Identification Key and Catalogue of Larval Antarctic Fishes

Edited by Adolf Kellermann

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Preface

This booklet has two parts which are complementary to each other: an identification key which attempts to include larvae from all fish families occurring in the Southern Ocean, and a catalogue which considers only the early stages of the most abundant bottom dwelling fishes, the percomorph notothenioid fishes. The original idea conceived in 1985 was to produce a synopsis of what was known about the larval development and ecology of notothenioid fishes as the peculiar element of the Antarctic fish fauna. Later on, when ichthyologists had become aware that difficulties still existed in identifying these larvae, it was suggested during the BIOMASS Post-SIBEX Fish Data Evaluation Workshop held at Cambridge, 1986, to have both, a key and a catalogue in one volume, with the key to be produced in collaboration with Tony North of the British Antarctic Survey. This idea was further enhanced by the growing interest of CCAMLR to develop new approaches for the conservation of the Antarctic fish fauna on the background of a severe threat to certain stocks by commercial fisheries. We hope that this publication meets the demands of the still growing international community of researchers concerned with Antarctic fishes; however, the key and catalogue are by no means complete and must be regarded as working documents. Hence, it is also hoped that they will be complemented by future efforts of the international community.

Many people have contributed in various ways to the production of this book. The Alfred-Wegener-Institute and its director Prof. G. Hempel provided the logistic framework and support, and SCAR and CCAMLR contributed financial aid. Part of the work was supported by the Deutsche Forschungsgemeinschaft. Thanks go to Miss A. Bremer and Mrs. S. Marschall for their technical assistance, and to W. Kloppenburg for his expertise in technical problems. Special thanks go to Dr. Werner Ekau for his invaluable editorial assistance.

Bremerhaven, February 1989

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KEY TO THE EARLY STAGES OF ANTARCTIC FISH

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Abstract:

A new field key has been produced to 58 species of Antarctic fish larvae. Other identifications are given to genera or type. Pigmentation is the main character used for discrimination in the key which permits rapid field identification, rather than counts of fin-rays, myomeres and other characters. However, in some cases species could not be separated easily by pigmentation and so a more detailed examination and such counts have been used where necessary.

Keywords: Antarctic fish, early life stages, identification key, taxonomy

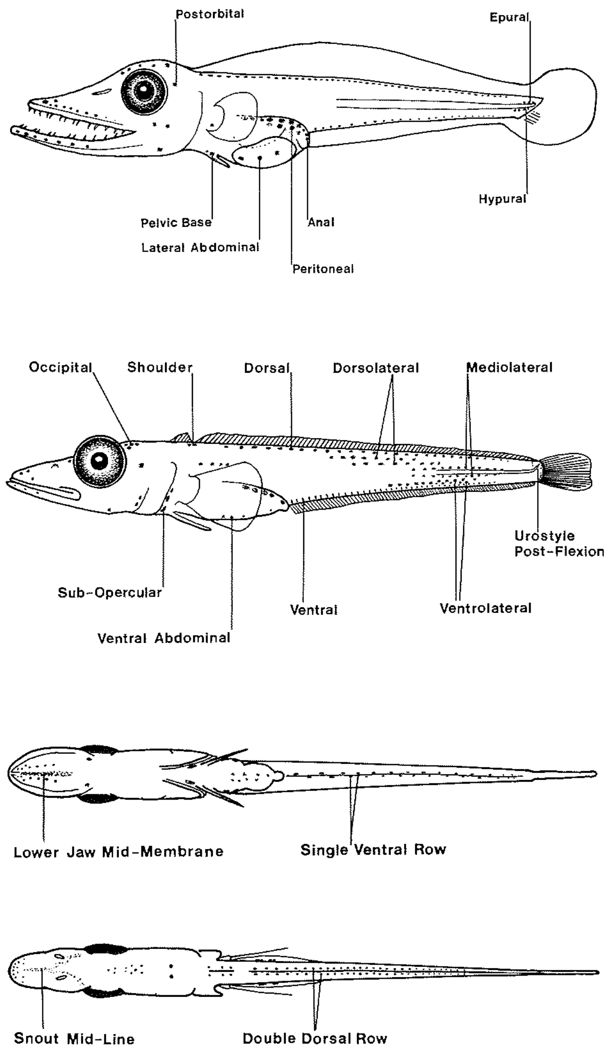

Fig. 1: Terminology used for descriptions of pigmentation.

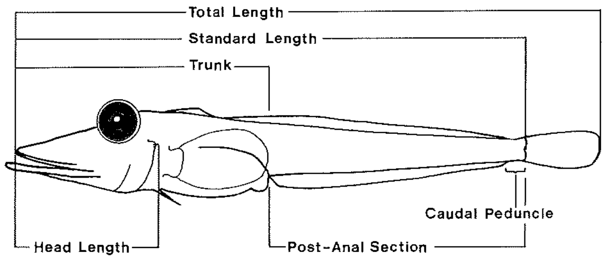

Fig. 2: Terminology used for measurements of larval body.

Introduction

CCAMLR has proposed monitoring the pre-recruit stages of Antarctic fish as a means of assessing the status of the fish stocks. Fischer & Hureau (1985) list Antarctic fish species which may be exploited by the fishery. These include numerous species of mainly notothenioid fishes. Identification of the early stages is the necessary pre-requisite in order to monitor their annual abundance. So far available guides to identify larval Antarctic fishes are the key by North & White (1982) and the atlas by Efremenko (1983), summarizing previously published work.

During the BIOMASS Post-SIBEX Fish Data Evaluation Workshop at Cambridge, UK in October 1986 it became clear that there were still problems in the identification of early stages of Antarctic fish (BIOMASS, 1987; 1988). The work towards this key originated during that workshop and is a direct result of the international co-ordination and collaboration generated by the BIOMASS programme.

This paper is based on the approach used in the key of North & White (1982) and is an attempt at a field guide for the identification of the early stages of Antarctic fish. The key has been compiled from information in recent literature especially the publications of V.N. Efremenko, and from detailed examination of specimens collected by the Alfred-Wegener-Institut für Polar- und Meeresforschung, the Institut für Seefischerei der Bundesforschungsanstalt für Fischerei, Hamburg and the British Antarctic Survey. The key is designed to identify the larvae from hatching until the onset of metamorphosis to the juvenile. In general, it does not include the metamorphosing stages which are intermediate in pigmentation and have all fin-rays developed.

Acknowledgements

We thank: the Alfred-Wegener-Institut für Polar- und Meeresforschung and the Deutsche Forschungsgemeinschaft (DFG), Grant He 86/54-1, SCAR and CCAMLR for financial contributions towards the publication costs of the key; British Antarctic Survey for travel funds; Werner Ekau of the Alfred-Wegener-Institut für Polar- und Meeresforschung for providing fin-ray and vertebrae counts of Weddell Sea fishes; Gerd Hubold of the Institut für Polarökologie der Universität Kiel for loaning his collection of Weddell Sea fish larvae; Volker Siegel and Karl-Hermann Kock of the Institut für Seefischerei der Bundesforschungsanstalt für Fischerei, Hamburg for providing their extensive collection of fish larvae from the Peninsula region; Alwynne Wheeler of the British Museum of Natural History London for access to a specimen; V.N. Efremenko for further notes on *Gymnodraco acuticeps*; O. Gon of the JLB Smith Institute of Ichthyology Grahamstown for access to specimens of *Cygnodraco mawsoni*; Sonja Schadwinkel for providing data and drawings of *Notolepis* spp.; all colleagues who provided specimens during the BIOMASS Workshop on early life history stages of Antarctic fish (Paris, September 1981) and all colleagues who provided specimens during the BIOMASS Post-SIBEX Fish Data Evaluation Workshops (Cambridge, October 1986 and August 1987).

Methods

Terminology

Taxonomic nomenclature follows Fischer & Hureau (1985).

Life stages were defined as follows:

Larva is the stage between hatching and metamorphosis to the juvenile. Preflexion and post-flexion larva are before and after upward flexion of urostyle respectively. Metamorphosis is the change from the larval to the juvenile stage. At the beginning of metamorphosis, all fin rays are developed and scales begin to form if they are present in the species.

Pigmentation

The description of pigmentation follows that of Russell (1976) (Fig. 1).

Description of specimens

Specimens were viewed from the side at x6 to x20 magnification using a binocular microscope. Counts of spines, and other features are therefore of one side of the fish only. Numbers of gill rakers are those on the anterior part of the lower limb of the first arch. The size of the larvae given is the standard length in mm.

Measurements

Measurements used for total length, standard length, head length and abdomen length are shown in Fig. 2.

Key to families and some species

1 a Eyes on stalks (Fig. 3) .... Bathylagidae

1 b Eyes not on stalks 2

2 a Eyes with ventral extension to orbit (Fig. 4) .... Myctophidae

2 b Eyes without ventral extension to the orbit 3

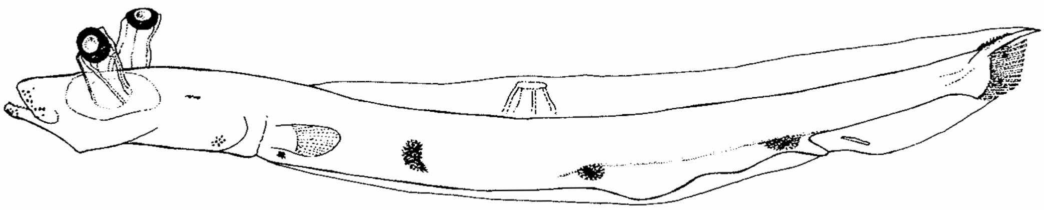

Fig. 3: Bathylagidae. *Bathylagus antarcticus*, 25.0 mm SL (from Gon, 1987).

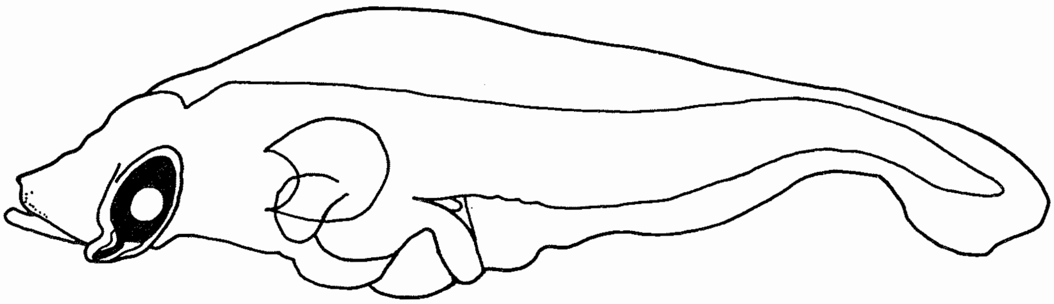

Fig. 4: Myctophidae. *Electrona carlsbergi*, 8.3 mm TL.

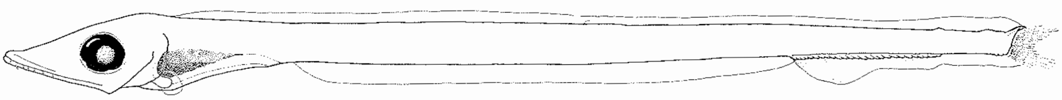

Fig. 5: Paralepididae. *Notolepis annulata*, 36.3 mm SL.

Fig. 6: Liparididae. Unspecified larva of 19.6 mm SL.

3 a Eyes oval, body extremely long and slim (Fig. 5) .... Paralepididae

3 b Eyes circular 4

4 a Pectoral fin with an elongated stalked base .... Macrouridae

4 b Pectoral fin base not stalk-like 5

5 a Pectoral fin base and rays extend ventrally to level with anus and ventral pectoral rays often separated from each other, pores above the upper jaw (Fig. 6) .... Liparidae

5 b Pectoral fin base normal and does not extend ventrally below mid-abdomen level 6

6 a Teeth obvious, small in pre-flexion larvae, long and canine like in later larvae (Figs. 7, 8) 7

6 b Teeth not obvious at x20 except very small teeth in late larvae 10

7 a Pelvic fin obvious, first ray or end of rays usually pigmented, in early larvae jaws extend caudally to beyond the middle of the eye (Fig. 8) ...... Channichthyidae

7 b Pelvic fin short 8

8 a Postanal section unpigmented except caudal fin (Fig. 9) .... *Psilodraco breviceps*

8 b Postanal section has some pigmentation 9

9 a A single dorsal and ventral pigment row (Fig. 10) .... *Champsocephalus gunnari*

9 b Dorsal pigment rows extend to below mid-lateral line, above the anterior of the anal fin, head pigmented including the opercules (Fig. 7) .... *Gymnodraco acuticeps*

9 c No continuous dorsal pigment row, postanal pigment bar near caudal peduncle .... *Dissostichus eleginoides*

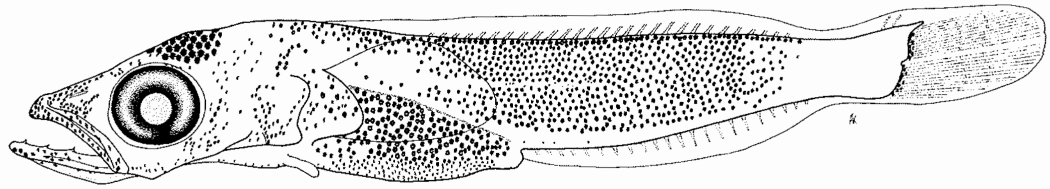

Fig. 7: Bathydraconidae. *Gymnodraco acuticeps*, 18.8 mm SL.

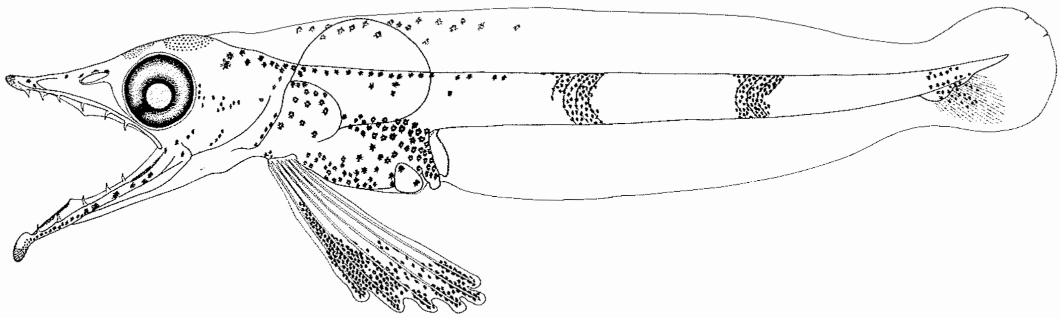

Fig. 8: Channichthyidae. *Dacodraco hunteri*, 19.7 mm SL.

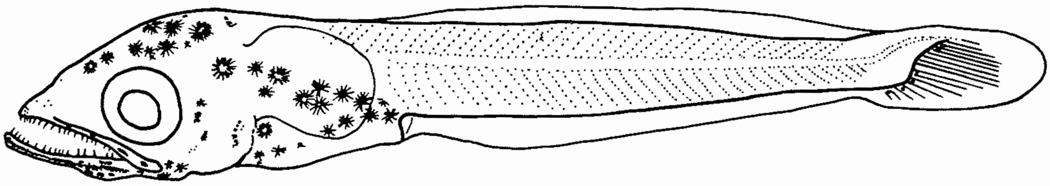

Fig. 9: Bathydraconidae. *Psilodraco breviceps*, 18.3 mm TL.

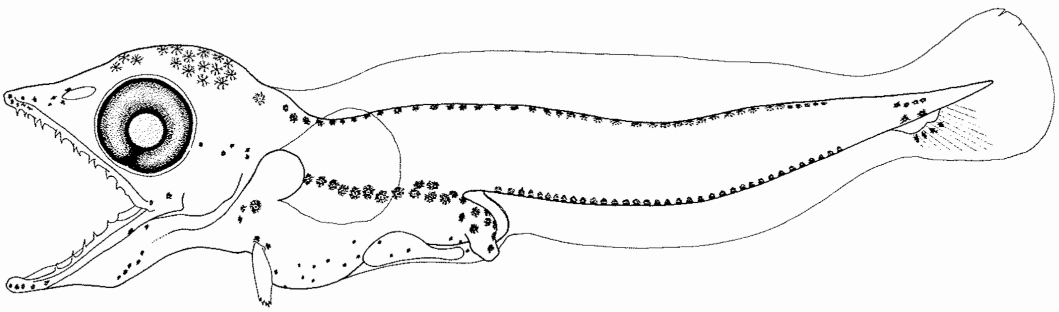

Fig. 10: Channichthyidae. *Champsocephalus gunnari*, 13.1 mm SL.

10 a Gut not long, postanal section long and slender (Figs. 5, 16); small body depth, except in some pre-flexion larvae; if gut long, body pigmented mostly all over (Fig. 17), or vertical pigment bar present on postanal section (Fig. 56) 19

10 b Gut long, postanal section long and slender, caudal fin often darkly pigmented, jaws long or short and pointed (Figs. 11, 12, 37) 20

10 c Gut not long, postanal section not long and slender (Figs. 13, 15, 50, 51) 11

11 a Pigmented mostly all over except the fins, more than 50 dorsal fin-rays (Fig. 14), spines may be present on the upper jaw (pre-maxillary) .... Muraenolepidae

11 b Less than 50 dorsal fin-rays 12

12 a Pigment on most of the head and abdominal regions 13

12 b Head and abdomen not pigmented all over 15

13 a Abdomen may extend ventrally to level with the distal tips of the anal fin-rays, overall body shape short and deep (Fig. 13) .... Artedidraconidae

13 b Abdomen does not extend far ventrally 14

14 a Vertical pigment bar on the postanal section .... (Nototheniidae), *Eleginops maclovinus*

14 b No pigment bar .... (Bathydraconidae), *Gymnodraco acuticeps*

15 a Overall shape short and deep, short postanal section (Fig. 15) 16

15 b Elongated shape, pigment on postanal section in dorsal, ventral or lateral rows, no vertical pigment bar present .... some Nototheniidae

16 a Vertical pigment bar on postanal section 17

16 b No vertical pigment bar on postanal section 18

17 a Postanal anterior ventral-ventrolateral melanophore row, opercular spine in later larvae .... Harpagiferidae

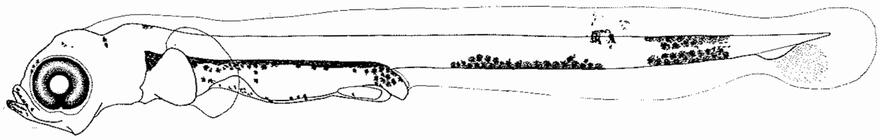

Fig. 11: Bathydraconidae. *Racovitzia glacialis*, 13.2 mm SL.

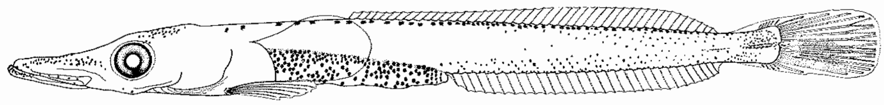

Fig. 12: Bathydraconidae. *Parachaenichthys charcoti*, 50.3 mm SL.

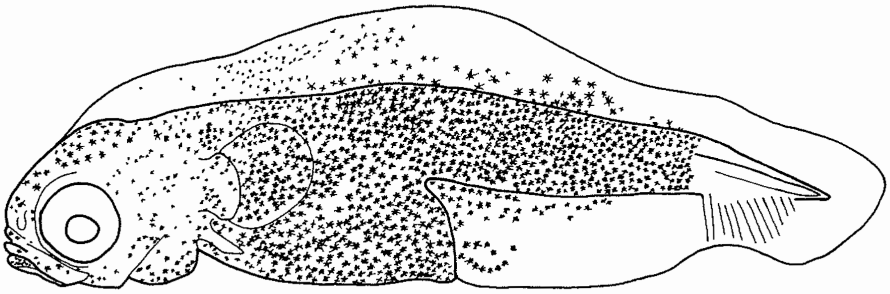

Fig. 13: Artedidraconidae. *Artedidraco mirus*, 10 mm TL.

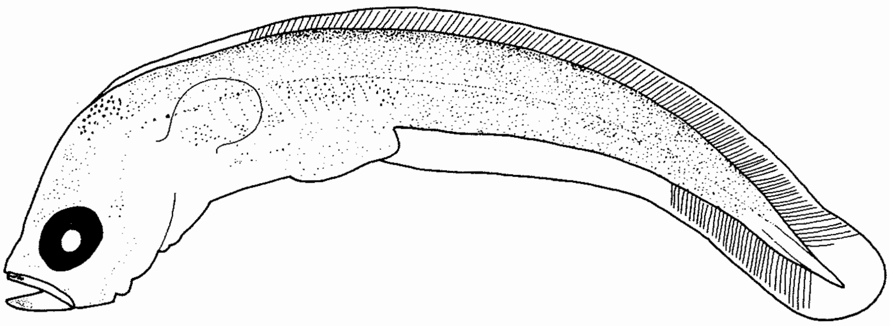

Fig. 14: Muraenolepidae. *Muraenolepis microps*, 16.6 mm TL.

17 b No postanal anterior ventral-ventrolateral melanophore row .... (Nototheniidae), *Eleginops maclovinus*

18 a Three dorsal fins, short pelvic fin (Gadidae) .... *Micromesistius australis*

18 b Two dorsal fins, long pelvic fin (Merlucciidae) .... *Merluccius hubbsi*

19 a No pigment on the postanal section (except on the caudal fin), not even a ventral row, very elongate and slim shape (Fig. 5) .... Paralepididae

19 b Some pigment on the postanal section if only a ventral row, except in some very early stages (Figs. 16, 17) .... Nototheniidae

20 a Dorsal abdomen (peritoneum) has more than five melanophores (Fig. 18) .... Bathydraconidae

20 b Gut has less than five melanophores or a dark patch of melanophores between the abdomen and the notochord (swimbladder) .... Myctophidae, *Gymnoscopelus* sp.

