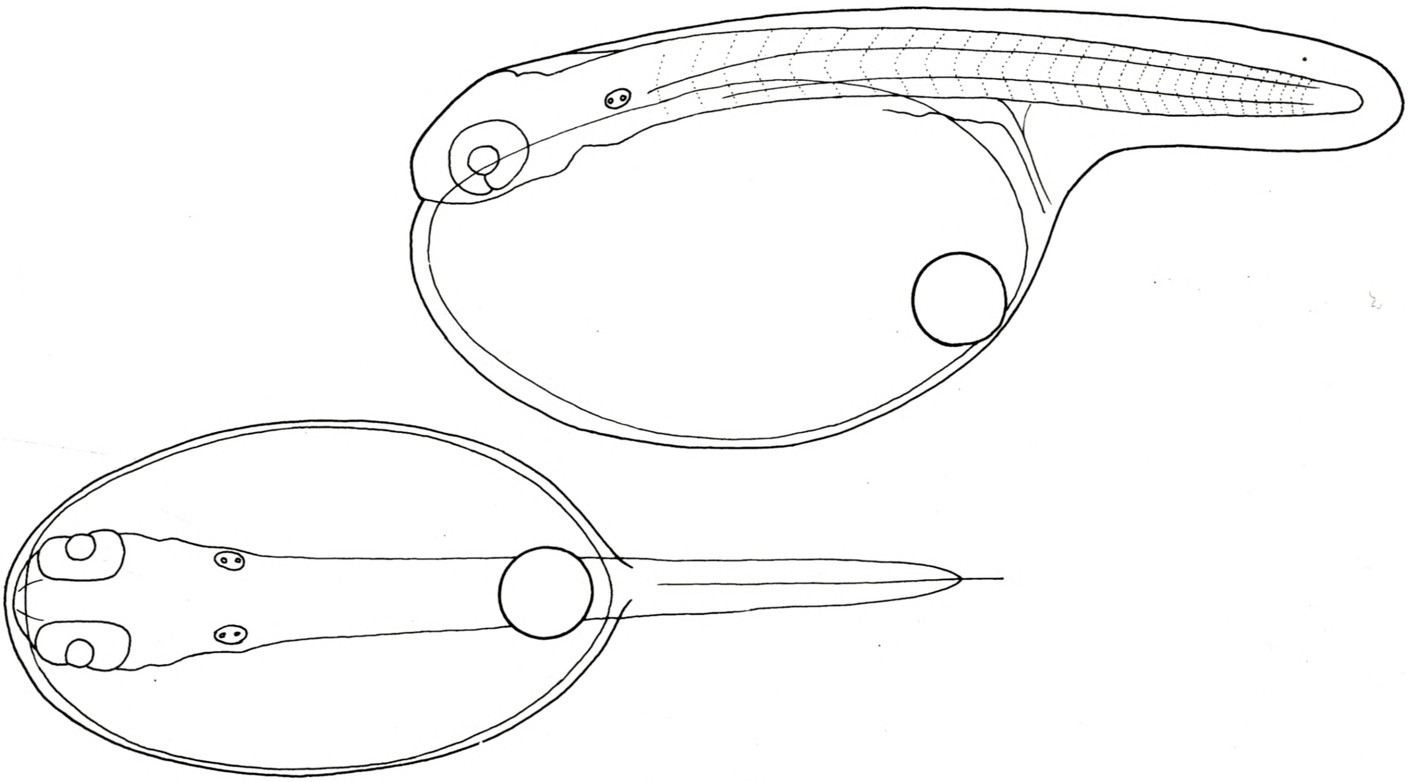


Figure 170
Species 2 soon after hatching, lateral and ventral views. NL (alive) = 1.8 mm, NL (fixed) = 1.6 mm . Myomeres: 14 + 16 = 30

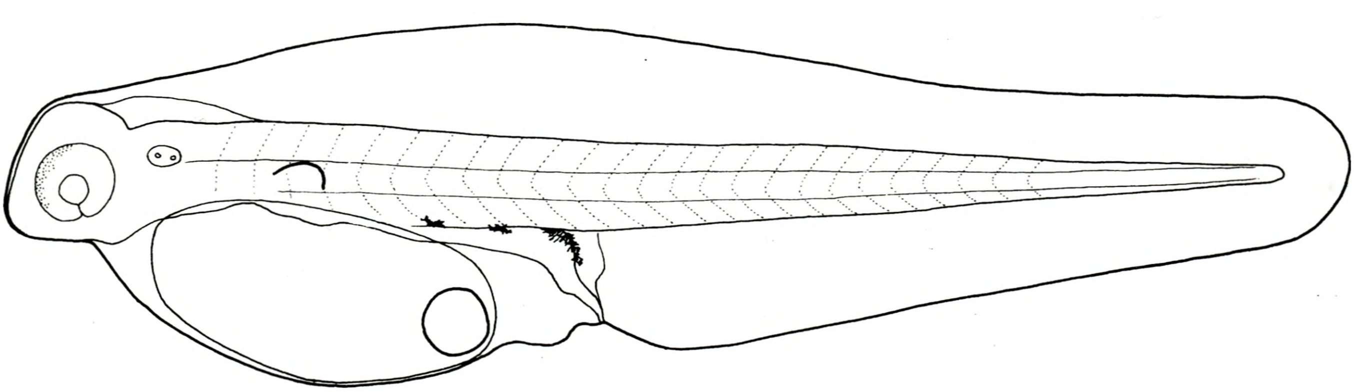


Figure 171
Species 2 at 2 days (15°C). NL (alive) = 2.7 mm, NL (fixed) = 2.4 mm . Myomeres: 12 + 14 = 26

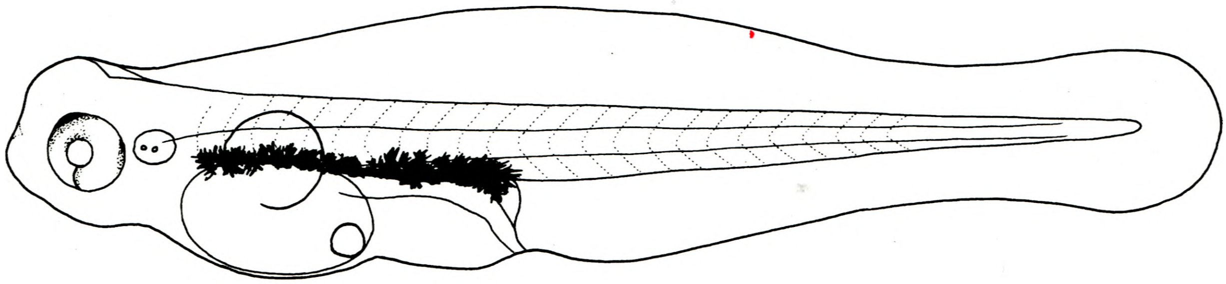


Figure 172
Species 2 at 4 days (15°C). NL (alive) = 2.9 mm, NL (fixed) = 2.7 mm . Myomeres: 12 + 13 = 25

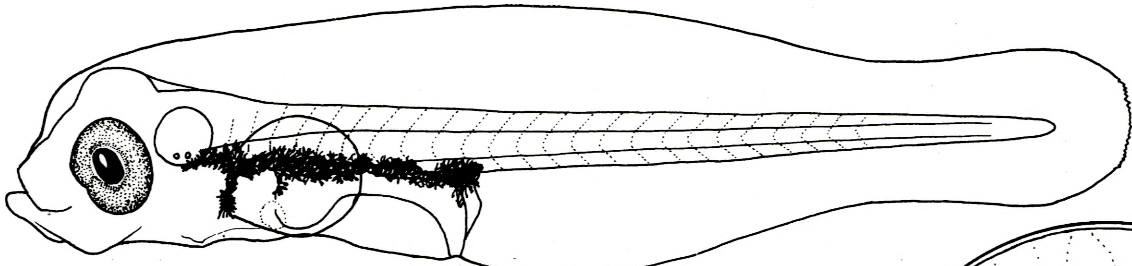


Figure 173
Species 2 at 8 days (15°C). NL (alive) = 3.0 mm, NL (fixed) = 2.8 mm . Myomeres: 10 + 15 = 25