Artedidraconidae

The Artedidraconidae includes the genera: *Artedidraco, Dolloidraco, Histiodraco*, and *Pogonophryne*. The larval stages of most species of this family have not been described. This key is a summary of present knowledge, and uses the extent of pigment coverage on the postanal section and the extent of the abdomen towards the dorsal fin.

1 a Lateral pigment extends about two thirds or more of postanal section, no melanophores on caudal peduncle . 2

1 b Lateral pigment extends about less than two thirds of postanal section, no melanophores on caudal peduncle . 4

2 a Abdomen massive and extends posteriorly to above the midline, lateral pigment extends about 77 - 89 % of postanal section in specimens of 17 - 29 mm SL, body heavily pigmented (Fig. 19) ...... *Pogonophryne marmorata*

2 b Abdomen large, but does not extend ventral to the anal fin, and dorsal part of the abdomen below the midline . 3

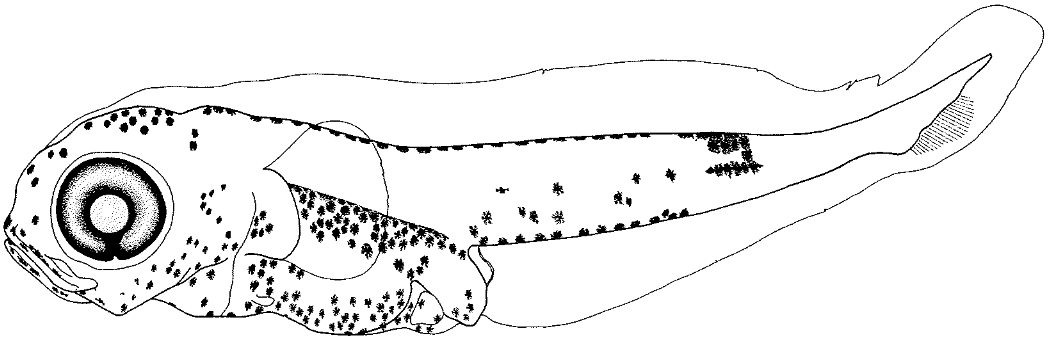

Fig. 15: Harpagiferidae. *Harpagifer antarcticus*, 9.2 mm SL.

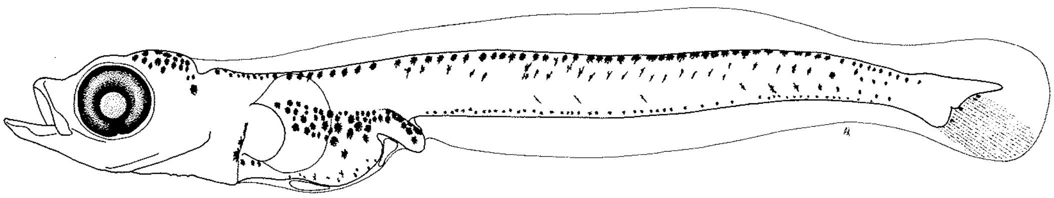

Fig. 16: Nototheniidae. *Trematomus centronotus*, 16.5 mm SL.

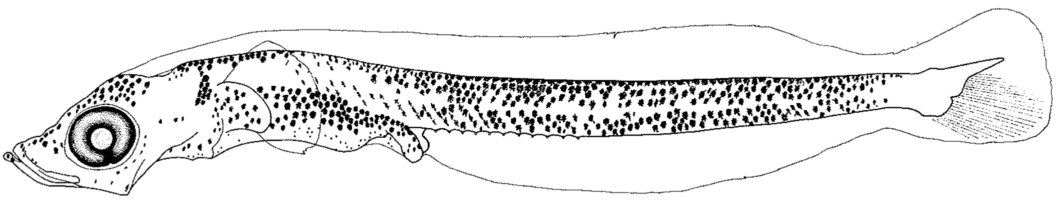

Fig. 17: Nototheniidae. *Aethotaxis mitopteryx*, 21.5 mm SL.

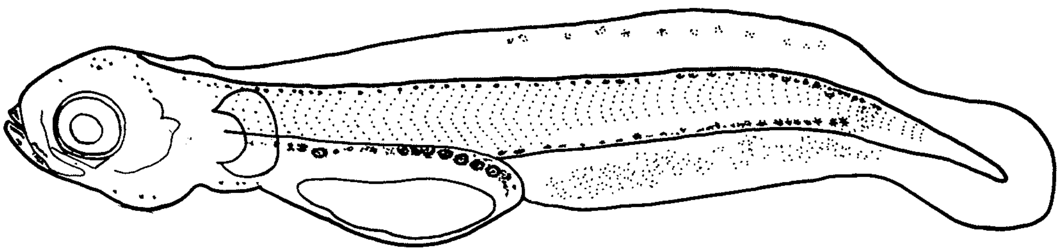

Fig. 18: Bathydraconidae. *Parachaenichthys georgianus*, 15 mm TL.

3 a Lateral melanophores extend posteriorly almost to caudal peduncle, covering about 85 % of postanal section. Caught at South Georgia (Fig. 13) .... *Artedidraco mirus*

3 b Lateral melanophores extend about 71 - 74 % of postanal section. Caught in the Antarctic Peninsula region and in the Weddell Sea (Fig. 20) .... *Artedidraco skottsbergi*

4 a Lateral melanophores extend about one third of the postanal section, abdomen massive and extends posteriorly to above the midline. Pelvic fin long and reaching far beyond the pectoral fin base at 22 mm SL. Fin ray counts D_1 III, D_2 23, A 15, P 17, 13 + 22 = 35 vertebrae .... *Dolloidraco longedorsalis*

4 b Lateral melanophores extend about 42 - 56 % of postanal section 5

5 a Abdomen massive and extends posteriorly to above the midline. Pelvic fin short at 18 mm SL, preanal length 65 - 66 % of SL. Lateral pigment extends about 54 - 56 % of postanal section. Caught in the Weddell Sea .... *Pogonophryne* sp.

5 b Abdomen large, but does not extend ventral to the anal fin, and dorsal part of abdomen below the midline 6

6 a Lateral pigment extends about half the postanal section, found near Shag Rocks (53°30'S, 42°00'W) .... *Artedidraco* sp. A

6 b Lateral pigment extends about 41 - 45 % of the postanal section in specimens of 13 - 19 mm SL. Caught in the Antarctic Peninsula region and in the Weddell Sea (Fig. 40) .... *Artedidraco* sp. B

Note, there is a species with more slender larvae than those described above, from the Prydz Bay and Weddell Sea regions curated by R. Williams Antarctic Division, Kingston and G. Hubold, respectively.

Bathydraconidae

This family includes the genera: *Akarotaxis, Bathydraco, Cygnodraco, Gerlachea, Parachaenichthys, Prionodraco, Racovitzia,* and *Vomeridens*. The sub-family Gymnodraconinae include the genera *Gymnodraco* and *Psilodraco*

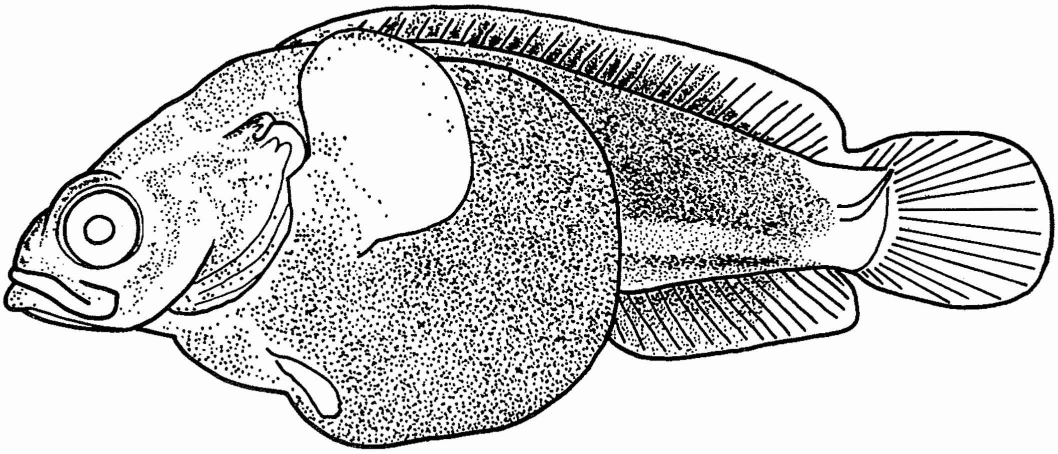

Fig. 19: Artedidraconidae. *Pogonophryne marmorata*, 27 mm TL.

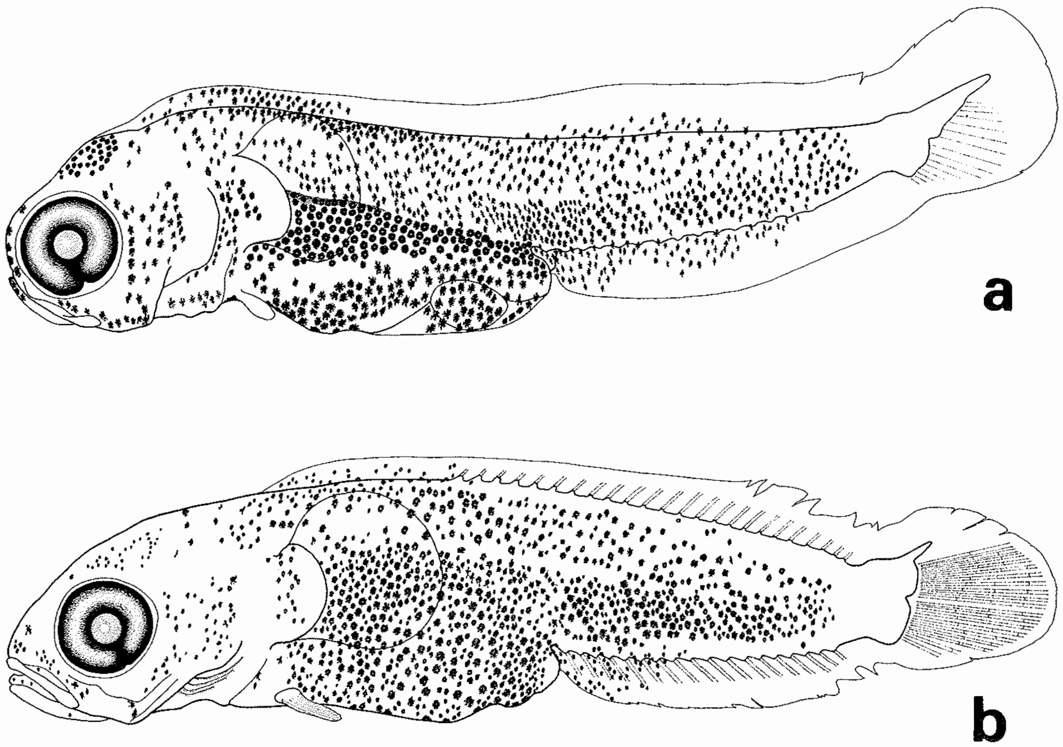

Fig. 20: Artedidraconidae. *Artedidraco skottsbergi*, 11.6 mm SL (a), 15.6 mm SL (b).

(Andriashev, 1983; 1987). The larvae of *Psilodraco breviceps* and *Gymnodraco* sp. are different from the rest of the Bathydraconidae in that their teeth are more prominent at an earlier stage, they are shorter and more deeper bodied, and do not have a well pigmented caudal fin. These differences add further weight to their seperation into a sub-family based upon the presence of pseudochoanae connecting the mouth and olefactory cavities (Jakubowski, 1975; Andriashev, 1983; 1987).

The key includes larvae of nine species. Most of the remaining and yet undescribed larvae belong to the genus *Bathydraco*. Therefore, a table is given at the end of the key, which summarises some meristic counts for the *Bathydraco* spp.. This table may be helpful to identify late larval or early juvenile stages.

1 a Pigment present on postanal section 2

1 b No pigment on the postanal section except on the caudal fin, jaws with numerous small teeth (Fig. 9) .... *Psilodraco breviceps*

2 a Body pigmented all over. Caudal peduncle and ventral region of postanal section may be free of melanophores 3

2 b Pigment on postanal section present as dorsolateral and ventrolateral rows or bars 4

3 a Single dorsal and dorsolateral pigment row above the abdomen, single melanophores above pectoral fin base and on the parietal and occipital head region (Fig. 21). Dorso- and ventrolateral series of spiny scales present from about 21 mm SL onward .... *Prionodraco evansii*

3 b Dorsal region above abdomen with wide pigment band. Caudal peduncle and a ventral stripe along postanal section free of pigment. A few obvious teeth present on the lower jaw (Fig. 7) .... *Gymnodraco acuticeps*

3 c Body heavily pigmented all over except lateral head regions. Abdomen swollen and ventrally rounded. Caudal fin entirely pigmented between rays and pigment groups present on the dorsal and ventral fin membrane between forming rays. No interorbital coronal pores at 37 - 39 mm SL. Caught in the Weddell Sea (Fig. 22). .... *Akarotaxis nudiceps*

4 a Continuous dorsal row or band of melanophores from the caudal peduncle to beyond the anus level 5

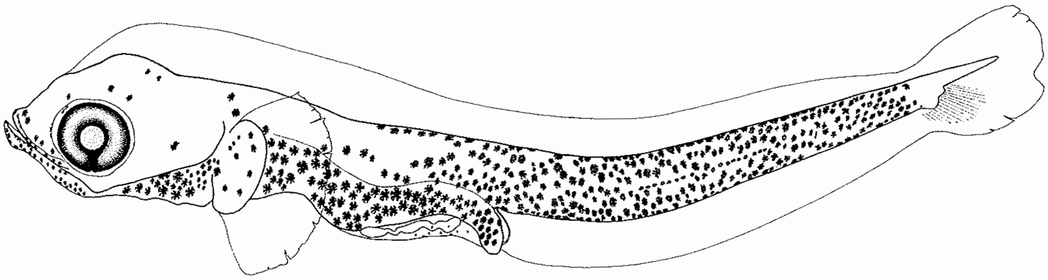

Fig. 21: Bathydraconidae. *Prionodraco evansii*, 13.1 mm SL.

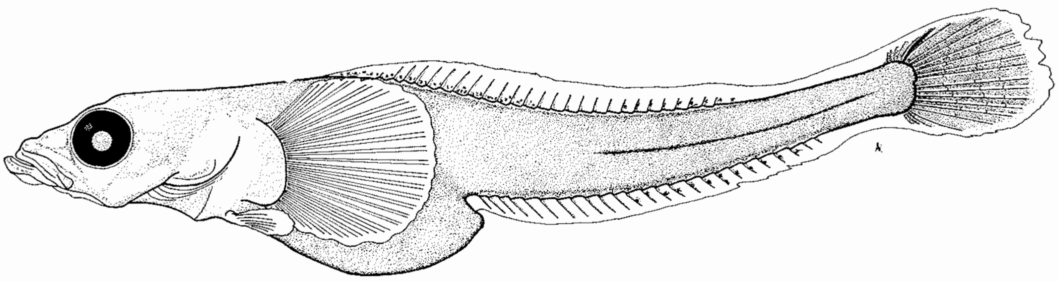

Fig. 22: Bathydraconidae. *Akarotaxis nudiceps*, 39.1 mm SL.

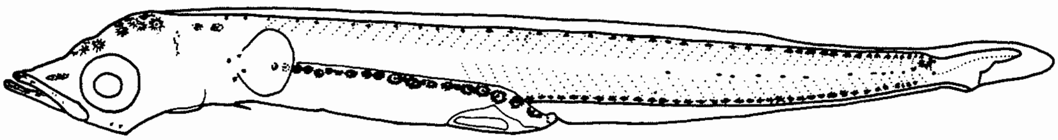

Fig. 23: Bathydraconidae. *Parachaenichthys georgianus*, 22.5 mm SL.

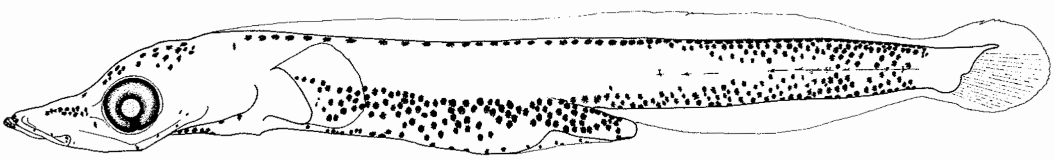

Fig. 24: Bathydraconidae. *Parachaenichthys charcoti*, 26.6 mm SL.

4 b Dorsal pigment restricted to posterior part of the postanal section although scattered dorsal and dorsolateral melanophores may be present 6

5 a Deep dorsal pigment band along postanal section which may extend beyond the anus level or reach the head. Pigment blotch on the ventral part of the caudal fin. Medial nasal stripe reaching the anterior orbit level (Fig. 25b). Interorbital coronal pores present by 30 mm SL. Transforming larvae of .... *Gerlachea australis*

5 b Single dorsal pigment row, always reaching beyond the pectoral fin base. Pigment blotch on the ventral part of the caudal fin. Medial nasal stripe not reaching the anterior orbit level (Figs. 12, 24). Caught in the Antarctic Peninsula region .... *Parachaenichthys charcoti*

5 c Pigmentation very similar to *P. charcoti*, but jaws reaching below the anterior orbit level at 22.5 mm SL (Fig. 23). Abdomen and pectoral fin longer at 28 mm total length than in the same size *P. charcoti*. Caught in waters around South Georgia ....
.... *Parachaenichthys georgianus*

6 a Single ventral pigment row which may be supplemented by numerous minute pigment cells below. Medial nasal pigment row reaching the anterior orbit level, most of the posterior postanal section pigmented (Fig. 25a) ....
.... *Gerlachea australis*

6 b Ventral-ventrolateral pigment band or bar along the postanal section 7

7 a Distinct vertical and horizontal bars present. Vertical bar may be intermittent mediolaterally, horizontal bar may reach the anus level and/or the vertical bar (Figs. 11, 26) .... *Racovitzia glacialis*

7 b Ventral band of minute melanophores, always reaching the anus level, scattered melanophores present between dorsal and ventral pigment bands (Fig. 27) ....
.... *Bathydraco antarcticus*

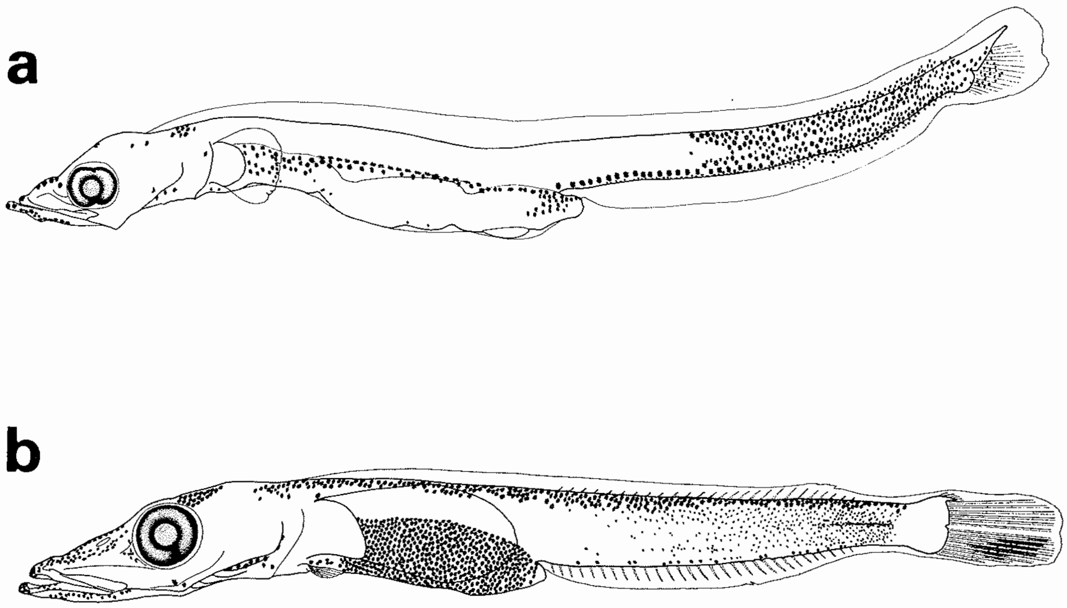

Fig. 25: Bathydraconidae. *Gerlachea australis*, 26.1 mm SL (a), 35.2 mm SL (b).

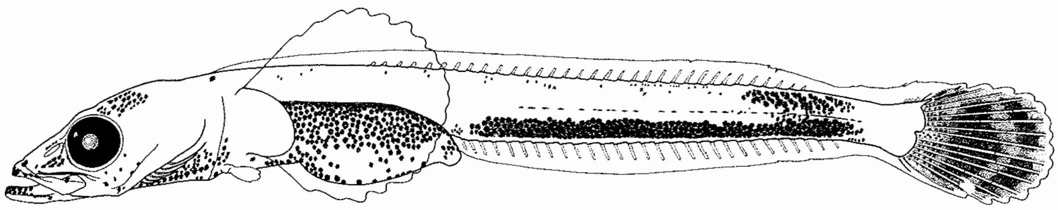

Fig. 26: Bathydraconidae. *Racovitzia glacialis*, 29.2 mm SL.