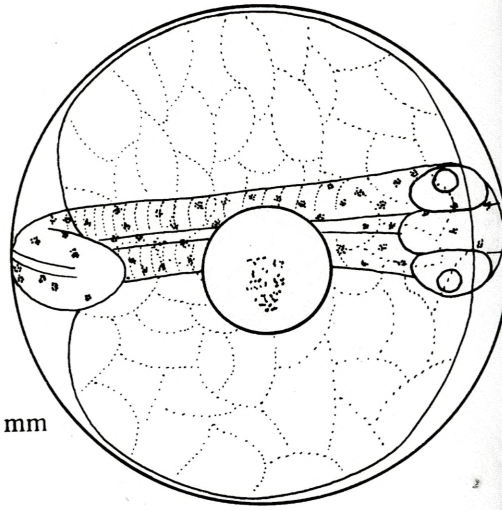


Figure 174
Species 3 egg. 0.94 mm in diameter, oil globule 0.24 mm

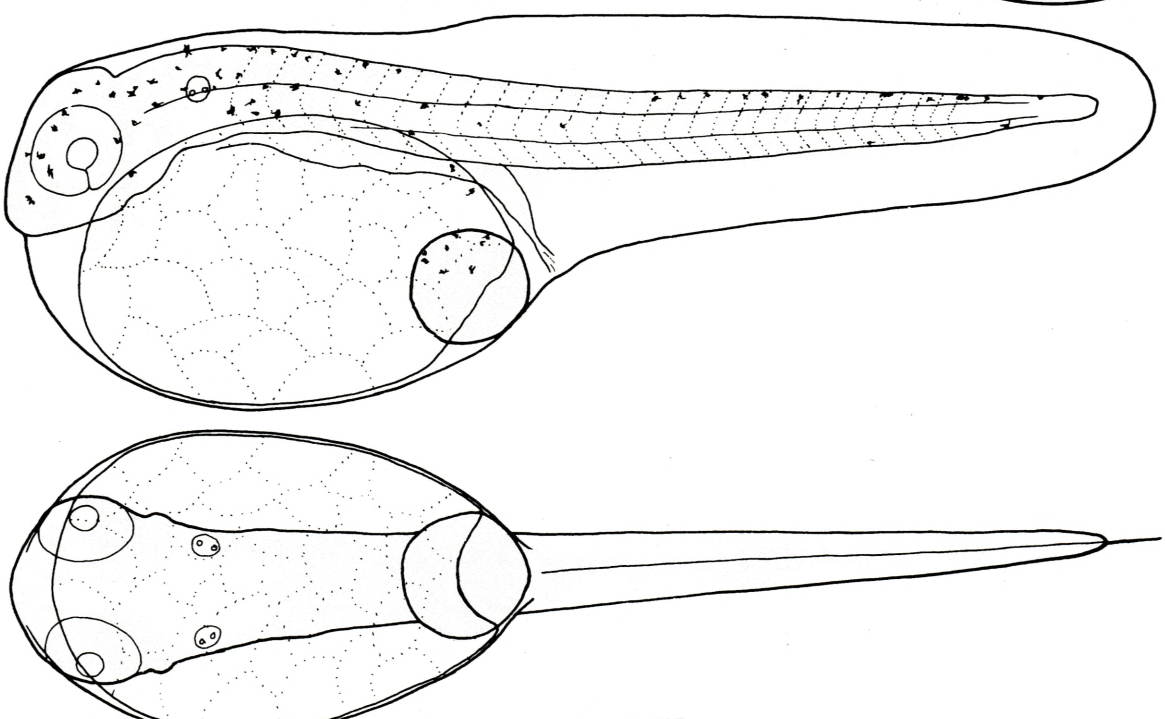


Figure 175
Species 3 soon after hatching, lateral and ventral views. NL (alive) = 2.2 mm, NL (fixed) unavailable, specimen damaged prior to fixing. Myomeres: 11 + 20 = 31

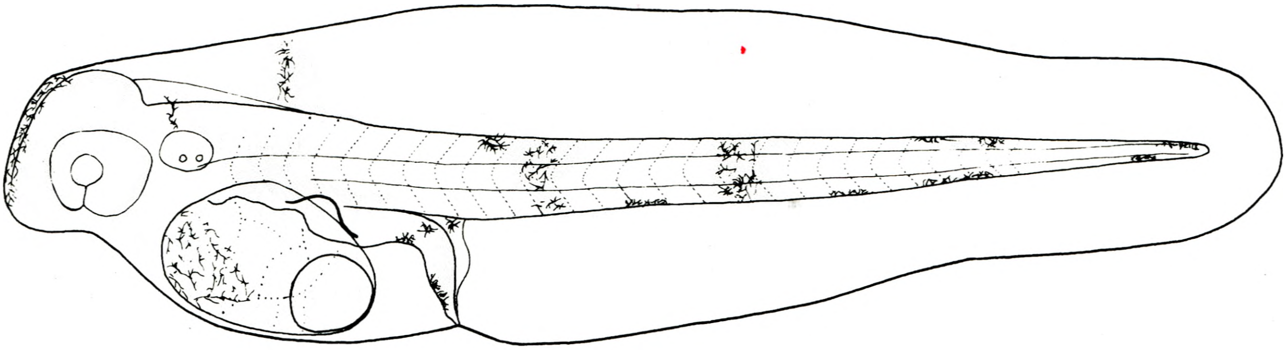


Figure 176
Species 3 at 2 days (15°C). NL (alive) = 3.0 mm, NL (fixed) = 2.8 mm . Myomeres: 9 + 19 = 28

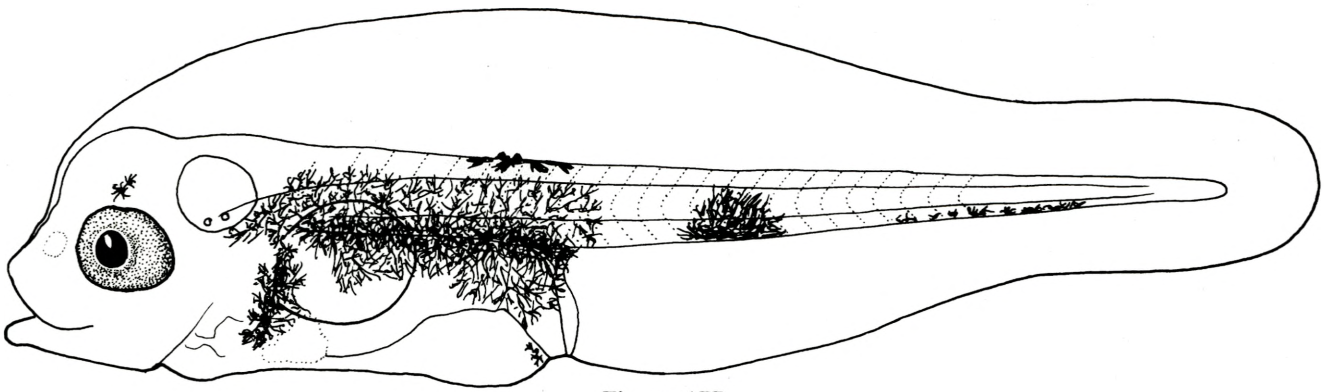


Figure 177
Species 3 at 8 days (15°C). NL (alive) = 2.9 mm, NL (fixed) = 2.7 mm . Myomeres: 10 + 16 = 26