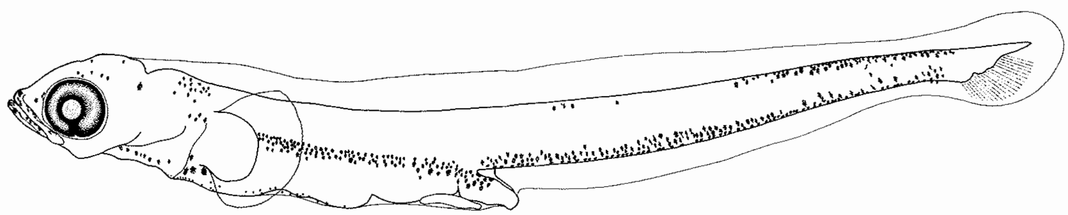

Fig. 27: Bathydraconidae. *Bathydraco antarcticus*, 15.3 mm SL.

Table 1: Meristic counts for *Bathydraco* spp. (From DeWitt, 1964; DeWitt, 1985; DeWitt & Hureau, 1979; DeWitt & Tyler, 1960).

Species	Pectoral	Dorsal	Anal	Gill rakers
B. scotiae	22-23	38-40	31-33	20-24
B. antarcticus	21-23	36-38	31-33	15-19
B. macrolepis	21-23	32-35	28-30	12-15
B. joannae	20-24	33-38	30-34	14-17
B. marri	21-23	33-38	30-33	11-15

Bathylagidae

Gon (1987) has reviewed the genus *Bathylagus* from the Southern Ocean. He recognized three species, *Bathylagus antarcticus*, *B. gracilis* (*B. euryops latifrons*) and *B. tenuis*. Larval *Bathylagus antarcticus* were described by Efremenko (1979) and Gon (1987). *B. antarcticus* has eyes on stalks (Fig. 3), a characteristic of several larvae of this and other families which increases the perceptive visual field (Moser, 1981).

Bovichthyidae

Hureau & Tomo ,(1977) described the first species of the Notothenioid family Bovichthyidae to be found in Antarctic waters which was *Bovichthys elongatus* from the Antarctic Peninsula. No larvae of this species have been described.

Channichthyidae

The family Channichthyidae includes the genera: *Chaenocephalus, Chaenodraco, Champsocephalus, Channichthys, Chionobathyscus, Chionodraco, Cryodraco, Dacodraco, Neopagetopsis, Pagetopsis* and *Pseudochaenichthys*. Iwami (1985) from osteological evidence noted the close similarity between several groups of genera: *Pagetopsis, Neopagetopsis* and *Pseudochaenichthys; Cryodraco, Chionobathyscus* and *Chaenocephalus; Chionodraco* and *Chaenodraco.*

The key can be used to identify channichthyiids up to a size of about 50 mm total length, i.e. before metamorphosis towards the juvenile is well advanced. Young larvae of *Chaenodraco wilsoni* and *Cryodraco antarcticus* of less than 29 mm SL have not yet been described, as well as early stages of

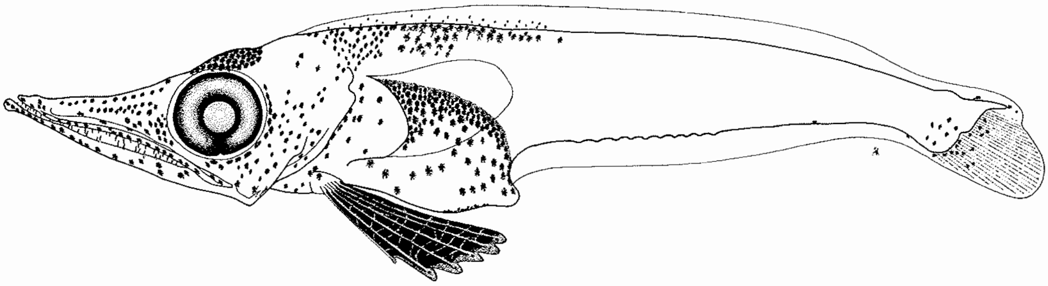

Fig. 28: Channichthyidae. *Pseudochaenichthys georgianus*, 26.9 mm SL.

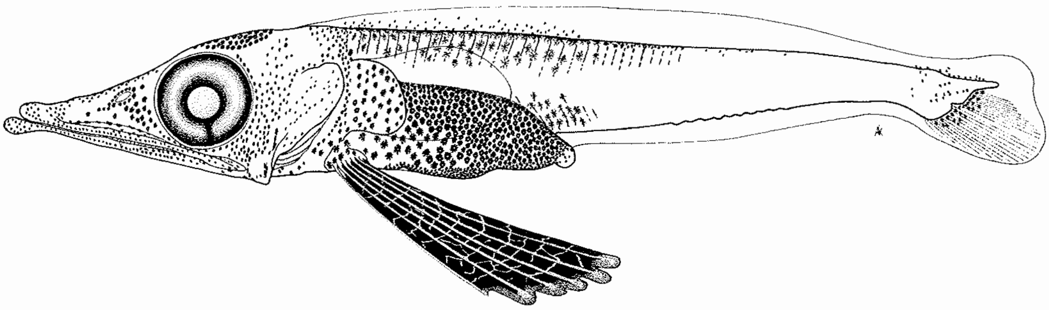

Fig. 29: Channichthyidae. *Pagetopsis macropterus*, 28.8 mm SL.

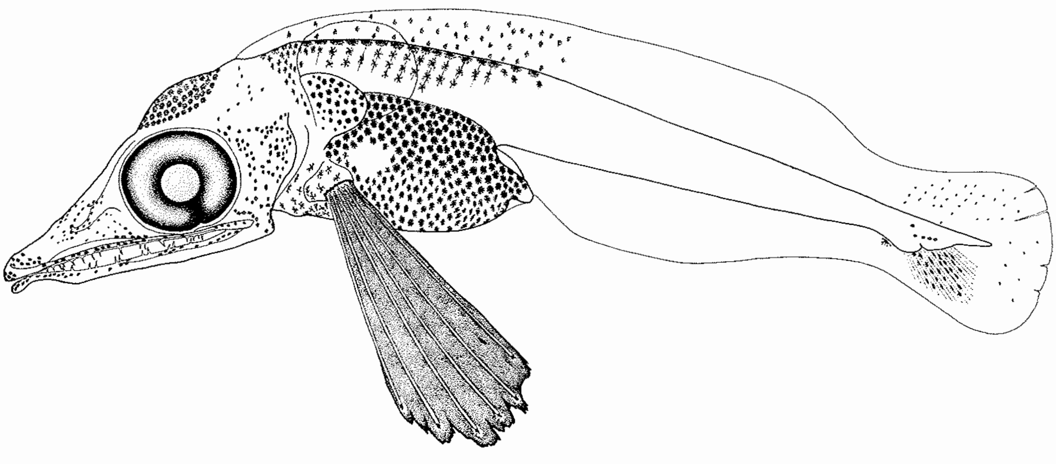

Fig. 30: Channichthyidae. *Pagetopsis maculatus*, 15.3 mm SL.

Neopagetopsis ionah. The latter are probably very similar to those of *Pagetopsis* spp.. So far, the larva figured by Kellermann (1986) could not be distinguished from larval *Pagetopsis maculatus* except by the higher number of myotomes (57). At the present state, it is not possible to distinguish larval *Chionodraco rastrospinosus* from larvae of *C. hamatus* and *C. myersi.*

1 a No postanal lateral pigment except on the caudal peduncle; if present, only on anterior part of postanal section 2

1 b Lateral pigment rows or bars on postanal section 5

2 a Complete dorsal row of melanophores present, small pelvic fin in early larvae (Fig. 10) .... *Champsocephalus gunnari*

2 b Dorsal melanophore row absent or incomplete 3

3 a Anterior dorsolateral pigment series on myosepta reaching no more than half way down to the peritoneal pigment, pelvic fin heavily pigmented (Fig. 28) .... *Pseudochaenichthys georgianus*

3 b Anterior dorsolateral pigment reaching more than half way down to the peritoneal pigment 4

4 a Larvae with 52 - 54 myotomes. Dorsolateral pigment not extending posteriorly beyond the anus level in larvae smaller than 23 mm, dorso- and ventrolateral pigment may be present on postanal section in larger larvae (cf. Regan, 1916; Plate IV). (Fig. 29) .... *Pagetopsis macropterus*

4 b Larvae with 49 - 51 myotomes. Dorsolateral pigment extending posteriorly beyond the anus level from 17 - 20 mm onward (Fig. 30) .... *Pagetopsis maculatus*

5 a Two vertical pigment bars present on postanal section, long slender jaws when viewed from above (Fig. 8) .... *Dacodraco hunteri*

5 b Lateral pigment rows present along postanal section ... 6

6 a A single dorsolateral and a single ventrolateral pigment row present along postanal section 7

6 b More than two lateral rows present, at least on the anterior postanal section 8

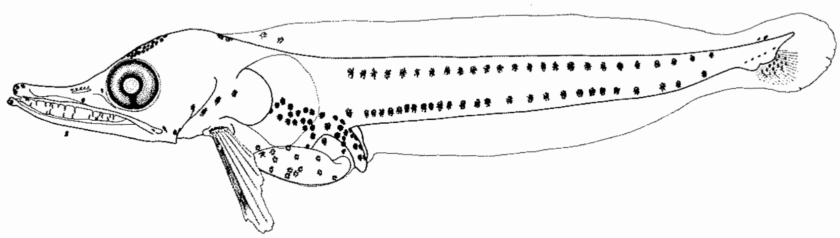

Fig. 31: Channichthyidae. *Chaenocephalus aceratus*, 19.8 mm SL.

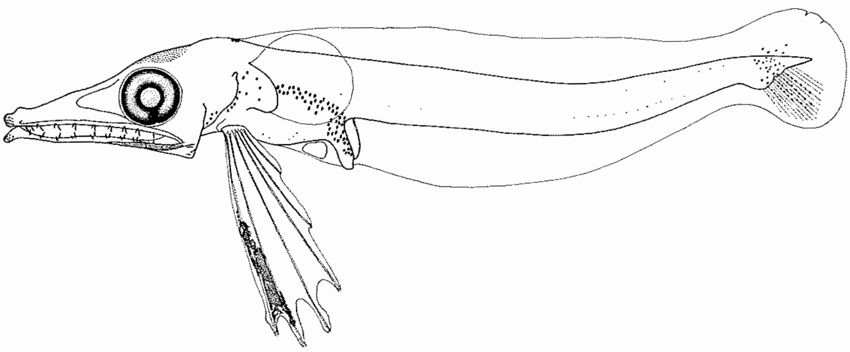

Fig. 32: Channichthyidae. *Chionobathyscus dewitti*, 25.4 mm SL.

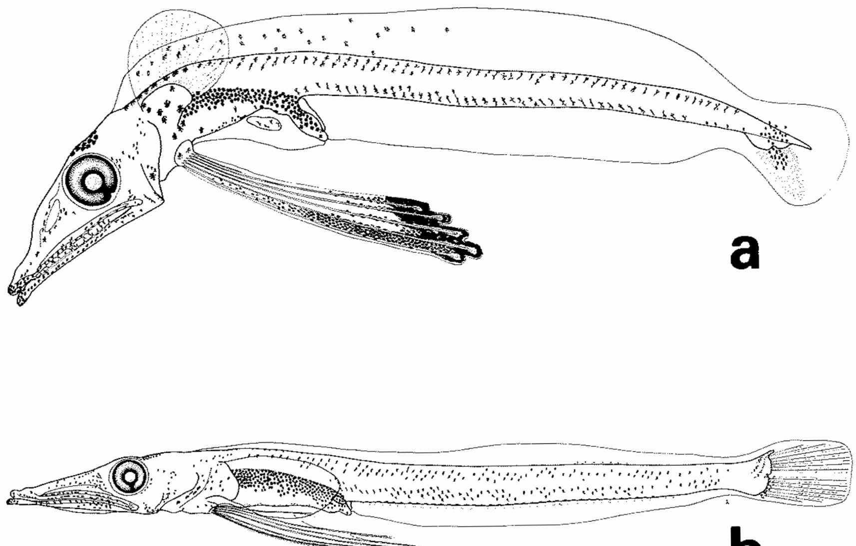

Fig. 33: Channichthyidae. *Cryodraco antarcticus*, 29.0 mm SL (a), 48.9 mm SL (b).

7 a Pectoral fin base only pigmented on upper anterior part (Fig. 31) .... *Chaenocephalus aceratus*

7 b Melanophores distributed over entire pectoral fin base (Fig. 32) .... *Chionobathyscus dewitti*

8 a Two dorsolateral and two ventrolateral pigment rows on the anterior postanal section and above the abdomen in small larvae (Fig. 33a), two or three each in larger specimens (Fig. 33b). Pelvic fin long, extending far beyond the anus level, with six rays (I, 5) .... *Cryodraco antarcticus*

8 b Two to three dorsolateral and two to three ventrolateral pigment rows on the anterior postanal section and above the abdomen in small larvae; further rows may be present in larger larvae (more than 30 mm SL) 9

9 a Two to three dorsolateral and two to three ventrolateral pigment rows on the anterior postanal section and above the abdomen (Fig. 34a), four to six such rows each in larvae longer than 35 - 40 mm SL (Fig. 34b). Pelvic fin not reaching beyond about one third of the postanal distance, with six rays (I, 5) .... *Chionodraco rastrospinosus*

9 b Two to three dorsolateral and two to three ventrolateral pigment rows on anterior postanal section and above the abdomen; a few melanophores of a fourth ventrolateral row may be present (Fig. 35). Pelvic fin not reaching beyond about one third of the postanal distance, with five rays (I, 4) .... *Chaenodraco wilsoni*

Harpagiferidae

There is only one genus in this family which is *Harpagifer.* Each species of the family is specific to a region (Hureau et al., 1980), therefore the larvae from a locality should be that of the parent species. The eggs of the genus are benthic which in the species where breeding has been observed are in a nest guarded by one or more of the parents (Daniels, 1978; Burren, 1988). This strategy of nesting should prevent dispersal of the eggs and make it likely that larvae of the species are also specific to the same locality as the parent species. A larva of *Harpagifer antarcticus* from the Antarctic Peninsula region is shown in Fig. 15.

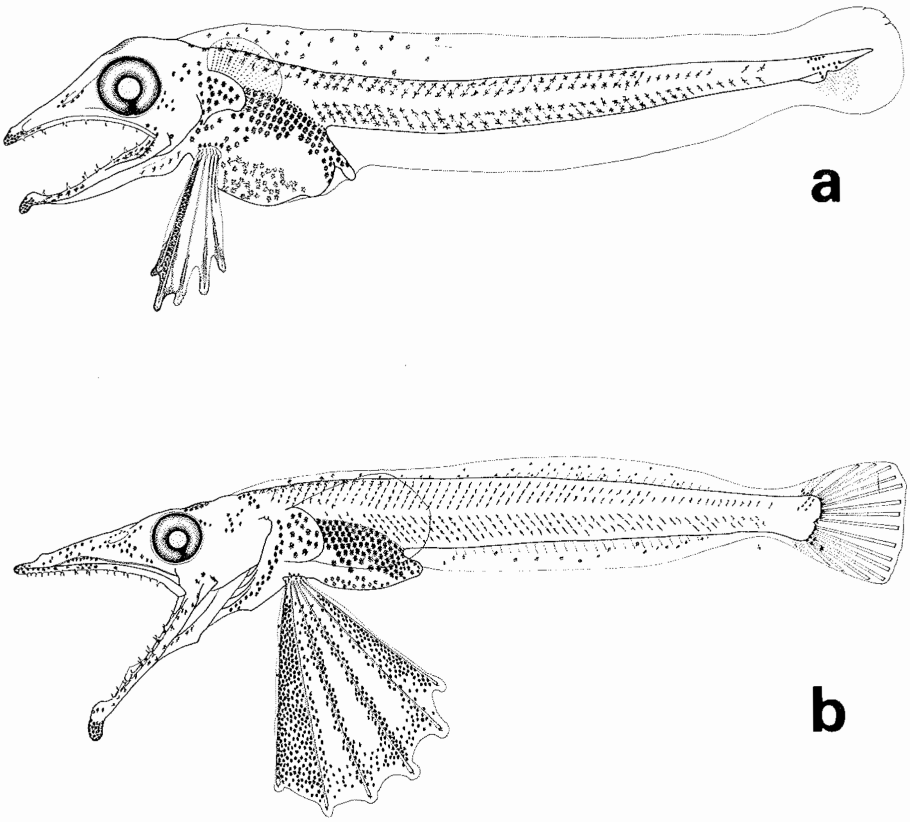

Fig. 34: Channichthyidae. *Chionodraco rastrospinosus*, 24.5 mm SL (a), 47.0 mm SL (b).

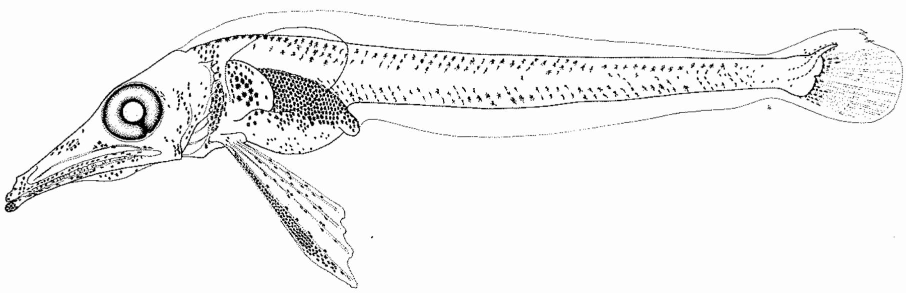

Fig. 35: Channichthyidae. *Chaenodraco wilsoni*, 34.0 mm SL.

Liparididae

Twenty six species or types of Liparididae are listed in Fischer & Hureau (1985) including: four species of *Careproctus*, one of *Genioliparis*, two of *Notoliparis* and 19 species of *Paraliparis*. Andriashev (1986) in his review of the genus *Paraliparis* of the Southern Ocean reports that there are 30 species known from the region.

The larvae of few Antarctic Liparididae have been reported. Larvae of *Careproctus georgianus* 12.5 - 14.5 mm total length have been described by Efremenko (1983). There is the figure of a single *Paraliparis antarcticus* of 19.6 mm total length in North & White (1982) (Fig. 6). However, in the light of Andriashev (1986) it is possible that this may be another species of the genus *Paraliparis*. The larvae of both *Paraliparis* and *Careproctus* described above were similar to the juveniles of the genera. If this is true for other species then they should be easy to identify to the generic level.

Macrouridae

Eight species from five genera of Macrouridae were reported from the Antarctic by T. Iwamoto in Fischer & Hureau (1985). Fahay and Markle (1984) describe the general characteristics of the larvae of this family which include a moderately long pectoral fin peduncle. The larvae of one species of Macrouridae, *Macrourus holotrachys* Günther, 1878, (*Macrourus whitsoni* Regan 1913), have been described (Efremenko, 1983). This species in common with the family has a stalked pectoral fin.

Muraenolepididae

Four species of *Muraenolepis* occur in the Southern Ocean (Fischer & Hureau, 1985). Larvae described as *Muraenolepis microps* were reported by North & White (1982) (Fig. 14) and Efremenko (1983). Gon (1988) has also reported a larval *Muraenolepis* sp. from Prydz Bay, in the Indian Ocean sector of the Southern Ocean. Larval *Muraenolepis* are unique in possessing spines on the pre-maxillary which may be a characteristic of the genus (Fahay & Markle, 1984). However, these spines are transitory and were not found in individuals of 70 mm total length (North, personal observations).

Myctophidae

The family Myctophidae includes many genera and several of these are represented in the midwater fish fauna of the Antarctic. These include: *Krefftichthys, Protomyctophum, Electrona, Lampanyctus* and *Gymnoscopelus*. Hulley (1981) reports more than 20 species of myctophids from the Southern Ocean. So far only the larvae of five species have been described.

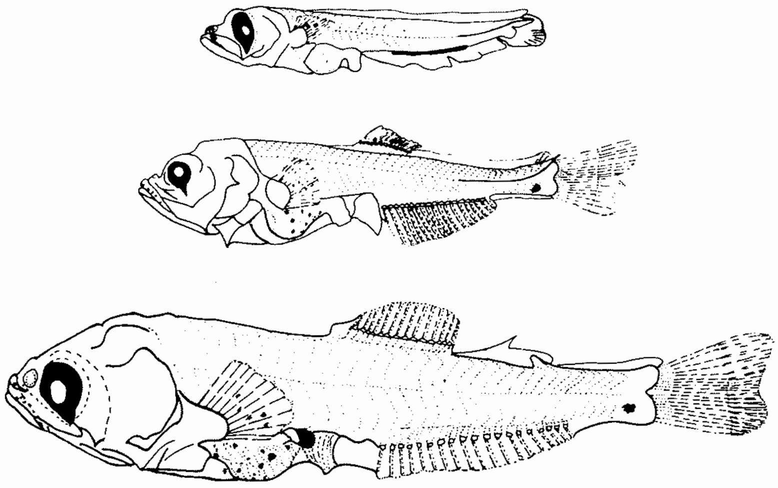

Fig. 36: Myctophidae. *Electrona antarctica*, 8.9 mm, 11.0 mm and 17.6 mm SL (from above; from Rasoanarivo & Aboussouan, 1983).

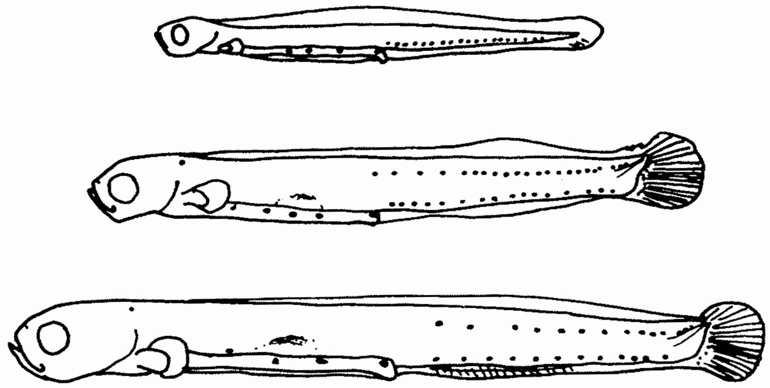

Fig. 37: Myctophidae. *Gymnoscopelus braueri*, 4.5 mm, 11.2 mm and 13 mm SL (from above; redrawn from Efremenko, 1972).

1 a Eyes with ventral extension 2

1 b Eyes with no ventral extension 4

2 a Gut long (Fig. 38) .... *Krefftichthys anderssoni*

2 b Gut short 3

3 a Melanophores on the anterior dorsal of the snout (upper lip). In later stages > 9 mm total length there is a melanophore below the urostyle (Fig. 36) .... *Electrona antarctica*

3 b Pigmented on the upper lip but without a hypural melanophore even when longer than 9 mm total length (Figs. 4, 39), provisionally identified as .... *Electrona carlsbergi*

4 a Vertical pigment bar on the postanal section .... *Gymnoscopelus opisthopterus*

4 b No vertical pigment bar on the postanal section (Fig. 37) .... *Gymnoscopelus braueri*

Nototheniidae

This family includes the genera: *Eleginops, Patagonotothen, Paranotothenia, Notothenia, Nototheniops, Pleuragramma, Trematomus, Pagothenia, Aethotaxis, Cryothenia*. The key is designed for larvae up to metamorphosis but not for late metamorphosing larvae which have a different, usually barred pigment pattern. In a few cases only, particularly where late larvae of different species are very similar and co-occur at the same time of the year, these have been included.

1 a Dorsal pigment row present over more than two-thirds of the postanal section 2

1 b Dorsal pigment row absent or restricted to the caudal peduncle or neck and shoulder regions 22

2 a Dorsal pigment row wide and deep, more than a single row, or a band of numerous melanophores 3

2 b A single dorsal pigment row 15

3 a No ventral pigment row 4

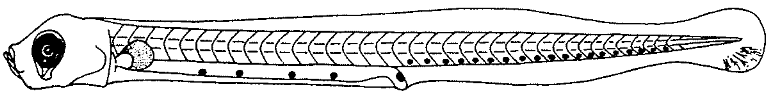

Fig. 38: Myctophidae. *Krefftichthys anderssoni* (redrawn from Efremenko, 1976).

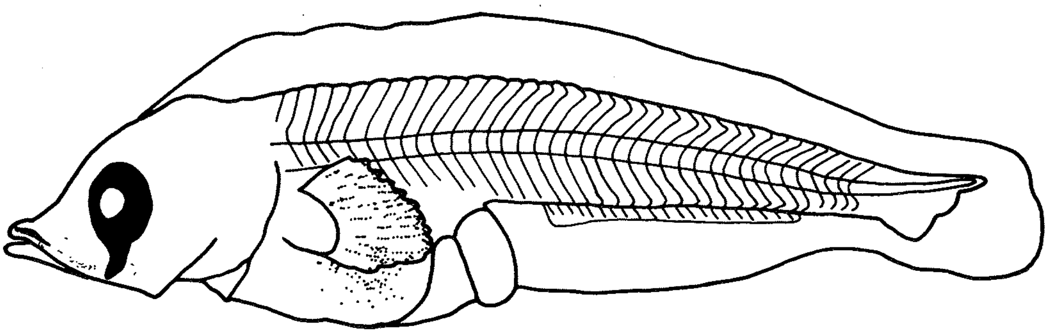

Fig. 39: Myctophidae. *Electrona carlsbergi*, 10 mm TL.

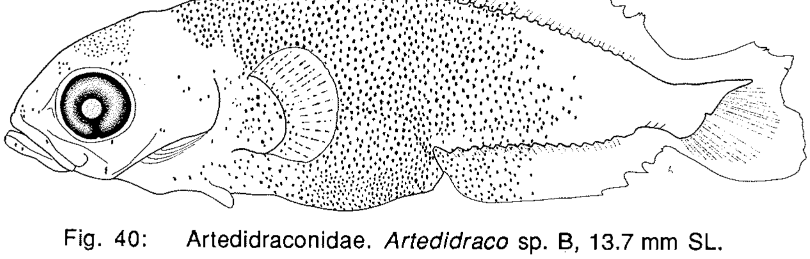

Fig. 40: Artedidraconidae. *Artedidraco* sp. B, 13.7 mm SL.

3 b Ventral pigment row present 8

4 a Ventrolateral row or group of melanophores (more than just a row) present on postanal section 5

4 b Body pigmented all over except ventral part of postanal section 6

5 a In early larvae jaws, snout and caudal peduncle not pigmented (Camus & Duhamel, 1985; Fig. 41), pectoral fin with 20 - 24 rays .... *Notothenia rossii*

5 b In early larvae jaws, snout and caudal peduncle pigmented with scattered melanophores; from about 17 mm SL onward the distal pectoral fin membrane may be pigmented. Pectoral fin with 16 - 19 rays (Fig. 43a) .... *Notothenia neglecta*

6 a Body long and slender (Fig. 17) ..... *Aethotaxis mitopteryx*

6 b Body short and deep, dorsal and anal fin rays forming 7

7 a Pectoral fin rounded, not reaching beyond the anus level, no pigment blotch present on the distal pectoral fin membrane (Fig. 42) .... *Notothenia rossii*

7 b Pectoral fin elongated, reaching beyond the anus level; pigment blotch present on the distal pectoral fin membrane (Fig. 43b) .... *Notothenia neglecta*

8 a Lateral pigment present on the postanal section 9

8 b No lateral pigment 12

9 a Ventral abdominal melanophores present 10

9 b No ventral abdominal pigment 11

10 a Scattered lateral melanophores on the posterior part of postanal section, margin of dorsal pigment band meandering, abdomen densely covered by melanophores .. .. *Trematomus scotti*

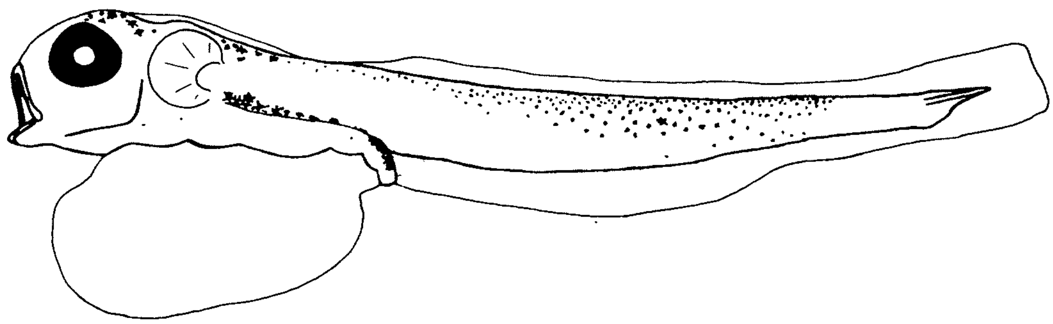

Fig. 41: Nototheniidae. *Notothenia rossii rossii*, about 9 mm SL (from Camus & Duhamel, 1985).

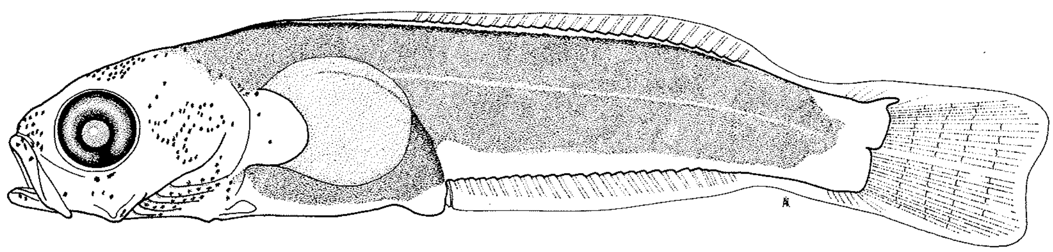

Fig. 42: Nototheniidae. *Notothenia rossii marmorata*, 19.0 mm SL.

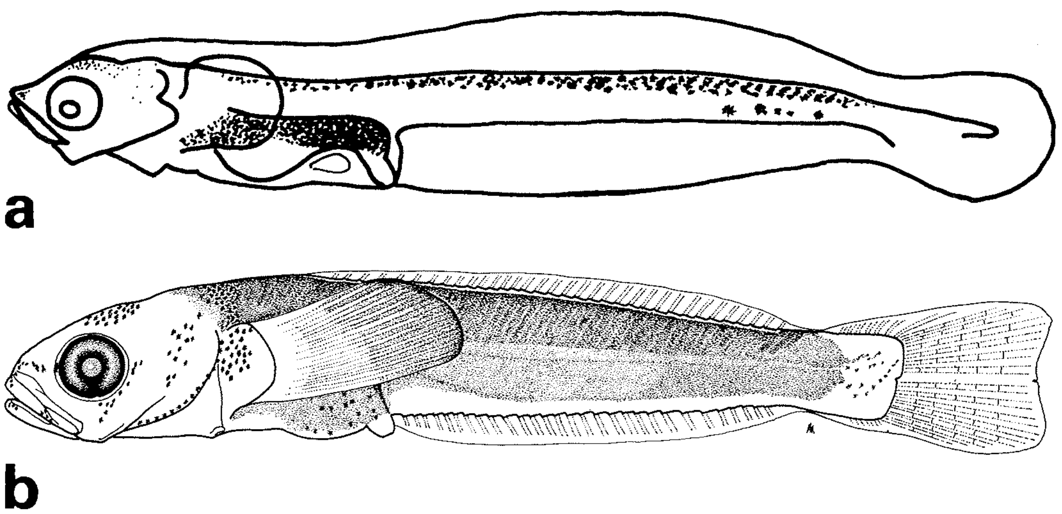

Fig. 43: Nototheniidae. *Notothenia neglecta*, 16.8 mm SL (a), 23.0 mm SL.

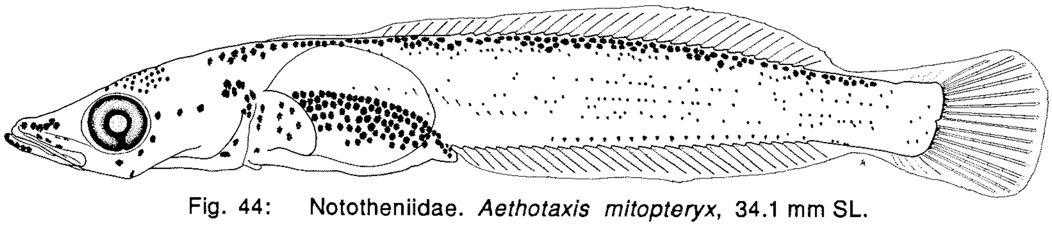

Fig. 44: Nototheniidae. *Aethotaxis mitopteryx*, 34.1 mm SL.

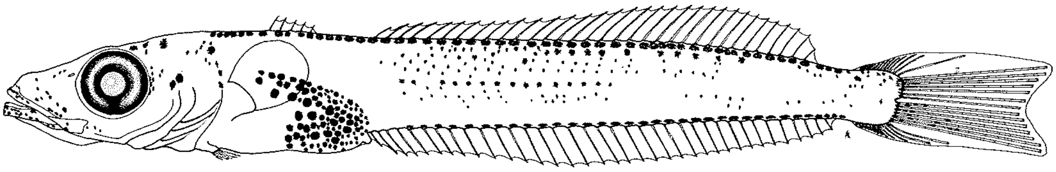

Fig. 45: Nototheniidae. *Pleuragramma antarcticum*, 47.6 mm SL.

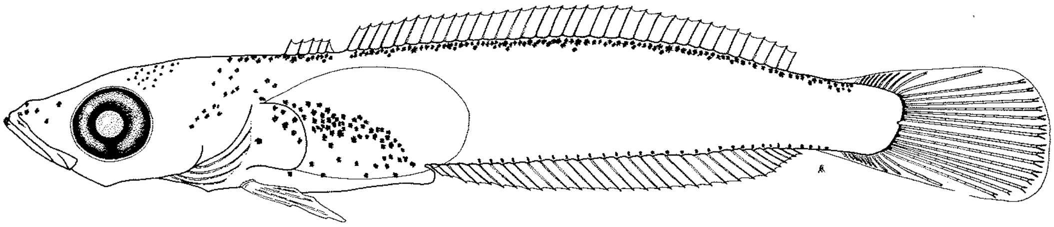

Fig. 46: Nototheniidae. *Pagothenia borchgrevinki*, 33.0 mm SL.

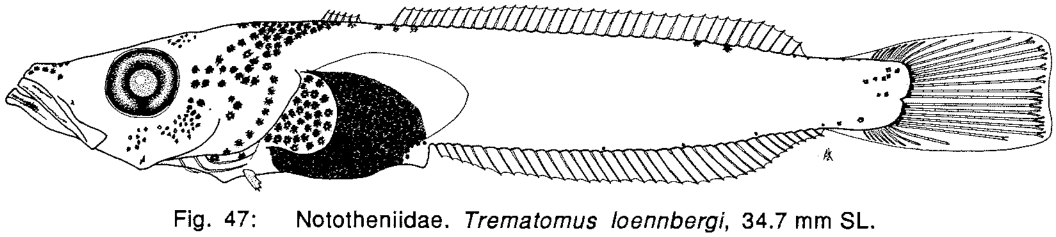

Fig. 47: Nototheniidae. *Trematomus loennbergi*, 34.7 mm SL.

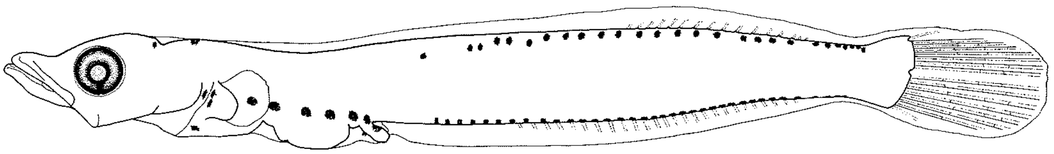

Fig. 48: Nototheniidae. *Pleuragramma antarcticum*, 17.5 mm SL.

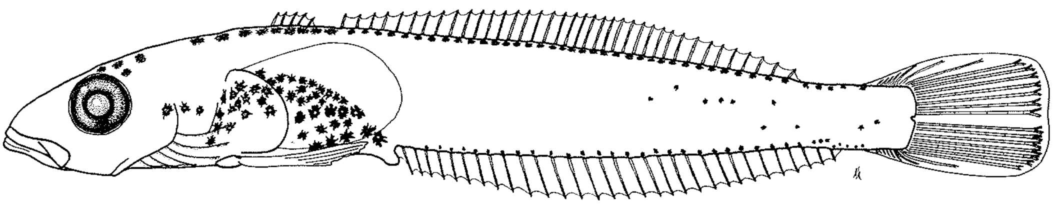

Fig. 49: Nototheniidae. *Trematomus nicolai*, 29.2 mm SL.

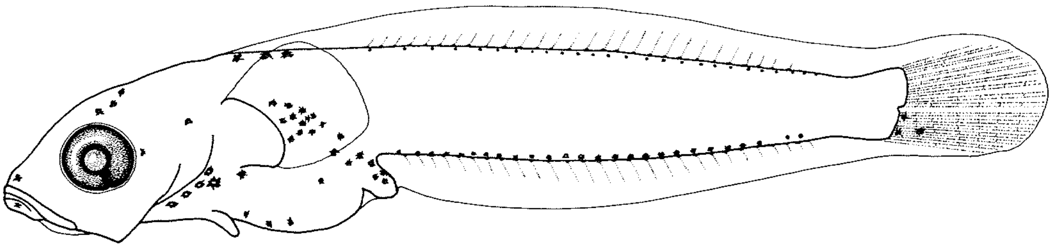

Fig. 50: Nototheniidae. *Notothenia angustifrons*, 12.4 mm SL.

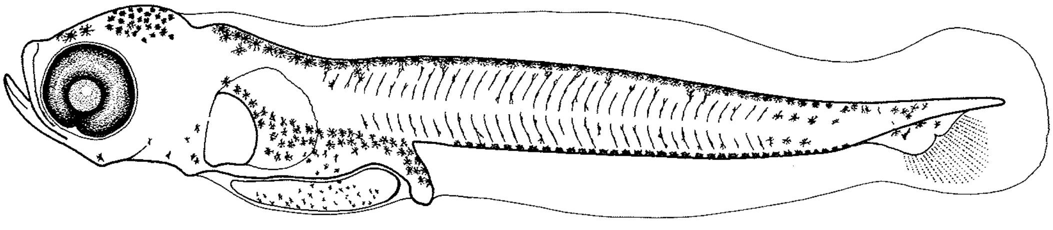

Fig. 51: Nototheniidae. *Trematomus newnesi*, 10.9 mm SL.

10 b Lateral pigment scattered along postanal section or forming a barred, chess-board like pattern, dorsal pigment band of numerous small pigment cells, ventrolateral part of abdomen with few melanophores .... *Pagothenia brachysoma*

11 a Lateral pigment in rows along postanal section, pelvic fin inconspicious, pectoral fin base pigmented (Fig. 44) .... *Aethotaxis mitopteryx*

11 b Lateral pigment in rows along postanal section, pelvic fin inconspicious, no pigment on pectoral fin base (Fig. 45) .... *Pleuragramma antarcticum*

11 c Lateral pigment scattered along postanal section or forming a barred pattern, pelvic fin long and well developped .... *Pagothenia borchgrevinki*

12 a Ventral abdominal pigment present 13

12 b No ventral abdominal pigment 14

13 a Abdomen densely covered by melanophores, dorsal row of single groups of pigment cells; pelvic fin short, reaching about the posterior margin of the pectoral fin base .... *Trematomus scotti*

13 b Ventrolateral part of abdomen with few melanophores, continuous dorsal pigment band of numerous small pigment cells .... *Pagothenia brachysoma*

14 a Dorsal pigment band continuous, extending from the caudal peduncle to beyond the pectoral fin base, pectoral fin base pigmented (Fig. 46) .... *Pagothenia borchgrevinki*

14 b Dorsal pigment band extending from the caudal peduncle to about the anus level, no pigment on pectoral fin base (Fig. 48) .... *Pleuragramma antarcticum*

15 a Lateral melanophores in lines along the myosepta, more than two continuous lateral rows 16

15 b No lateral pigment, or lateral melanophores not in lines along the myosepta; if in lines, no more than two lateral lines present 17

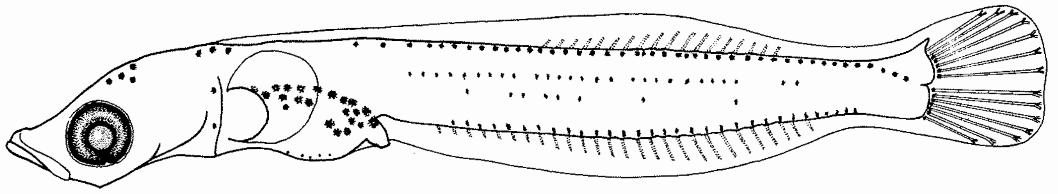

Fig. 52: Nototheniidae. *Trematomus centronotus*, 21.7 mm SL.

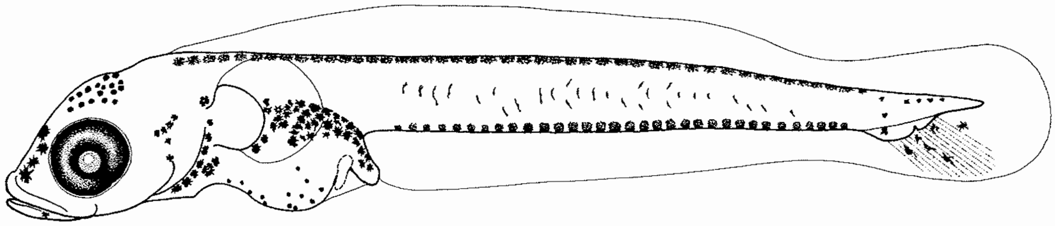

Fig. 53: Nototheniidae. *Notothenia gibberifrons*, 12.7 mm SL.

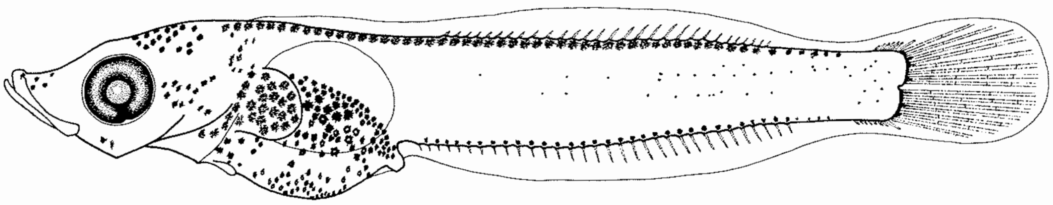

Fig. 54: Nototheniidae. *Trematomus eulepidotus*, 35.6 mm SL.

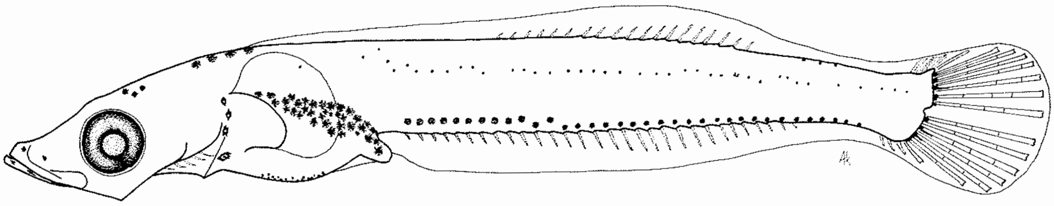

Fig. 55: Nototheniidae. *Trematomus lepidorhinus*, 23.0 mm SL.