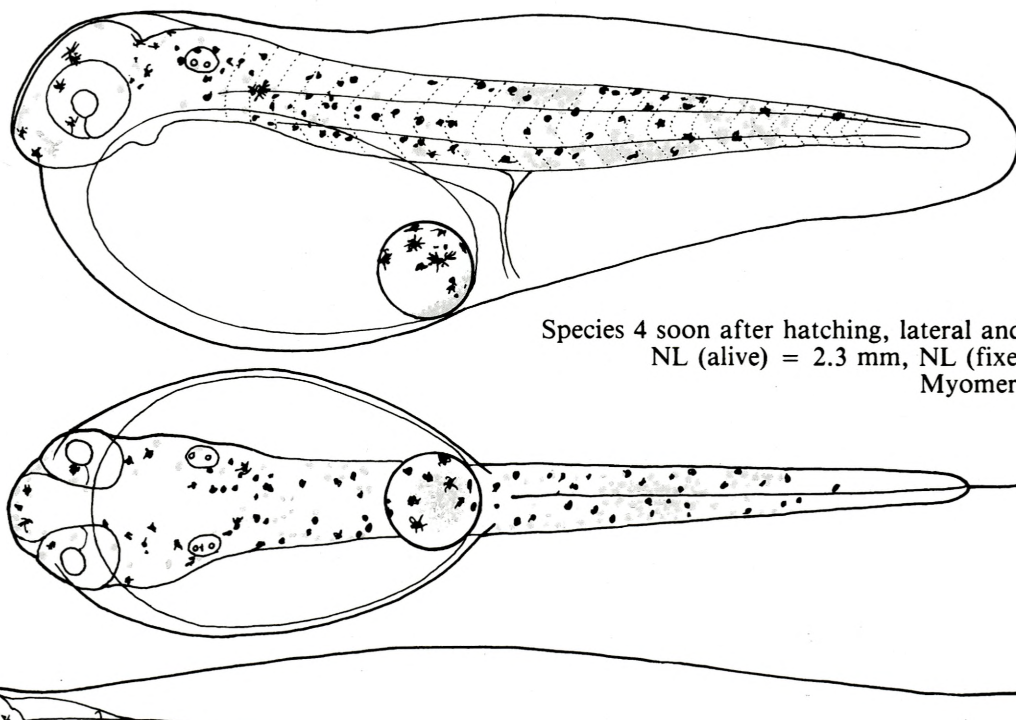


Figure 178
Species 4 soon after hatching, lateral and ventral views.
NL (alive) = 2.3 mm, NL (fixed) = 2.0 mm .
Myomeres: 12 + 17 = 29

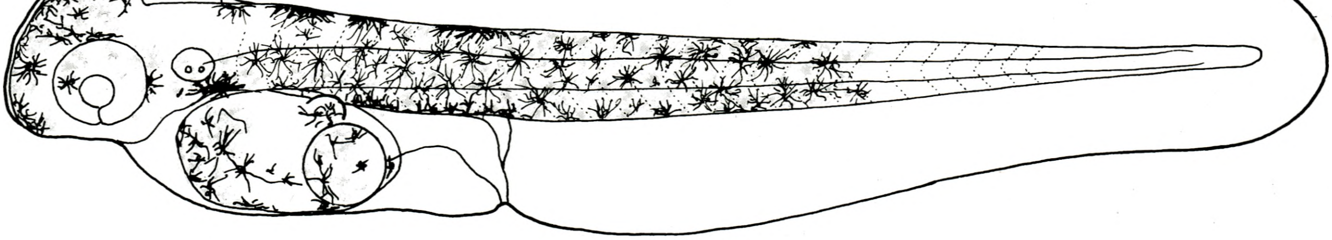


Figure 179
Species 4 at 2 days (15°C). NL (alive) = 2.9 mm, NL (fixed) = 2.6 mm . Myomeres: 10 + 17 = 27