16 a Ventral abdominal pigment present (Fig. 51) .... *Trematomus newnesi*

16 b No ventral abdominal melanophores (Fig. 45) .... *Pleuragramma antarcticum*

17 a No lateral pigment or only a few scattered melanophores 18

17 b At least one row of lateral pigment evident 21

18 a Ventral abdominal pigment present 19

18 b No ventral abdominal pigment 20

19 a No pigment, or only a few melanophores on lateral and ventrolateral region of abdomen (Fig. 50) .... *Notothenia angustifrons*

19 b Abdomen entirely covered by melanophores, dense pigment group on the neck region ..... *Trematomus loennbergi*

20 a Dorsal pigment row extending from the caudal peduncle to beyond the pectoral fin base level, upper part of pectoral fin base pigmented (Fig. 49) .... *Trematomus nicolai*

20 b Dorsal pigment row extending from the caudal peduncle to the anus level or less, no pigment on pectoral fin base, early larvae of (see Regan, 1916; Efremenko, 1983) .... *Pleuragramma antarcticum*

21 a No pigment on the snout, between the eyes and on the pectoral fin base (Fig. 16). Dorsal pigment row extends from the caudal peduncle to the head although melanophores of this row may be weak or absent above the abdomen (Fig. 52). A dorsolateral and a ventrolateral pigment row on the postanal section. Larval stages of ... . *Trematomus centronotus*

21 b Anterior part of the head pigmented. Dorsal pigment row extends to the head although the row may be intermittent in early larvae. Lateral pigment rows present, reaching about the anus level. No pigment on the pectoral fin base present in early larvae (Fig. 53). Larval stages of .... *Notothenia gibberifrons*

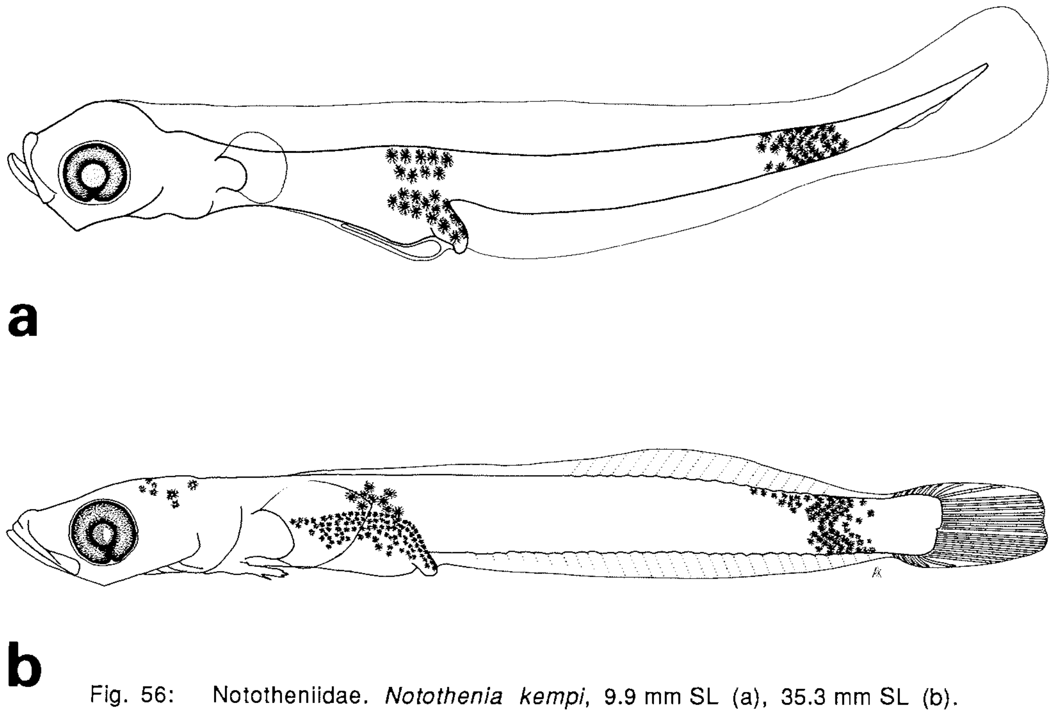

Fig. 56: Nototheniidae. *Notothenia kempi*, 9.9 mm SL (a), 35.3 mm SL (b).

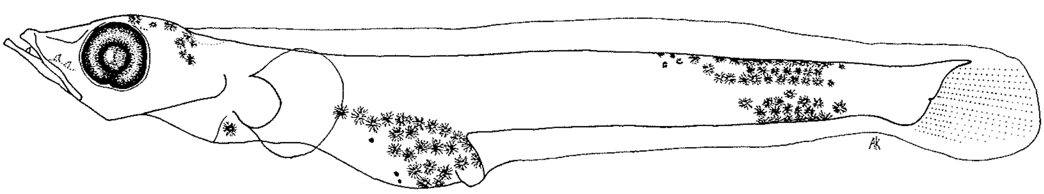

Fig. 57: Nototheniidae. *Dissostichus eleginoides*, 20.5 mm TL.

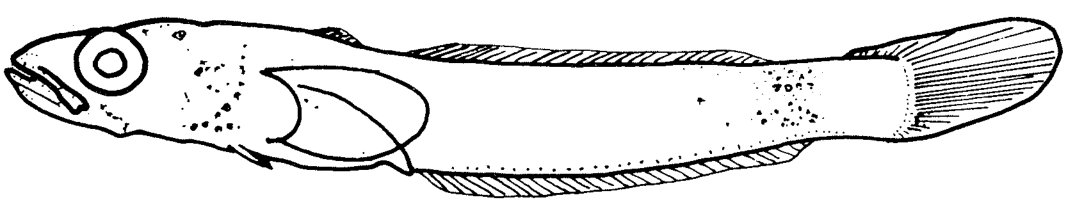

Fig. 58: Nototheniidae. *Dissostichus eleginoides*, 46.5 mm SL.

21 c Scattered lateral pigment present on posterior part of postanal section, sometimes forming a short lateral row. Melanophores present on the upper part of the pectoral fin base, no ventral abdominal melanophores (Fig. 49) .... *Trematomus nicolai*

21 d Anterior part of the head pigmented. Dorsal row extends from the caudal peduncle to the abdomen only, or, extends to the head, but may be weak above the abdomen. Abdomen well pigmented, ventral abdominal melanophores present. Pectoral fin base completely pigmented or only on the upper part (Fig. 54). Larval stages of .... *Trematomus eulepidotus*

22 a Vertical band of melanophores on the postanal section 23

22 b No vertical band of melanophores 26

23 a No ventral melanophore row 24

23 b Ventral melanophore row present 25

24 a Dorsolateral pigment above the abdomen (Fig. 56), no obvious teeth, or small teeth in late larvae........................... .... *Notothenia kempi*

24 b No pigment above the abdomen, teeth obvious from about 20 mm SL onward (Fig. 57). Larvae of .... *Dissostichus eleginoides*

25 a No obvious teeth, or very small teeth in late larvae. Dorsolateral pigment above the abdomen, pelvic fin long at 33 mm SL .... *Notothenia squamifrons*

25 b Teeth obvious, pelvic fin short at 33 mm SL. Late larvae of (Fig. 58) .... *Dissostichus eleginoides*

26 a No ventral abdominal melanophores 27

26 b Ventral abdominal melanophores present 29

27 a Dorsolateral melanophore row may be present with variable numbers of melanophores, more than five melanophores on the peritoneum 28

27 b No dorsolateral melanophore row, five or less melanophores on the peritoneum, anterior ventral pigment often faint or missing (Fig. 59) .... *Pagothenia hansoni*

28 a Anterior ventral pigment well developped, dorsolateral pigment row may be present, a single melanophore present below the pectoral fin base, pre-flexion larvae until 18 - 20 mm SL, 40 or more ventral melanophores on postanal section (Fig. 60) .... *Nototheniops larseni*

28 b Anterior ventral pigment well developped, dorsolateral pigment row always present, extending about two thirds or more of the postanal section length. Pre-flexion larvae until 15 - 17 mm SL, 35 or less ventral melanophores on postanal section (Fig. 61). Larvae of .... *Nototheniops nudifrons*

28 c Short posterior dorsal and ventral pigment rows on the cauda, single anterior ventral melanophores may be present. Single dorso- and ventrolateral melanophores may be present, post-flexion larvae at 15 mm SL. Fin ray counts D_1 VI, D_2 35, A 30, P 24, and 48 vertebrae. Unidentified nototheniid transforming larvae of 15 29 mm SL, caught in the Weddell Sea in summer (Fig. 62).

29 a Anterior dorsal pigment on the neck region, either a dense group or a short row 30

29 b No anterior dorsal pigment, or a single, medial melanophore present on the neck region 33

30 a Lateral pigment row on the postanal section 31

30 b No lateral pigment row on the postanal section 32

31 a Dorsolateral pigment row of 30 or more melanophores, short dorsal pigment row on the caudal peduncle (Figs. 55, 63) .... *Trematomus lepidorhinus*

31 b Dorsolateral pigment row of less than 30 melanophores, short ventrolateral row may be present; small larvae of less than 18 - 20 mm SL of ...... *Trematomus eulepidotus*

32 a Peritoneal pigment only present on the dorsal and ventral abdominal regions (Fig. 64). Early larvae of .... *Notothenia angustifrons*

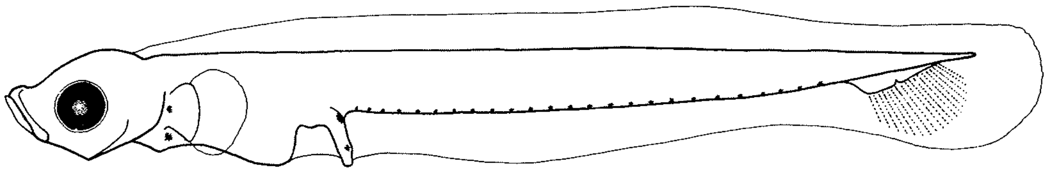

Fig. 59: Nototheniidae. *Pagothenia hansoni*, 15.1 mm SL.

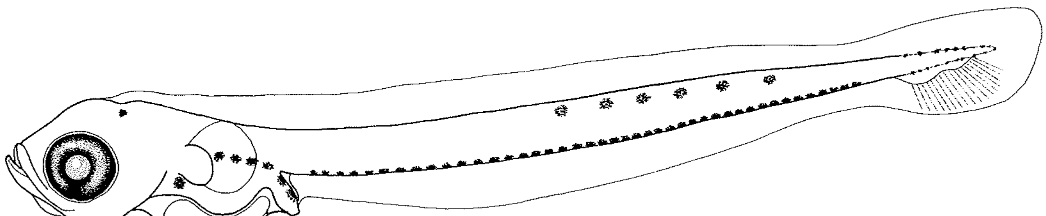

Fig. 60: Nototheniidae. *Nototheniops larseni*, 9.8 mm SL.

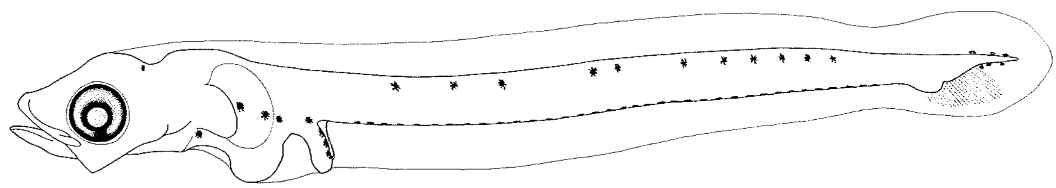

Fig. 61: Nototheniidae. *Nototheniops nudifrons*, 15.1 mm SL.

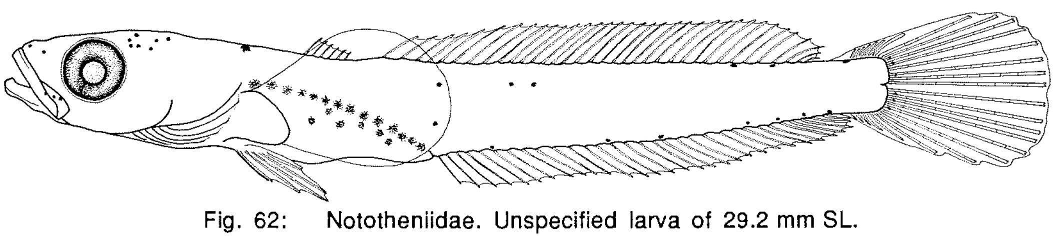

Fig. 62: Nototheniidae. Unspecified larva of 29.2 mm SL.

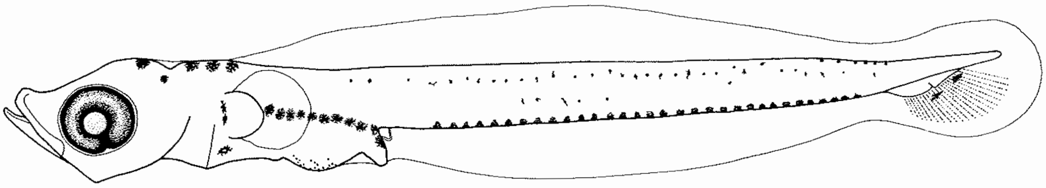

Fig. 63: Nototheniidae. *Trematomus lepidorhinus*, 14.5 mm SL.

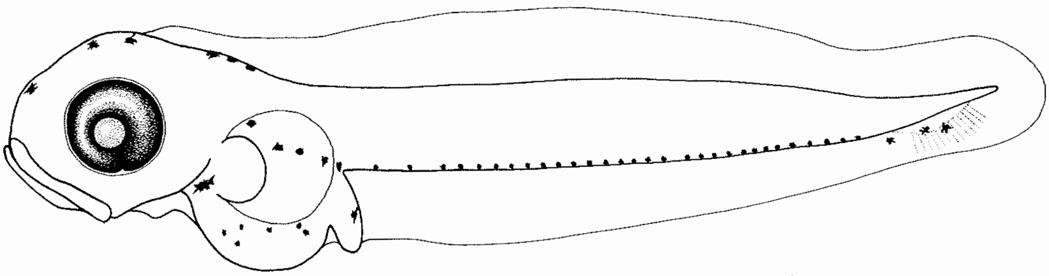

Fig. 64: Nototheniidae. *Notothenia angustifrons*, 6.5 mm SL.

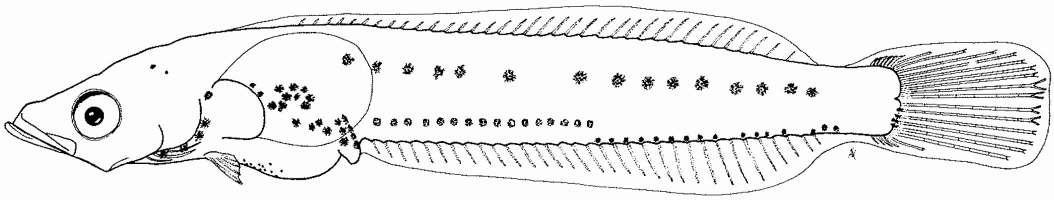

Fig. 65: Nototheniidae. *Nototheniops nudifrons*, 29.2 mm SL.

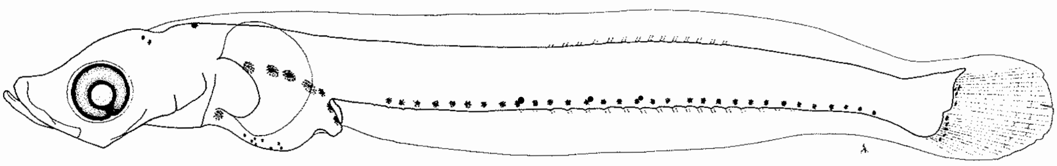

Fig. 66: Nototheniidae. *Trematomus scotti*, 15.5 mm SL.

32 b Abdomen entirely covered by melanophores, dense anterior dorsal pigment group on the neck region (Fig. 47) .... *Trematomus loennbergi*

33 a More than three dorsal caudal peduncle melanophores, dorsolateral pigment row may be present (Efremenko, 1984) .... *Patagonotothen brevicauda guntheri*

33 b Three or less dorsal caudal peduncle melanophores 34

34 a Dorsolateral melanophore row always present, extending about two thirds or more of the postanal section length. Ventral pigment row often varies slightly in level in transforming larvae (Fig. 65) .... *Nototheniops nudifrons*

34 b Dorsolateral melanophores may be present and of variable extent along the postanal section. Anterior ventral melanophores may be faint or absent. A single medial, subcutaneous melanophore on the neck region (Fig. 66). Larvae of .... *Trematomus scotti*

Paralepididae

There are two genera and a total of four species from the Southern Ocean (Fischer & Hureau, 1985). So far only larvae of *Notolepis coatsi* have been described (Efremenko, 1978). However, larvae collected in the Scotia Sea and in the Antarctic Peninsula region could be identified as *N. coatsi* (Fig. 67) and *N. annulata* (Fig. 68); larval *N. annulata* have dense peritoneal pigment blotches on both sides of the abdomen and a relatively longer head whereas larval *N. coatsi* show the dense peritoneal pigment blotch only on the left side of the abdomen until about 55 - 60 mm SL (S. Schadwinkel, Alfred-Wegener-Institut für Polar- und Meeresforschung, Bremerhaven, FRG, unpublished data).

Discussion

The Notothenioidei especially the Nototheniidae are very similar in appearance, even as adults. Therefore it is not surprising that there are some errors in previously published works. These are listed by authors and species as they were described, followed by the updated identification: North & White (1982) *Gymnoscopelus* sp. is *Krefftichthys anderssoni*; Everson (1968) *Notothenia rossii* is *Notothenia gibberifrons*; Hureau (1970) *Trematomus bernacchii* is *Pleuragramma antarcticum*; Regan (1916) *Cryodraco* sp. is *Dacodraco hunteri, Gymnodraco acuticeps* is probably a *Bathydraco* sp.; Efremenko (1984) *Trematomus eulepidotus* is *T. loennbergi, Trematomus han-*

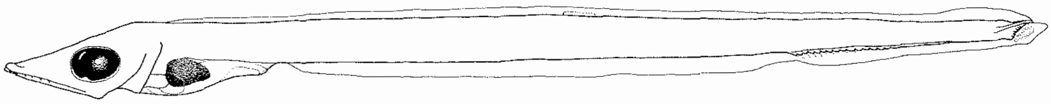

Fig. 67: Paralepididae. *Notolepis coatsi*, 41.0 mm SL.

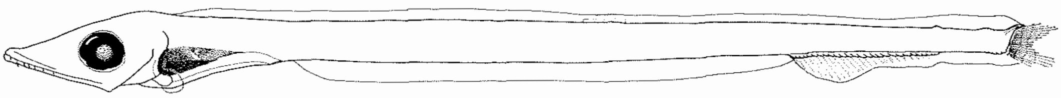

Fig. 68: Paralepididae. *Notolepis annulata*, 36.3 mm SL.

soni is *T. eulepidotus* (see Efremenko, 1983), *Trematomus loennbergi* is *T. lepidorhinus*. For the *Notothenia kempi* / *Pagothenia bernacchii*-problem see BIOMASS (1987; 1988).

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CATALOGUE OF EARLY LIFE STAGES OF ANTARCTIC NOTOTHENIOID FISHES

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Abstract:

The catalogue includes the early stages of 42 Antarctic species of the percomorph suborder of notothenioid fishes from the Atlantic sector of the Southern Ocean. For each species the pigmentation pattern and larval development are described and illustrated with drawings. Information is presented on the spatial and temporal occurrence and, where available, on the food of the pelagic stages. The distinguishing characters of similar and co-occurring larvae of other fishes are listed for each species. A brief summary of the main features of their development and ecology is provided and discussed with some conclusions.

Keywords: Antarctic fish, early life stages, catalogue, description, distribution, food

1. Introduction

Fishes of the suborder Notothenioidei are the most prominent and predominant group of the Antarctic coastal ichthyofauna. They are represented by six families: Artedidraconidae, Bathydraconidae, Bovichthyidae, Channichthyidae, Harpagiferidae, Nototheniidae. Early life stages of some species were described early this century with a few studies following much later (Pappenheim, 1912; Regan, 1916; Nybelin, 1947; Everson, 1968). At the onset of a large scale commercial harvesting of the demersal stocks at the end of the 1960s, taxonomic studies were also propagated systematically (Efremenko, 1979a, b, 1983, 1984; North & White, 1982). At the same time the early life history was investigated by work in the field and in the laboratory (Daniels, 1978; Rembiszewski *et al.*, 1978; Wörner & James, 1981; White *et al.*, 1982, and other studies). During the past couple of years, the amount of information on the early life of notothenioid Antarctic fishes has increased markedly and larval development and ecology are well documented for a number of species. However, most studies have focussed on subantarctic islands and on the Antarctic Peninsula areas whereas few data are available from the almost permanently ice covered seas of high latitudes.

The demersal fish stocks are presently one of the intensively exploited marine resources (Kock *et al.*, 1985). Further, notothenioid fishes may play an important role as food of warm-blooded top predators (see review by Hempel, 1985). The ecological and commercial significance of fishes demands for a thorough understanding of their life cycle. The perception of functional relationships linking larval survival to the biotic (food, predators) and physical (ice, water masses) environmental parameters may help to explain recruitment variability. Knowledge of these relationships may also elucidate the adaptative significance of the main features of reproduction (spawning season and site, egg size, hatching period) in evolutionary terms. Most of these parameters and features, however, are poorly documented for Antarctic fishes, and some species still await description of their early stages. Ultimately, morphology and development of larvae may provide evidence of phylogenetic relationships among notothenioid fishes (Hureau, 1982).

This catalogue includes descriptions of the early life stages of 42 species of notothenioid fishes from the Atlantic sector of the Antarctic Ocean. The spatial and temporal occurrence and, where available, the food and feeding dynamics of early stages are provided for each species, as well as identification characters to distinguish the larvae of similar, co-occurring species. The foundation of this study was published works as well as eggs, larvae and pelagic juvenile fishes collected during Antarctic Expeditions of the Federal Republic of Germany to South Georgia, the Antarctic Peninsula and the Weddell Sea between 1975 and 1987.

The terminology used in the catalogue differs from that recommended in Hureau (1982). The term 'larva' is applied to specimens from hatch until the full fin ray complement is present. This includes the yolk sac stages and fin formation in transforming larvae, and follows the generalized scheme of early life history stages proposed by Kendall *et al.* (1984). The term 'juvenile' refers to specimens with the complete number of rays present in all fins (Kendall *et al.*, 1984).

2. Methods

Developmental series were identified in most cases by comparison of meristic counts of juvenile fishes with published data from adult fishes (Andriashev, 1959; DeWitt, 1985; DeWitt & Hureau, 1979; Eakin, 1981; Ekau, 1988; Fischer & Hureau 1985; Kock *et al.*, 1984; Norman, 1938). For several species, developmental series were complemented by published descriptions of larval or juvenile stages (Regan, 1916; Efremenko, 1984).

Fin ray and vertebrae counts were taken from specimens cleared in 1 - 4 % potassium hydroxide and stained with Alizarin S (Hollister, 1934). Best results were obtained when specimens were transferred to a 30 % glycerol solution in potassium hydroxide after staining. A pure glycerol storage medium was achieved by evaporation in a drying kiln at 30°C. For permanent storage, a few Thymol crystals were added to prevent growth of fungi. Washing out the preservatives before staining and clearing is not recommended.

The descriptions of early stages refer to preserved specimens when viewed from the side so that counts of melanophores or teeth are given for one side of the larva, only. With two exceptions (Figs. 5b, 39), all fish were preserved in seawater formaldehyde solution. Fin ray counts are given as D_1 (first dorsal), D_2 (second dorsal), A (anal) and P (pectoral fin), vertebrae counts are given separately for the trunk, caudal and the total number of vertebrae (including the urostyle). The distinguishing characters of similar, co-occurring species refer to larvae unless otherwise stated. Length measurements refer to standard length (SL) or total length (TL). The pectoral fin rays are not shown in the drawings for clarity, and shading has been avoided.

3.1 *Artedidraco mirus* Lönnberg, 1905

Description of larvae

Body covered densely with pigment except the caudal peduncle and narrow unpigmented stripes along the dorsal and ventral finfolds. Groups of small melanophores present on the dorsal stripe in late larvae and juvenile fishes (Fig. 1). Operculum and parietal region of head with less dense pigment coverage. Specimens of 16 - 20 mm SL had the fin ray counts D_1 III, D_2 23 - 24, A 17 - 18, P 16 - 17, and the complete number of vertebrae was present V 13 + 21 - 22 = 34 - 35 (n = 5). A mental barbel and barred pigmentation develop at 28 mm SL (North, pers. comm.). A specimen of 24 mm SL similar to that in Fig. 1 is reported by Efremenko (1983) from the South Orkney Is., but dorsal fin ray counts are above the ranges given by Eakin (1981).

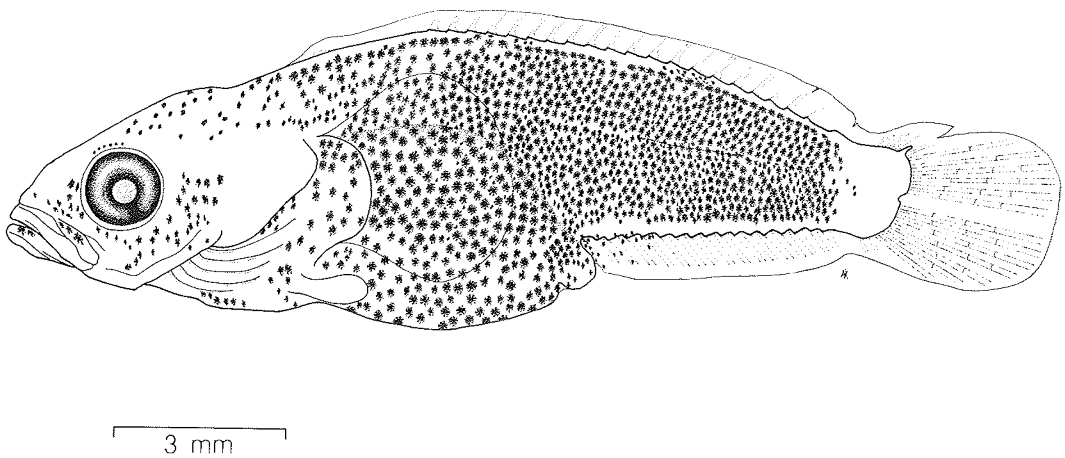
Spatial and temporal occurrence

Larvae were confined to the shelf areas around South Georgia. Smallest observed larvae were about 7 mm in length (North, pers. comm.). During the second half of December, larvae of 12 - 24 mm SL were recorded in nearshore surface waters over bottom depths of 22 - 255 m. Judging from nearly ripe females found in May (Regan, 1916), spawning is in winter, and larval lengths indicate a hatching period in spring.

Distinguishing characters of similar, co-occurring species

Confusion with larval *Notothenia rossii* may occur at similar lengths, but the postanal length in *N. rossii* larvae is more than 46 % of SL.

Fig. 1: *Artedidraco mirus*. Transforming larva of 16.1 mm SL; "Walther Herwig", St. 70/173, 27 December 1975, South Georgia.


3 mm

3.2 ***Artedidraco skottsbergi*** **Lönnberg, 1905**

Description of early stages

Body covered densely with pigment except the caudal peduncle and narrow unpigmented stripes along the dorsal and ventral finfolds (Fig. 2). On the head the pigment is less dense on the parietal regions. On the body the pigmentation on the dorsolateral part of the postanal section is less dense than in the ventrolateral part. Melanophores sometimes also present on the distal part of the pectoral fin base. Specimens of 19.5 - 24.9 mm SL had the fin ray counts D_1 III - IV, D_2 25 - 26, A 18 - 20, P 16 - 17, and the complete number of vertebrae V 13 - 14 + 24 = 37 - 38 (n = 4). Preanal length 56 - 64 % of SL, body depth at pectoral fin base level 19 - 28 % of SL, both increasing with SL.

Spatial and temporal occurrence

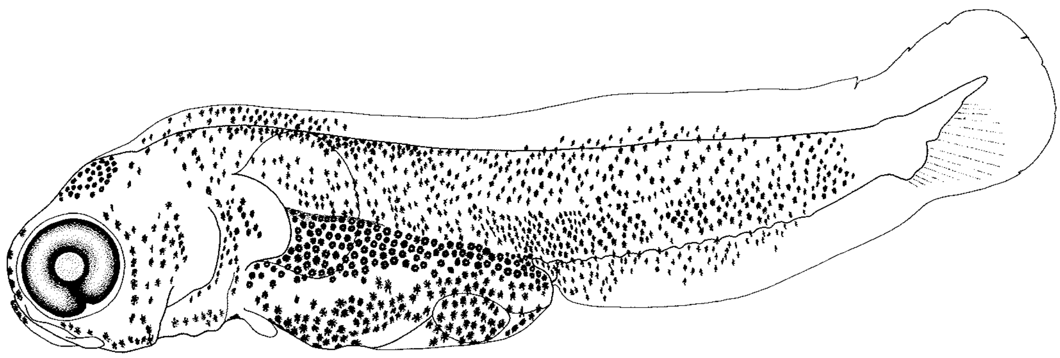
Larvae and early juvenile fishes were confined to surface waters on the shelves of southern Bransfield Strait and Joinville Island (Antarctic Peninsula). Smallest larvae of 10.0 - 14.5 mm SL with remains of yolk were recorded between early November and early December suggesting that hatching occurs in spring (October - November). Larvae and early juveniles of 15.1 - 24.9 mm SL were caught from mid January until late February, but not thereafter (Kellermann, 1989).

Distinguishing characters of similar, co-occurring species

Pogonophryne marmorata: Body depth at pectoral fin base level 34 - 36 % of SL in specimens of 17.0 - 29.0 mm SL. Abdomen extends posteriorly to above the midline. Lateral pigment extends about 77 - 89 % of postanal section.

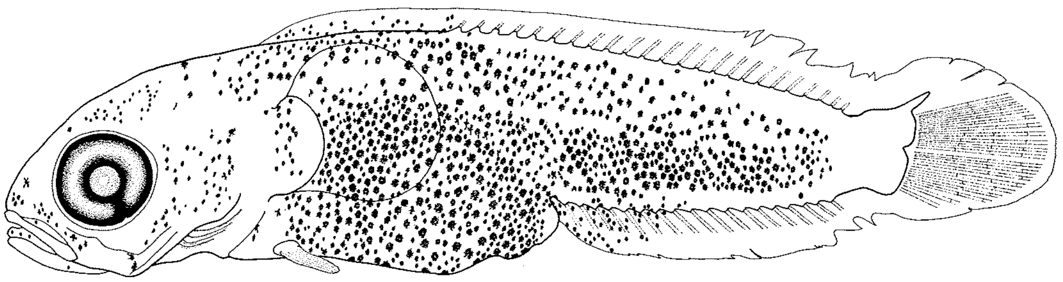
Artedidraco sp. B: Lateral pigment extends about 41 - 45 % of the postanal section at 13 - 19 mm SL. (caught in the Peninsula and Weddell Sea regions)

Fig. 2: ***Artedidraco skottsbergi.*** **a) Larva with yolk, 11.6 mm SL; "Polarstern", St. 118, 5 November 1987, Antarctic Peninsula. b) Transforming larva, 15.6 mm SL; "Polarstern", St. 132, 6 February 1983, Weddell Sea.**



a

2 mm



b

3 mm

3.3 *Pogonophryne marmorata* Norman, 1938

Description of early stages

Body covered heavily with pigment except the caudal peduncle and narrow unpigmented stripes along the dorsal and ventral finfolds (Fig. 3). Head region less dense pigmented. Preanal length 61 - 64 % of SL, body depth at pectoral fin base level 34 - 36 % of SL in specimens of 17.0 - 29.0 mm SL. Lateral pigment extends about 77 - 89 % of length of postanal section. Specimens of 20.2 - 31.0 mm SL had the fin ray counts D_1 II, D_2 26 - 28, A 17 - 18, P 19 - 21, and the complete number of vertebrae was present from 29.0 mm SL onward: V 15 + 23 = 38 (n = 5). The description agrees with that of Efremenko (1983) and with Fig. 10 of North & White (1982).

Spatial and temporal occurrence

In the Antarctic Peninsula area, larvae and early juvenile fishes of 17.0 - 31.0 mm SL were captured in February and mid March. They occurred in oceanic surface waters of Bransfield Strait and along the pack-ice edge to the east of Joinville Island (north-western Weddell Sea) over bottom depths of 500 - 3200 m (Kellermann, 1989; see Kellermann & Kock, 1984).

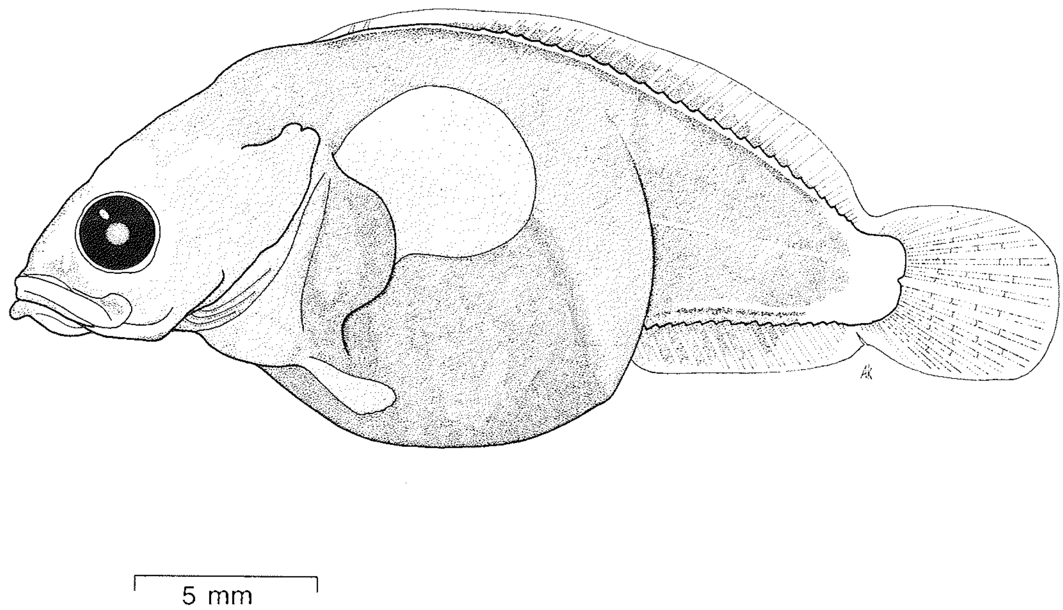
Distinguishing characters of similar, co-occurring species

Artedidraco skottsbergi: Body depth at pectoral fin base level 19 - 28 % SL in specimens of 10.0 - 24.9 mm SL. Lateral pigment extends about 71 - 74 % of length of postanal section.

Artedidraco sp. B: Lateral pigment extends about 41 - 45 % of length of postanal section in specimens of 13.8 - 19.3 mm SL. (caught in the Peninsula and Weddell Sea regions)

Dolloidraco longedorsalis: Lateral pigment extends over 36.5 % of length of postanal section and pelvic fin reaching beyond pectoral fin base at 22 mm SL.

Fig. 3: ***Pogonophryne marmorata*. Transforming larva, 24.2 mm SL; "Walther Herwig", St. 140/59, 16 February 1981, Antarctic Peninsula.**


5 mm

3.4 *Akarotaxis nudiceps* (Waite, 1916)

Description of larvae

The description refers to two transforming larvae of 37.0 - 39.1 mm SL. Body heavily pigmented all over with less dense pigment cover on the head (Fig. 4). There is pigment present on the fin fold between dorsal and ventral fin rays, and on the caudal fin between fin rays and on the proximal part of caudal fin rays. There is a dense line of pigment laterally along the mid line of the postanal section. Fin ray and vertebrae counts in the specimen from Fig. 4 were D 26+, A 25+, P 24, V 17 + 32 = 49 (complete). The abdomen is strikingly swollen in contrast to the long and slim cauda.

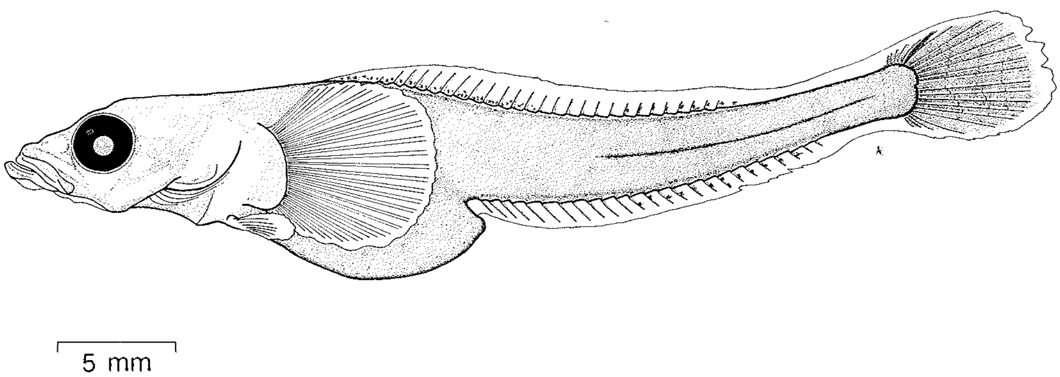
Spatial and temporal occurrence

Two specimens of 37.0 and 39.1 mm SL were captured in the north-eastern Weddell Sea in early March and mid February, respectively (G. Hubold, unpubl. data).

Distinguishing characters of similar, co-occurring species

The only bathydraconid species reported to date with such heavily pigmented larvae. Early larvae may be assumed to have a pigmentation pattern of similar density. Larval *Prionodraco evansii* have a dense pigmentation on the postanal section, but there are only single melanophores above the abdomen and on the shoulder region (see section 3.10).

Fig. 4: ***Akarotaxis nudiceps.*** **Transforming larva, 39.1 mm SL; "Polarsirkel", St. 264, 17 February 1981, Weddell Sea.**


5 mm

3.5 *Bathydraco antarcticus* Günther, 1887

Description of early stages

The basic pigmentation pattern consists of a ventral band of melanophores reaching the anus level, a dorsal band of pigment which extends cranially during larval development, and clusters of dorso- and ventrolateral melanophores on the posterior part of the postanal section, which form a vertical pigment band in advanced larvae and early juveniles (Fig. 5). There is pigment on the occipital head region, on the snout and along the jaws, on the cleithral isthmus, below the pectoral fin base and on the dorsal part of the abdomen. Ventral abdominal melanophores are present. In the smallest larvae (Fig. 5a) there is a group and a series of melanophores on the shoulder region and above the pectoral fin base. The forming caudal fin has pigment between fin rays (Fig. 5b, c). A small cluster of pigment is present in front of the orbit, forming a lateral nasal stripe in early juvenile fishes. Specimens of 32 - 35 mm SL had fin ray counts D 35 - 37, A 31, P 21-22 and the complete number of vertebrae V 17 - 18 + 35 = 52 - 53 (n = 2).

Spatial and temporal occurrence

Larvae of 15 - 18 mm SL were captured in the southern Weddell Sea in early January, the smallest larvae had yolk remains. Larvae of 21 - 26 mm SL with first anal fin rays forming occurred in the same area in the first half of February (Hubold, 1989). Early juvenile fishes (Fig. 5c) were obtained from the Antarctic Peninsula in January. These records suggest either latitudinal differences in the hatching season, or an extended hatching period which, however, is not indicated by the larval lengths from the Weddell Sea. There, hatching is likely to occur in early summer (December).

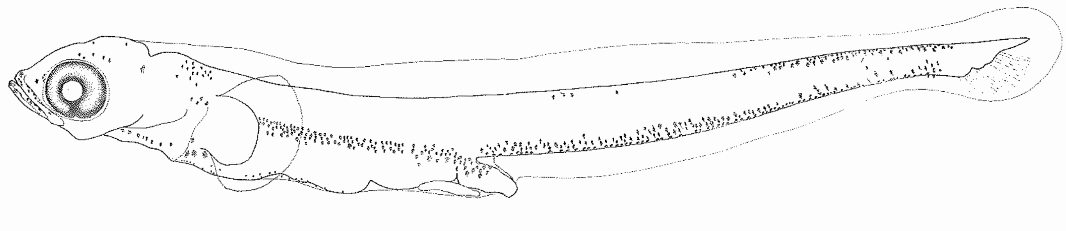
Distinguishing characters of similar, co-occurring species

Prionodraco evansii: Dorso- and ventrolateral melanophores on postanal section reaching anus level in larvae, postanal section thus completely pigmented. Lateral rows of spiny scales present from about 21 mm SL onward.

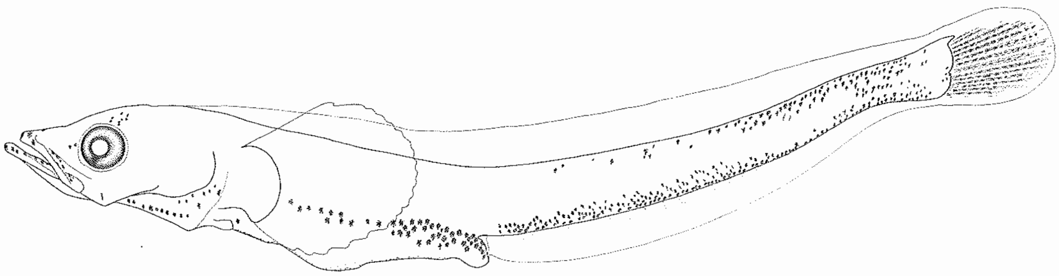
Gerlachea australis: Ventral pigment band consisting of single large melanophores on the anterior part of the postanal section with minute pigment spots along the ventral margin in early larvae; broad vertical pigment band on posterior postanal section.

Parachaenichthys charcoti: Dorsal row of single melanophores, reaching the pectoral fin base level.