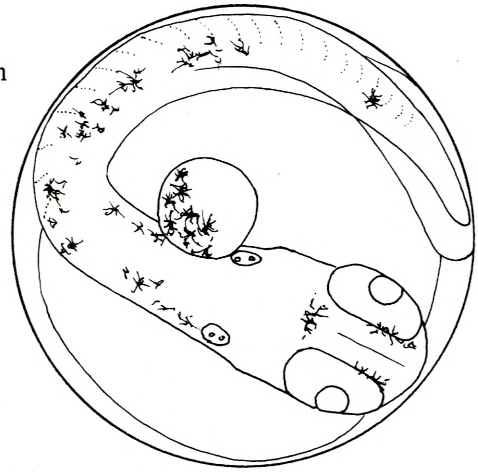


Figure 180
Species 5 egg. 0.90 mm in diameter, oil globule 0.19 mm

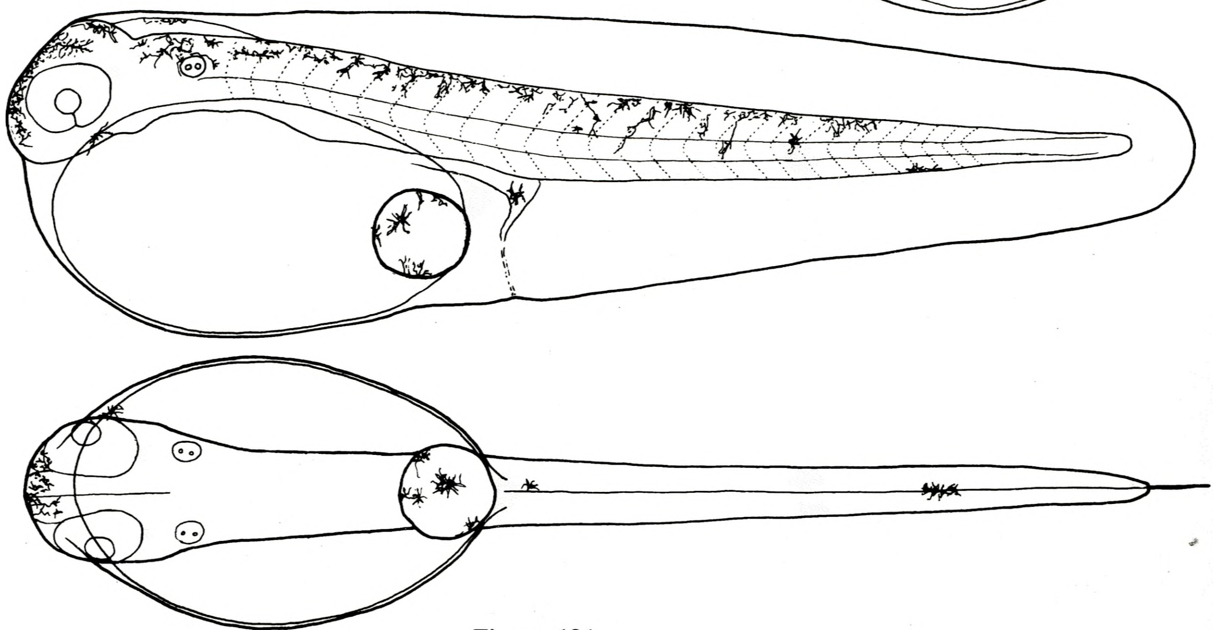


Figure 181
Species 5 soon after hatching, lateral and ventral views. NL (alive) = 2.5 mm, NL (fixed) = 2.2 mm . Myomeres: 11 + 17 = 28

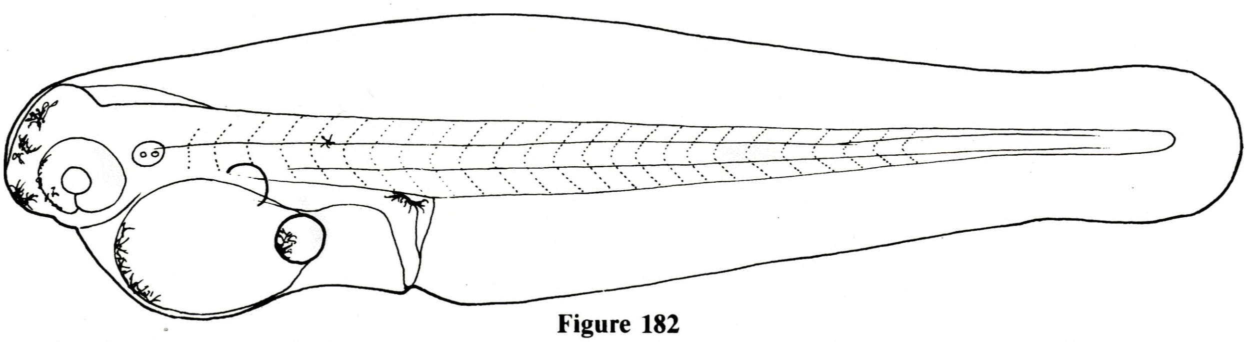


Figure 182
Species 5 at 2 days (15°C). NL (alive) = 3.5 mm, NL (fixed) = 3.1 mm . Myomeres: 9 + 17 = 26

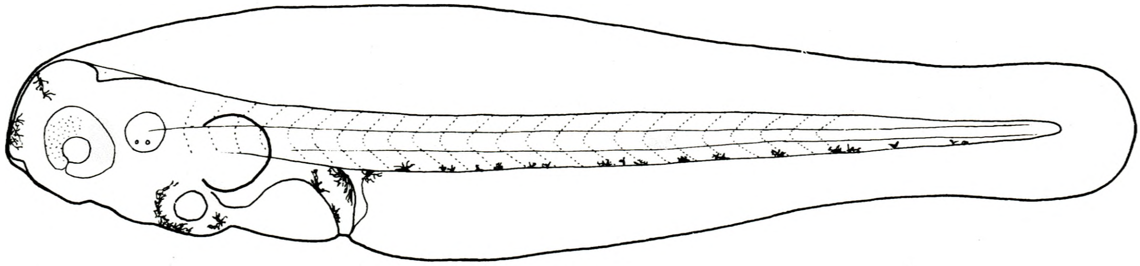


Figure 183
Species 5 at 4 days (15°C). NL (alive) = 3.4 mm, NL (fixed) = 2.8 mm . Myomeres: 8 + 17 = 25