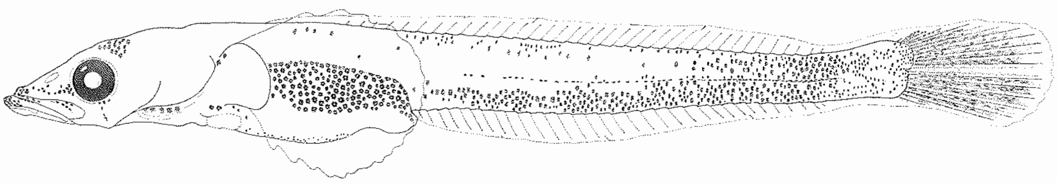
Fig. 5: ***Bathydraco antarcticus*. a) Larva with yolk, 15.3 mm SL; "Polarsirkel", St. 34/35, 4 January 1981, Weddell Sea. b) Transforming larva of 21.9 mm SL (alcohol preserved); "Polarstern", St. 298/29, 5 February 1985, Weddell Sea. c) Transforming larva of 32.3 mm SL; "John Biscoe", 20 January 1987, Antarctic Peninsula (BAS collection).**



a



b



c

3.6 *Gerlachea australis* Dollo, 1900

Description of early stages

The basic pigmentation pattern is a ventral row of melanophores reaching the anus level, a dorsal band which extends cranially during larval development, and dorso- and ventrolateral pigment cells forming a broad vertical band of the posterior postanal section (Fig. 6). There is a group of melanophores in the neck region, along the opercular margin, below the pectoral fin base, at the tip of the snout and along the lower jaws. In larvae (Fig. 6a) there is sparse pigment on the occipital region and a medial stripe of melanophores on the upper snout which is supplemented by a lateral stripe in juveniles (Fig. 6b). Abdominal pigment is restricted to a dorsal band and few ventral abdominal spots in larvae which develops into a dense coverage of the whole abdomen in juveniles. Specimens of 35.2 and 62.0 mm SL had the fin ray counts D 43 - 45, A 35, P 27 - 28, and the complete number of vertebrae V 25 + 38 = 63 (n = 2).

Spatial and temporal occurrence

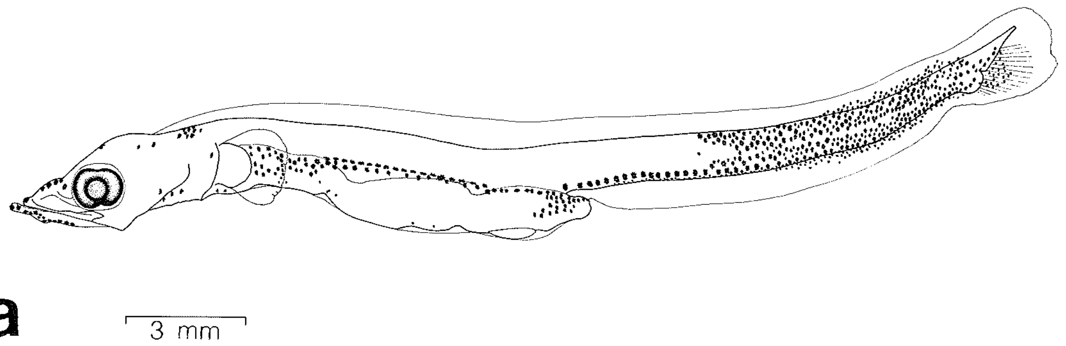
In the Antarctic Peninsula region, early stages were confined to shelf and slope waters of Weddell Sea origin to the north of Joinville Island. During the 1977/78 season, they were recorded in early December (larva, 34 mm), mid January (transforming larva, 42 mm) and early March (juvenile, 62 mm). Another larva of 26.1 mm SL was taken in mid November 1987. Juvenile fishes were reported as occasional by-catch of krill tows (Slosarczyk & Rembiszewski, 1982). In the Weddell Sea, juvenile fishes of 35 - 52 mm SL were captured in February (G. Hubold, unpubl. data). Hatching is likely to occur in late winter or spring, and larval development is concluded during the first summer. Catches of larger juveniles in semi-commercial pelagic tows (Hubold & Ekau, 1987) may indicate that the pelagic life mode is maintained even longer.

Distinguishing characters of similar co-occurring species

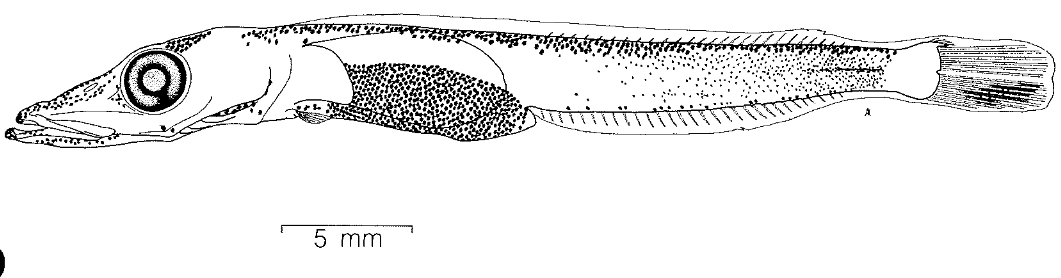
Parachaenichthys charcoti: Dorsal row of single melanophores extending to the pectoral fin base level.

Bathydraco antarcticus: Ventral pigment band consisting of numerous small melanophores, no minute pigment cells along ventral margin of postanal section; lower part of abdomen unpigmented except ventral abdominal pigment.

Fig. 6: *Gerlachea australis*. a) Larva with yolk, 26.1 mm SL; "Polarstern", St. 132, 14 November 1987, Antarctic Peninsula. b) Transforming larva, 35.2 mm; "Polarstern", St. 171, 16 February 1983, Weddell Sea.



a



b

3.7 *Gymnodraco acuticeps* Boulenger, 1902

Description of larvae

The basic pigmentation pattern consists of a dorsal row of melanophores, and dense lateral pigment above the posterior part of the abdomen and along the postanal section (Fig. 7). The caudal peduncle and a narrow ventral stripe along the cauda are free of pigment, except a short ventral row of minute pigment indicating the formation of a series extending caudally in later stages (see Efremenko, 1983, Fig. 28). There is pigment on the base of the pectoral fin, on the parietal and occipital head region, on the frontal and lateral parts of the snout, on the jaws, on the cleithral isthmus and at the base of the forming caudal fin. The abdomen is covered by melanophores with ventral abdominal pigment present. There are three or four teeth in the lower jaw. The specimen described by Regan (1916) resembles a *Bathydraco* sp. rather than *G. acuticeps*.

Spatial and temporal distribution

Larvae of 16.4 - 27.3 mm SL occurred in shelf waters of the southern Bransfield Strait (Antarctic Peninsula) between mid November and mid December (Kellermann, 1989). Juvenile fishes of 33.7 - 34.2 mm SL were captured in the Scotia Sea off the South Shetland Islands in January (Efremenko, 1983), and they were reported as occasional by-catch of semi-commercial krill trawls in Bransfield Strait in February/March (Slosarczyk & Rembiszewski, 1982). Early stages are also reported from Prydz Bay in spring (R. Williams, unpubl. data), and from the Weddell Sea in summer (G. Hubold, unpubl. data). Larval lengths in the Peninsula region suggest that hatching occurs in spring (October). The larval development is concluded during the first summer and the early juveniles maintain a pelagic mode of life at least until fall.

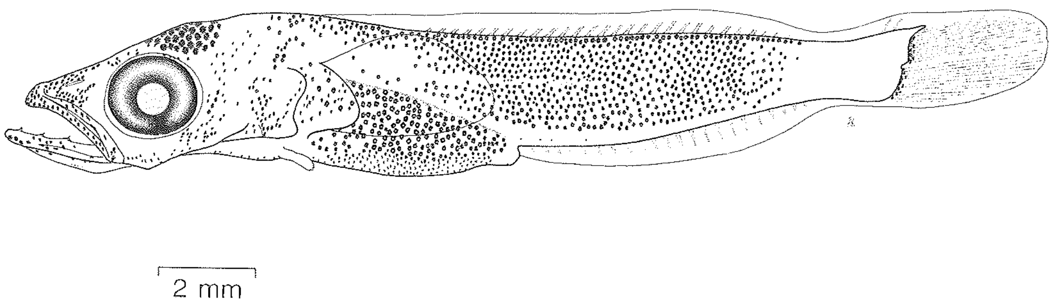
Food and feeding

Single larvae of 18 mm SL were captured by SCUBA divers underneath pack-ice in the north-western Weddell Sea in late October 1988 (B. Seim, Tromsø University). These had fed on small calanoid and harpacticoid copepods, presumably taken from the ice subsurface.

Distinguishing characters of similar, co-occurring species

Larvae may be confused with early stage artedidraconids, which, however, lack the teeth in the lower jaw, and have a heavier lateral pigmentation above the abdomen.

Fig. 7: *Gymnodraco acuticeps*. Larva of 18.8 mm SL; caught under ice, 4 November 1985, Prydz Bay.


2 mm

3.8 *Parachaenichthys charcoti* (Vaillant, 1906)

Description of early stages

The basic pigmentation pattern consists of a dorsal row and a ventral band of melanophores, and lateral pigment groups forming a vertical band on the posterior postanal section (Fig. 8). There is dorsal and lateral pigment on the abdomen, ventral abdominal melanophores are present. There is pigment on the occipital head region, along the margin of the operculum, on the cleithral isthmus, on the jaws, on the tip of the snout, and there is a lateral nasal pigment stripe in larvae (Fig. 8a) which is supplemented by a short medial stripe in early juveniles (Fig. 8b). The caudal peduncle is unpigmented in larvae whereas small pigment clusters develop there in later stages. A specimen of 45 mm SL had the fin ray counts D 42, A 30, P 23, and the complete number of vertebrae V 25 + 37 = 62.

Spatial and temporal occurrence

Smallest larvae of 23 - 32 mm SL were recorded in the Antarctic Peninsula region between late October and early December. They were chiefly confined to shelf waters in the southern Bransfield Strait and off Joinville Island which are influenced by Weddell Sea waters. Early juvenile fishes of 45 - 58 mm were captured in shelf and slope waters throughout the area (Palmer Archipelago to north of Elephant Island) between mid January and mid March (Kellermann, 1989). They occurred as occasional by-catch of semi-commercial krill trawls in February/March (Slosarczyk & Rembiszewski, 1982). Larvae of the closely related *Parachaenichthys georgianus* hatch from June onwards (South Georgia; North & White, 1987). Smallest observed larvae off South Georgia were 11 - 17 mm in length (North & Ward, in press). Assuming similar length at hatch in *P. charcoti*, but longer incubation periods in the Peninsula region, larval lengths in spring may indicate that hatching occurs in late winter (August - September). Larval development is concluded during the first summer, and a pelagic mode of life of early juveniles is maintained at least until fall.

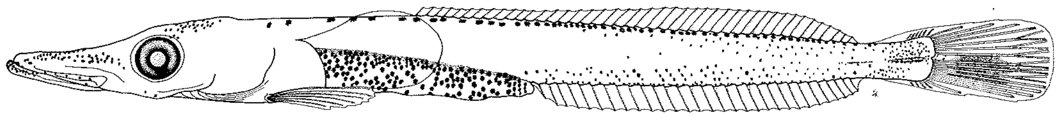
Distinguishing characters of similar, co-occurring species

Gerlachea australis: No continuous dorsal row of single melanophores, reaching the pectoral fin base level. Medial nasal stripe present in larvae.

Bathydraco antarcticus: No continuous dorsal row of single melanophores reaching the pectoral fin base level, isolated pigment groups or spots instead; no lateral nasal stripe present in larvae.

Fig. 8: *Parachaenichthys charcoti*. a) Larva of 26.6 mm SL; "Polarstern", St. 168, 6 November 1983, Antarctic Peninsula. b) Juvenile fish of 50.3 mm SL; "John Biscoe", St. 1047, 11 February 1982, Antarctic Peninsula.

a 3 mm



b 5 mm

3.9 *Prionodraco evansii* Regan, 1914

Description of early stages

The basic pigmentation pattern is a ventral row of melanophores, and a dense pigment coverage of the postanal section extending cranially into a dorsal row reaching the abdomen, and lateral pigment groups above the abdomen (Fig. 9). There are melanophores on the jaws, on the lateral and upper nasal region, on the snout, along the cleithral isthmus and the opercular margin and on the pectoral fin base. In larvae (Fig. 9a), there are a few pigment spots on the occipital and parietal head regions, and single melanophores above the pectoral fin base, the caudal peduncle is mostly free of pigment. In early juveniles (Fig. 9b), there are groups of melanophores on the occipital and parietal head regions, the pectoral fin base and on the caudal peduncle and proximal parts of the caudal fin rays. The dorsal and lateral abdominal regions are covered by melanophores, ventral abdominal pigment is present. The dorso- and ventrolateral series of spiny scales which are characteristic for this species develop from about 21 mm SL onward. Specimens of 21.5 - 36.4 mm SL had the fin ray counts D 35 - 36, A 29 - 31, P 23 - 24 (n = 4), and from 30.0 mm SL onward the number of vertebrae is complete with V 16 + 33 - 34 = 49 - 50 (n = 2).

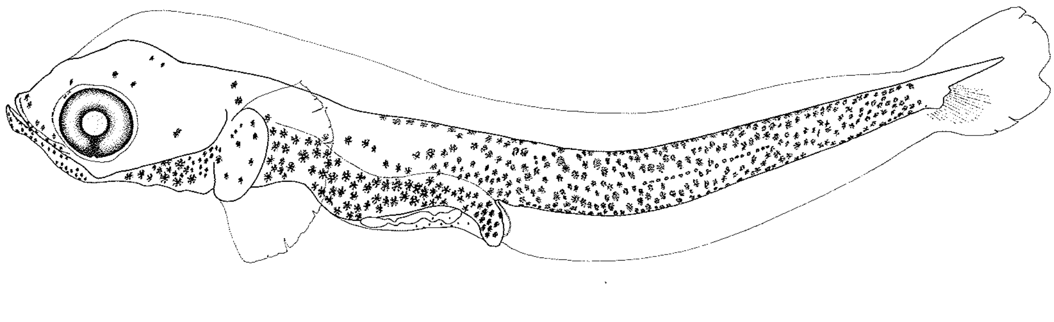
Spatial and temporal occurrence

In the Antarctic Peninsula region, larvae of 12.0 - 14.2 mm SL with yolk remains were captured in early November and early December. They were chiefly confined to shelf areas of Joinville Island under the direct influence of Weddell Sea water. Larvae and early juveniles in February (21.5 - 36.4 mm), and juvenile fishes in March (44 - 50 mm) occurred throughout the area (Palmer Archipelago to Elephant Island) (Kellermann, 1989). Juvenile fishes were found as an occasional by-catch of semi-commercial krill trawls in February/March (Slosarczyk & Rembiszewski, 1982). Larval lengths and yolk remains suggest that hatching occurs in spring (late October - November). The larval development is concluded during the first summer, and the pelagic life mode is maintained in juveniles at least until fall. In the eastern Weddell Sea, a larva of 13 mm SL was caught in November, and latest records in the season were made in February (Hubold, 1989).

Distinguishing characters of similar, co-occurring species

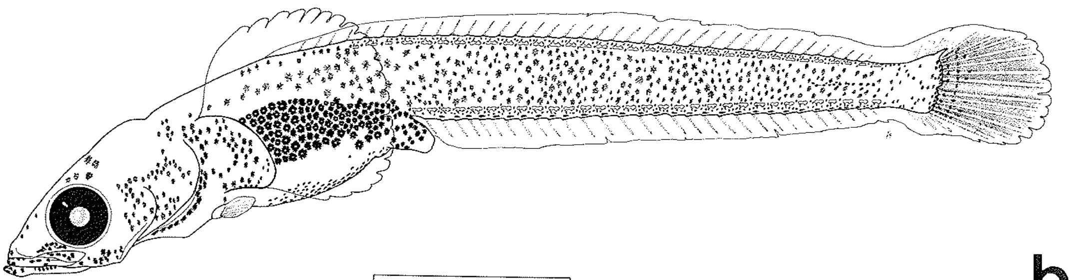
Bathydraco antarcticus:	Only few dorsolateral pigment groups or spots on anterior postanal section; no melanophores present on the pectoral fin base in larvae.
Gerlachea australis:	No lateral pigment on the anterior postanal section.
Gymnodraco acuticeps:	Caudal peduncle and adjacent parts of cauda as well as a ventral stripe reaching the anus level free of pigment.

Fig. 9: *Prionodraco evansii*. a) Larva of 13.1 mm SL with yolk; "Polarstern", St. 208, 10 November 1983, Antarctic Peninsula. b) Juvenile fish of 25.5 mm SL; "Walther Herwig", St. 19/4, 30 January 1981, Antarctic Peninsula.



2 mm

a



5 mm

b

3.10 *Psilodraco breviceps* Norman, 1938

Description of early stages

The basic pigmentation pattern consists of a short dorsal series of melanophores above the pectoral fin base, pigment on the occipital and parietal head regions, along the jaws, on the posterior opercular margin, on the snout, on the dorsal and lateral abdominal region and on the origin of the caudal fin rays (Fig. 10). The cauda are free of pigment. The short dorsal pigment series is not yet developped at a length of 16 mm SL (Efremenko, 1983). Specimens of 25 - 29 mm SL had the fin ray counts D 29 - 30, A 28 - 29, P 26, and the complete number of vertebrae V 14 - 15 + 32 - 33 = 46 - 47 (n = 4). Small teeth are present in the upper and lower jaws.

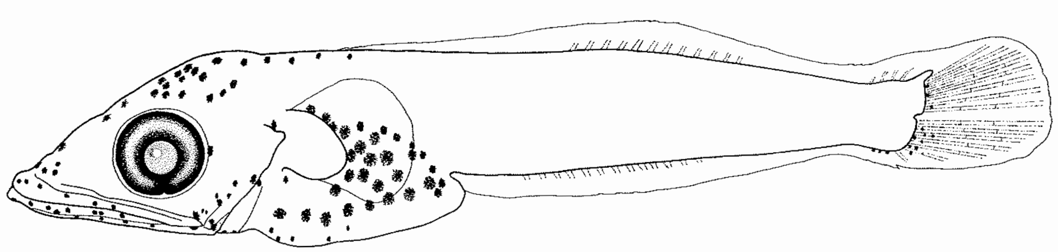
Spatial and temporal occurrence

Early stages were confined to shelf areas around South Georgia. Small larvae of 11 - 16 mm SL can be encountered from September to mid January which suggests an extended hatching period of several months (North, pers. comm.). During the second half of December (1975 and 1977), larvae of 17 - 29 mm SL were captured in nearshore waters and fjords (Cumberland Bays) over bottom depths of 86 - 235 m. In early April (1978), advanced larvae of 29 - 38 mm SL were caught in Fortuna Bay on the northern coast of South Georgia.

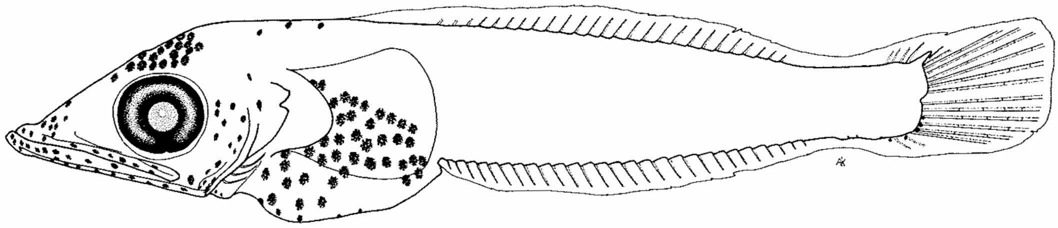
Distinguishing characters of similar, co-occurring species

The larvae may be confused with larval icefishes, but these can be readily distinguished by the presence of a well developped pelvic fin and of pigment on the postanal section.

Fig. 10: ***Prilodraco breviceps.*** **a) Transforming larva of 17.1 mm SL; "Walther Herwig", St. 70/173, 27 December 1975, South Georgia. b) Transforming larva of 21.9 mm SL; "Walther Herwig", St. 70/173, 27 December 1975, South Georgia.**



a 2 mm



b 3 mm

3.11 *Racovitzia glacialis* Dollo, 1900

Description of early stages

The basic pigmentation pattern consists of a vertical bar of melanophores on the posterior postanal section, and a horizontal ventrolateral pigment stripe which may reach the vertical band and/or the anus level (Fig. 11). The vertical band may extend onto the primordial fin fold in larvae, and between the developing fin rays in later stages. In early larvae (Fig. 11a), there are a few melanophores on the occipital head region, on the anterior orbit and along the jaws, and there is a single melanophore on the neck region. There are dorsal groups and lines of abdominal melanophores, ventral abdominal pigment is present. In transforming larvae (Fig. 11b), this pattern is supplemented by denser occipital pigment, parietal spots below the eye, a pigment group on the cleithral isthmus and along the pectoral fin base insertion, a lateral nasal stripe, lateral abdominal pigment, and groups and spots of dorsolateral melanophores at irregular intervals which may reach the pectoral fin base level. The caudal fin is densely pigmented. Juvenile fishes (Fig. 11c) have a barred and spotted pigment coverage with the vertical bar and horizontal stripe still recognizable. Juveniles of 59 - 65 mm SL had the fin ray counts D 34 - 35, A 28 - 29, P 24, and the complete number of vertebrae V 19 + 32 - 33 = 51 - 52 (n = 2).