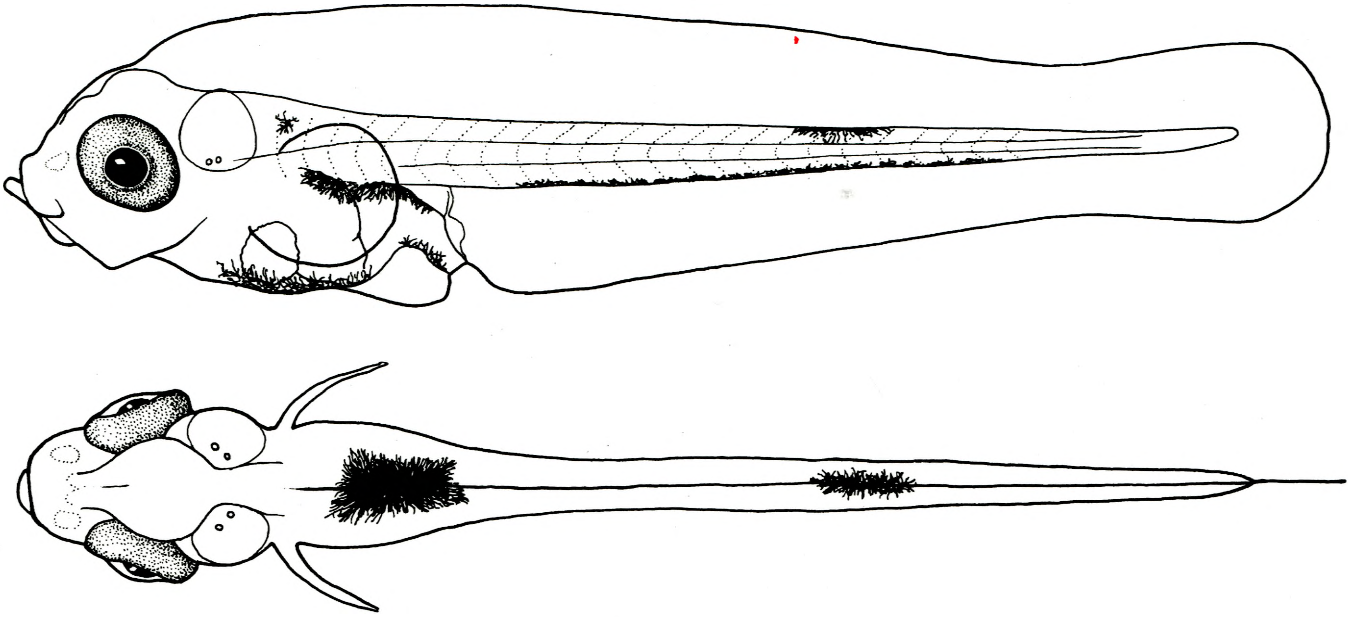


Figure 184
Species 5 at 16 days (15°C), lateral and dorsal views. NL (alive) = 4.2 mm, NL (fixed) = 3.9 mm .
Myomeres: 8 + 17 = 25

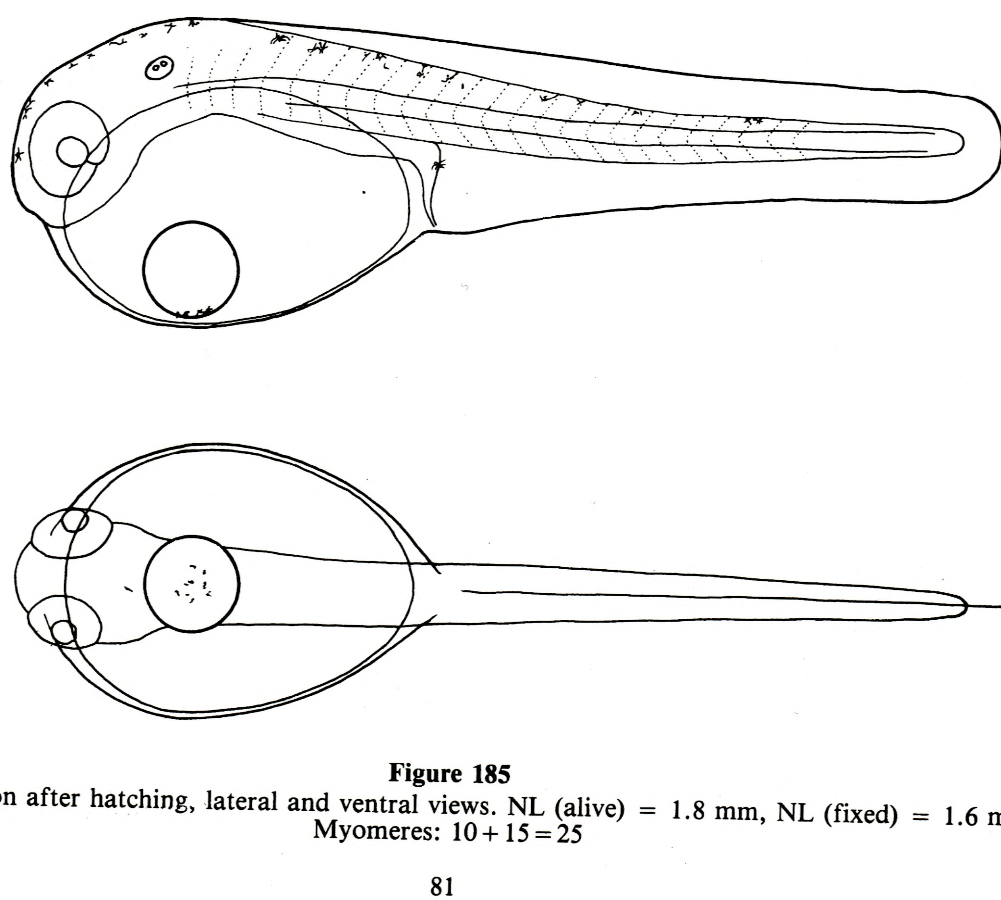


Figure 185
Species 6 soon after hatching, lateral and ventral views. NL (alive) = 1.8 mm, NL (fixed) = 1.6 mm .
Myomeres: 10 + 15 = 25

Figure 186

Distribution of post-collection incubation times (15°C) for 29 species. The logarithm of the number of eggs that hatched during each 12-h period after collection is plotted against the time interval between collection and hatching

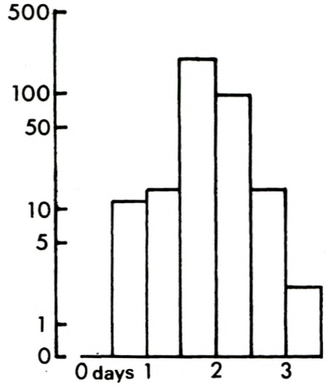


Fig. 186.1
Etrumeus teres

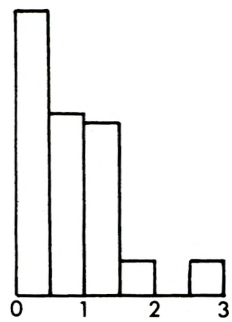


Fig. 186.2
Engrualis capensis

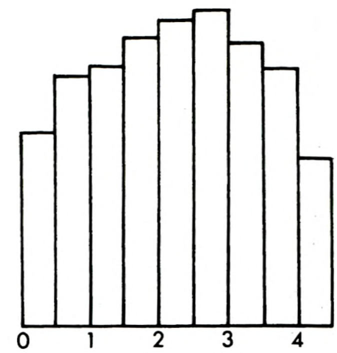


Fig. 186.3
Gaidropsarus capensis

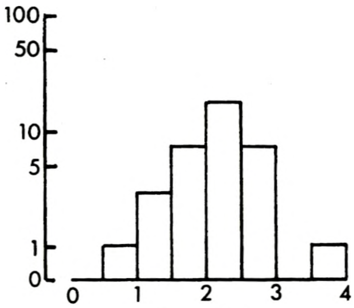


Fig. 186.4
Physiculus capensis

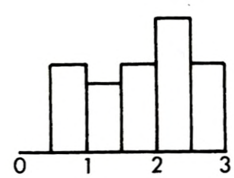


Fig. 186.5
Merluccius capensis

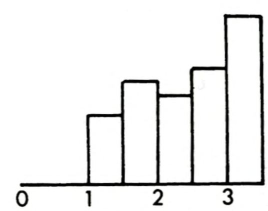


Fig. 186.6
Species 1
(Carapidae)

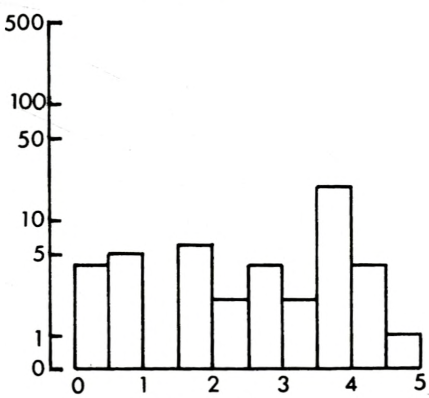


Fig. 186.7
Genypterus capensis

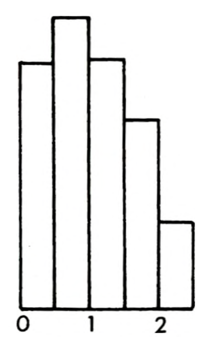


Fig. 186.8
Arnoglossus capensis

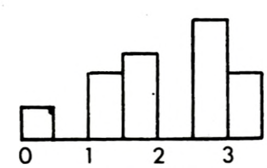


Fig. 186.9
Austroglossus microlepis

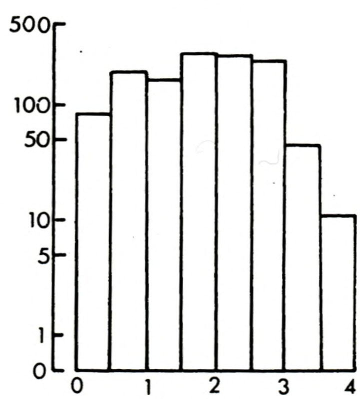


Fig. 186.10
Heteromycteris capensis

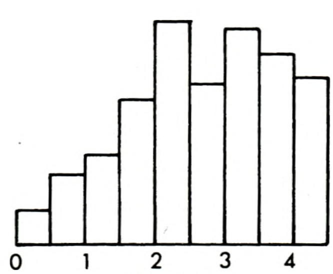


Fig. 186.11
Synaptura kleini

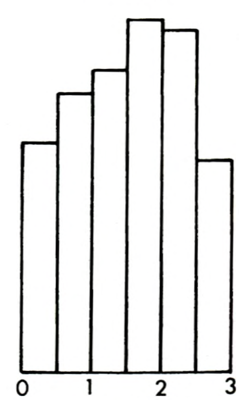


Fig. 186.12
Cynoglossus capensis

Figure 186 (Cont.)

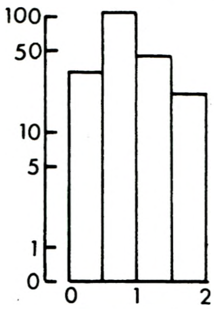


Fig. 186.13
Paracallionymus costatus

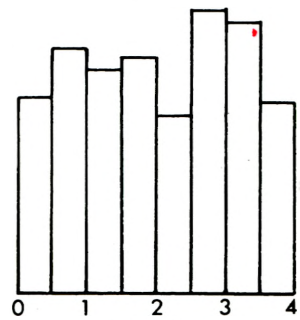


Fig. 186.14
Cheilodactylus fasciatus

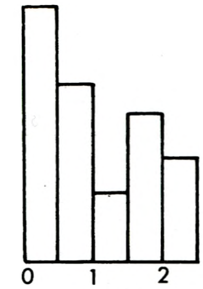


Fig. 186.15
Trachurus t. capensis

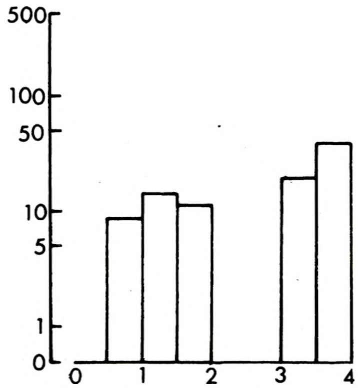


Fig. 186.16
Pterosmaris axillaris

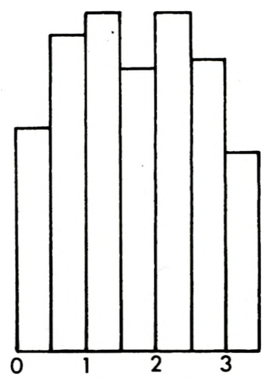


Fig.186.17
Diplodus sargus

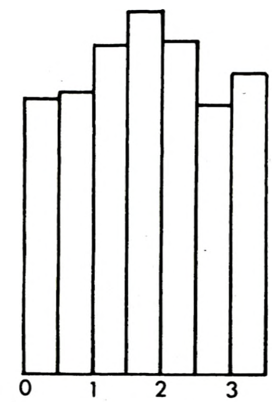


Fig. 186.18
Lithognathus mormyrus

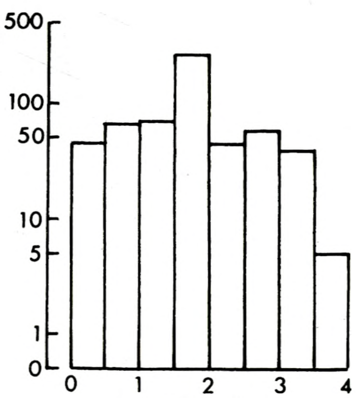


Fig. 186.19
Pachymetopon blochi

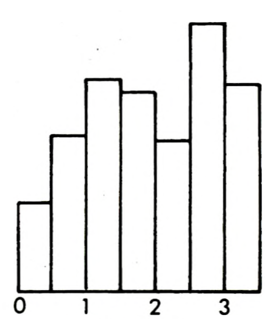


Fig. 186.20
Species 5

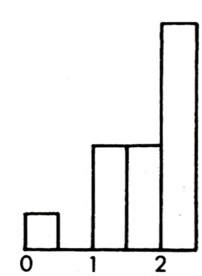


Fig. 186.21
Perciform Species 1

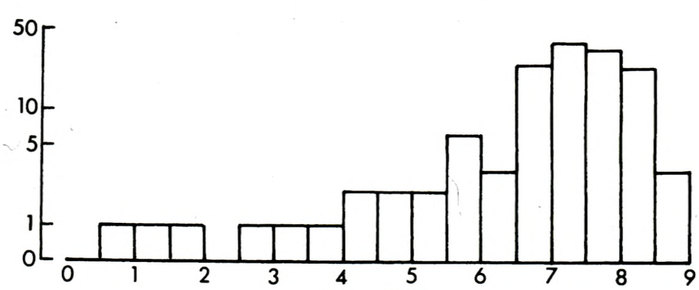


Fig. 186.22
Congiopodus spinifer

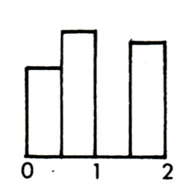


Fig.186.23
Coccotropsis gymnoderma

Figure 186 (Cont.)

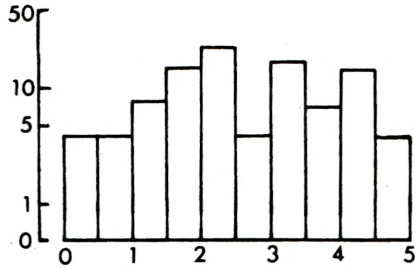


Fig. 186.24
Trigla
?capensis

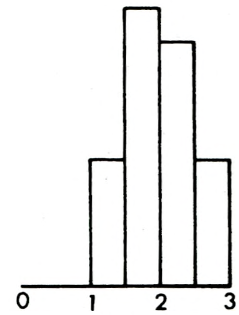


Fig. 186.25
Helicolenus
dactylopterus

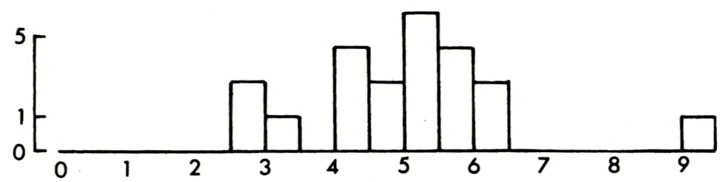


Fig. 186.26
(Leptocephalus)
Species 1

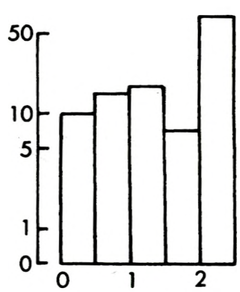


Fig. 186.27
Species 2

Fig. 186.28
Liza
richardsoni

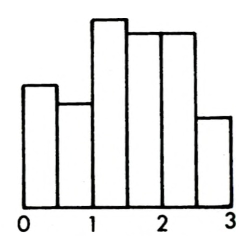


Fig. 186.29
Species 3