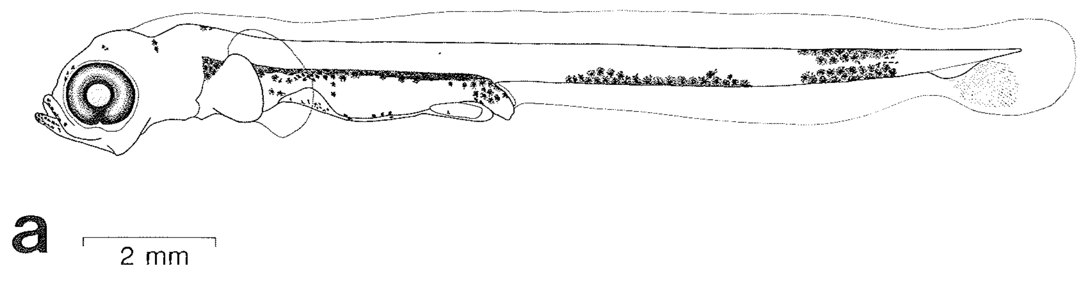
Spatial and temporal occurrence

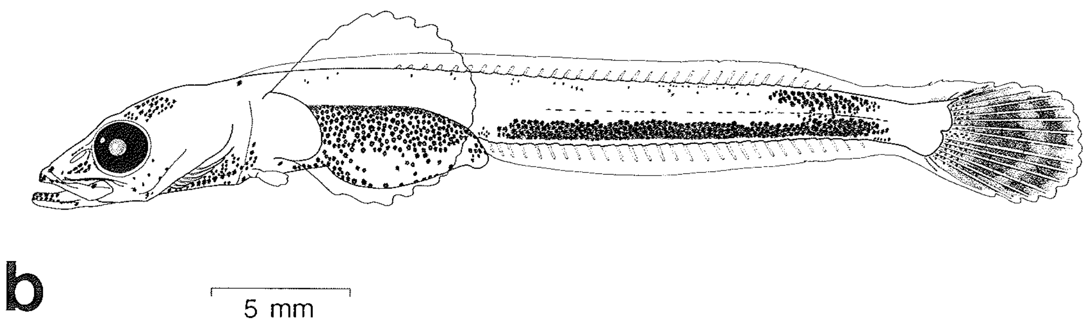
In the Antarctic Peninsula region larvae of 12.0 - 13.2 mm SL with yolk remains were captured in the western part of Bransfield Strait in the second half of November suggesting that hatch occurs in spring (November). A single larva of 17.4 mm SL was caught in February. Juveniles of 65 - 76 mm SL were reported from oceanic waters along the pack-ice edge to the east of Joinville Island in February (Kellermann & Kock, 1984). In the eastern Weddell Sea larvae had 16 mm SL in spring and 17 - 29 mm SL in summer (Hubold, 1989). Hence, it may be assumed that the pelagic development extends throughout winter and the second summer, and that the juvenile fishes were at least one year old.

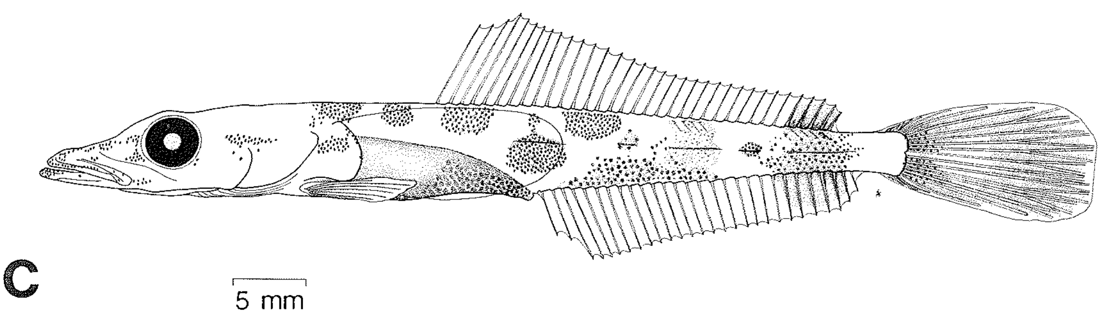
Distinguishing characters of similar, co-occurring species

Notothenia kempi:	No horizontal ventrolateral pigment bar along postanal section; a dorsolateral group of melanophores above the abdomen.
Bathydraco antarcticus:	Ventrolateral pigment band always reaching the anus level, consisting of less dense, small melanophores, vertical pigment band less dense and intermittent.
Gerlachea australis:	Medial nasal pigment stripe present; no dense horizontal pigment bar on postanal section.
Parachaenichthys charcoti:	Continuous dorsal row of melanophores present, reaching the pectoral fin base level.

Fig. 11: ***Racovitzia glacialis.*** **a) Larva with yolk, 13.2 mm SL; "Polarstern", St. 142, 16 November 1987, Antarctic Peninsula. b) Transforming larva, 29.2 mm SL; "Polarstern", St. 349, 21 February 1985, Weddell Sea. c) Juvenile fish of 59.6 mm SL; "Meteor", St. 135/14, 15 February 1981, Antarctic Peninsula.**


a
2 mm


b
5 mm


c
5 mm

3.12 *Chaenocephalus aceratus* Lönnberg, 1906

Description of early stages

The basic pigmentation pattern consists of a dorsolateral and a ventrolateral row of melanophores on the postanal section (Fig. 12). There is pigment on the tips of the jaws, on the occipital head region, on the posterior jaw angle and along the opercular margin and the anterior part of the pectoral fin base. There is a dorsal group or short row of melanophores on the neck region. The dorsal part of the abdomen is covered by pigment cells, ventral abdominal pigment is present. There is pigment on the caudal peduncle, on the base of the caudal fin rays, and between the spine and the first soft ray of the pelvic fin. In early larvae (Fig. 12a), the yolk is entirely covered by melanophores. In transforming larvae (Fig. 12b), there is additional pigment on the lateral part of the snout, along the jaws and on the parietal head region. A ventral row of small melanophores is visible from about 30 mm SL onward. Specimens of 57 - 75 mm SL had the fin ray counts D_1 VI - VIII, D_2 39 - 40, A 38 - 40, P 24 - 26 and the complete number of vertebrae V 18 - 20 + 42 - 46 = 62 - 64 (n = 6). There were 61 - 62 myotomes in larvae of 21 - 26 mm SL.

Spatial and temporal distribution

Antarctic Peninsula: Findings of early larvae of 15 - 18 mm SL in inshore waters of the South Shetland Islands in August suggest that hatching commences in mid winter (Slosarczyk, 1987). Larvae of 19 - 40 mm SL, the smallest bearing a yolk sac, were recorded in Rectangular Midwater Trawls (RMT 1+8) in November and early December; most larvae were caught in shelf and slope waters around Elephant Island (Kellermann, 1989). Larval and early juvenile fishes caught by semi-commercial pelagic trawls in summer (January/February) were between 33 and 59 mm SL (Kellermann & Kock, 1984; Slosarczyk, 1986). Single larvae of 22 - 23 mm SL with yolk remains were found in January and March (Slosarczyk, 1986; Kellermann, 1989), and may indicate an extended hatching season. Inshore mass occurrence of larvae in February (Anvers Island) was reported by Douglas & Hemmingsen (1971), but identification has not been reconfirmed. Larvae and juveniles are a frequent by-catch of semi-commercial krill trawls in summer and fall (Rembiszewski *et al.*, 1978; Slosarczyk & Rembiszewski, 1982).

South Georgia: Larval hatch occurs from August - December (North & White, 1987). During the first half of November (1977), larvae of 21 - 38 mm SL were caught in near-shore waters at bottom depths of 110 - 195 m. In late December (1975), larvae were of 28 - 41 mm SL and occurred near the coast at bottom depths of 93 - 260 m.

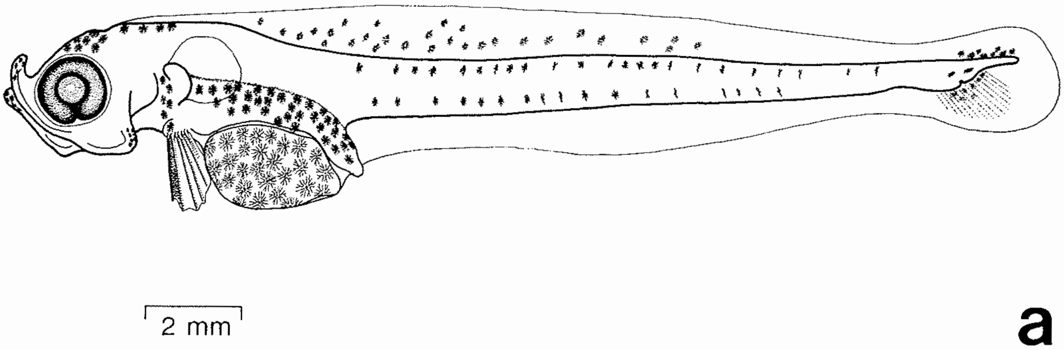
Food

The principal food of early stages in summer and fall (Antarctic Peninsula region) consists of euphausiids, mostly *Thysanoessa macrura* and furcilia larvae, larval nototheniid fishes and amphipods such as *Themisto gaudichaudii* (Kellermann, 1986b).

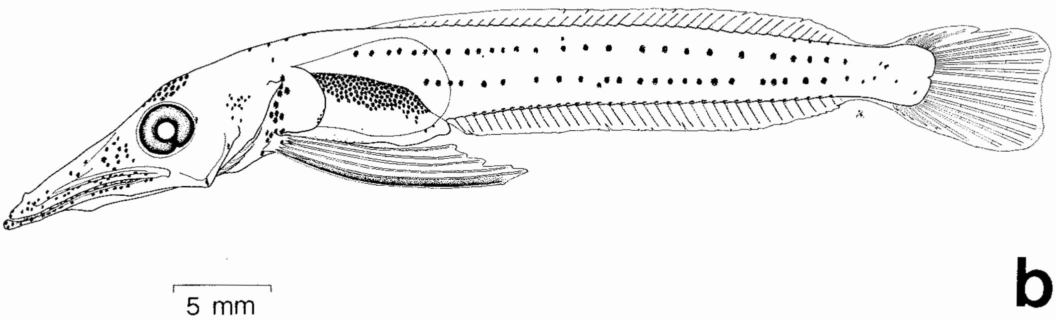
Distinguishing characters of similar, co-occurring species

Chionobathyscus dewitti: There are 68 - 69 myotomes in larvae of 17 - 29 mm SL; pigment on entire pectoral fin base.

Fig. 12: *Chaenocephalus aceratus*. a) Larva with yolk. 21.1 mm SL; "Walther Herwig", St. 73/76, 24 November 1977, Antarctic Peninsula. b) Transforming larva of 50.2 mm SL; "Polarstern", St. 116, 2 June 1986, Antarctic Peninsula.



a



b

3.13 *Chaenodraco wilsoni* Regan, 1914

Description of early stages

The basic pigmentation pattern consists of a short, anterior dorsal row, and of 2 - 3 dorso- and 2 - 3 ventrolateral rows of melanophores on the postanal section (Fig. 13). There is pigment on the tip of the snout, along the jaws, on the medial and lateral parts of the snout, on the occipital and parietal head regions, along the posterior opercular margin, on the neck region, on the pectoral fin base, on the pelvic fin between the spine and the first soft ray with scattered melanophores along the other soft rays, on the caudal peduncle and on the bases of the caudal fin rays. There is pigment on the dorsal and lateral parts of the abdomen, ventral abdominal pigment is present. The number of ventrolateral pigment rows on the postanal section may increase to four during larval development, and in late larvae there are complete dorsal and ventral pigment rows (see Efremenko, 1983). Specimens of 45 - 58 mm SL had the fin ray counts D_1 VI - VIII, D_2 38 - 40, A 30 - 35, P 21 - 24, and the complete number of vertebrae V 18 - 19 + 41 - 44 = 60 - 62 (n = 5). The pelvic fin has the counts I, 4.

Spatial and temporal occurrence

In the Antarctic Peninsula region, larvae of 30 - 38 mm SL were caught between late October and late November. Most records were made in shelf and oceanic waters of the eastern approaches of Bransfield Strait. In summer and fall, most records of larvae and early juveniles stem from semi-commercial pelagic krill trawls and length ranges were 43 - 68 mm SL in January/February (Kellermann & Kock, 1984), and 44 - 72 mm SL in March of the same year (Slosarczyk, 1987). During these months, larvae and juveniles occurred throughout Bransfield Strait and along the pack-ice edge in the north-western Weddell Sea (Kellermann & Kock, 1984; Slosarczyk & Rembiszewski, 1982). In spring, but especially in summer and fall early stages were only captured together with aggregations or swarms of the Antarctic krill (Kellermann & Slosarczyk, 1984; Kellermann, 1989). Larval lengths in spring indicate that hatching occurs during winter. In the eastern Weddell Sea, single larvae of 40 mm SL were taken in October - November (Hubold, 1989). Early stages were also reported from Prydz Bay (Williams, 1985).

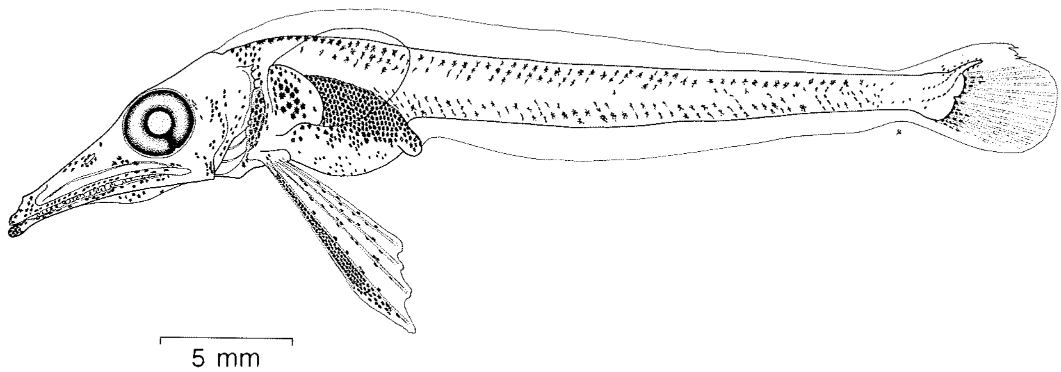
Food

Larvae in spring had preyed on late furcilia stages of euphausiids (Kellermann, 1986). The diets in summer and fall consisted exclusively of euphausiids, chiefly juvenile *Euphausia superba* and, less frequently, *Thysanoessa macrura* (Kellermann, 1986b; Rembiszewski *et al.*, 1978).

Distinguishing characters of similar, co-occurring species

Larvae smaller than 30 mm have not yet been recorded. The most reliable distinguishing character is the pelvic fin ray count, which is I, 5 in all other icefish species.

Fig. 13: ***Chaenodraco wilsoni*. Larva of 34.0 mm; "Polarstern", St. 96, 3 November 1987, Antarctic Peninsula.**


5 mm

3.14 *Champsocephalus gunnari* Lönnberg, 1905

Description of early stages

The basic pigmentation pattern consists of a dorsal and a ventral row of melanophores (Fig. 14). There is pigment on the tip of the snout, on the posterior jaw angle, on the parietal and occipital head regions, below the pectoral fin base, on the pelvic fin insertion, on the caudal peduncle and on the dorsal part of the abdomen. Ventral abdominal pigment is present. The pelvic fin is small and inconspicious in small larvae (Fig. 14a). In transforming larvae (Fig. 14b), there are melanophores along the jaws, on the upper anterior part of the pectoral fin base and on the bases of the caudal fin rays. Specimens of 46 - 55 mm SL had the fin ray counts D_1 IX - X, D_2 38 - 40, A 37 - 39, P 26 - 27, and the complete number of vertebrae V 17 + 45 = 62 (n = 3). The drawing of a channichthyid larva by Everson (1968) belongs to this species.

Spatial and temporal distribution

Antarctic Peninsula: Larvae were only captured south of Elephant Island and near the western South Shetland Islands; they were of 12 - 23 mm SL, the smallest with yolk remains, and were caught between mid February and mid March (Kellermann, 1989). Larvae are uncommon and single specimens only were also reported by other workers (Balbontin *et al.*, 1986; Sinque *et al.*, 1986).

South Georgia: Hatching was estimated to occur from September throughout November (North & White, 1987). Small larvae with yolk (12.5 - 15.3 mm SL) were recorded from mid August to mid October (Efremenko, 1979a). In early November and mid December (1977), single specimens of 21 - 50 mm SL were caught in near-shore shelf waters of 86 - 235 m bottom depths around the island. In late December (1975), two size groups occurred in Rectangular Midwater Trawls and semi-commercial krill trawls with modes of 23 mm and between 30 and 37 mm SL (range: 19 - 42 mm). These data indicate an extended hatching season as suggested by North & White (1987), but there is also evidence that hatching occurs much later in the season in the Antarctic Peninsula region than at South Georgia. From the South Orkney Islands, length ranges are reported that are similar to those at South Georgia (Efremenko, 1979a). Everson's (1968) larva of 16.8 mm, however, was taken there in inshore waters in early January. Juvenile fishes are an abundant by-catch of semi-commercial krill trawls, particularly at South Georgia (Rembiszewski *et al.*, 1978).

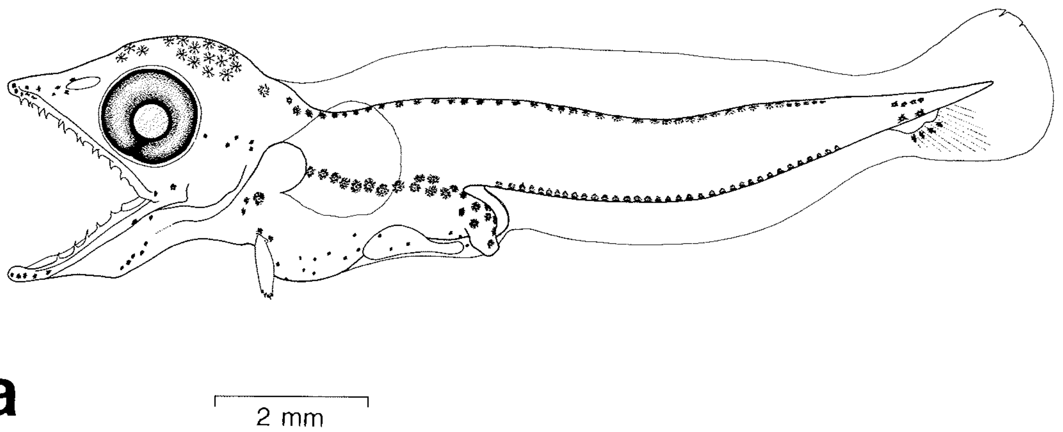
Food

North and Ward (in press a, b) reported that at South Georgia the diet of first feeding larvae in late winter was copepods, especially adult female *Drepanopus forcipatus*. In summer they preyed mainly on *D. forcipatus* but consumed a greater portion of immature stages. Euphausiids and larvae of other fish species were also recorded in the diet.

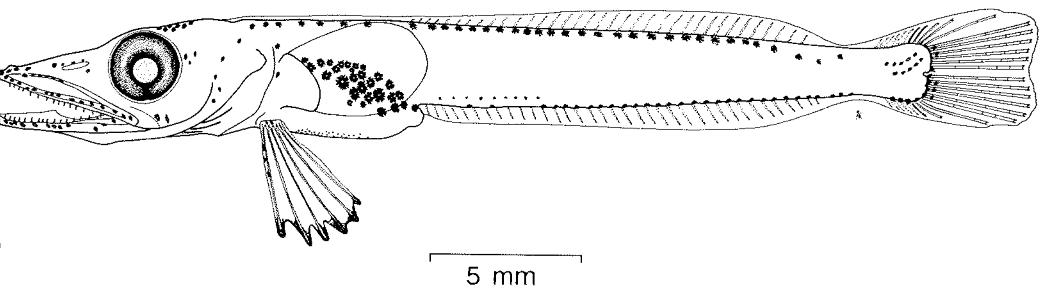
Distinguishing characters of similar, co-occurring species

Larvae of other icefish species can be distinguished by the well developed pelvic fin, the lack of a continuous dorsal pigment row and the presence of lateral pigment on the postanal section.

Fig. 14: ***Champsocephalus gunnari*. a) Larva with yolk, 13.1 mm SL; "Walther Herwig", St. 146, 23 February 1985, Antarctic Peninsula. b) Transforming larva, 31.5 mm SL, "Walther Herwig", St. 70/173, 27 December 1975, South Georgia.**



a



b

3.15 *Chionobathyscus dewitti* Andriashev & Neelov, 1978

Description of early stages

The basic pigmentation pattern consists of a dorsolateral and a ventrolateral row along the postanal section (Fig. 15). There is pigment on the tips of the jaws, on the occipital region, along the posterior opercular margin, on the pectoral fin base, on the neck region, on the pelvic fin between the spine and the first soft ray and along the distal part of the second soft ray, on the caudal peduncle and on the dorsal part of the abdomen. Ventral abdominal pigment is present. In small larvae (Fig. 15a), there was also pigment along the jaws and on the parietal head region, whereas in larger larvae (Fig. 15b), there was dense pigment on the proximal parts of the lower jaw. Pigmentation of all the larger larvae was rather faded and inconspicious. The number of myotomes of all specimens examined was 68 - 69 (17 + 51 - 52) which corresponds to the number of vertebrae in adult fishes.

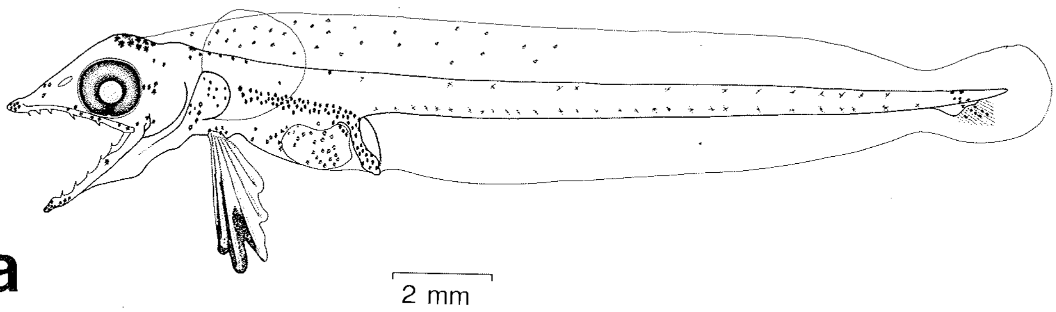
Spatial and temporal distribution

Larvae of 17.0 - 20.9 mm SL were caught in the eastern Weddell Sea in February 1980 and 1983 (Hubold, unpubl. data). Three larvae of 25.4 - 29.1 mm SL were recorded in the southwestern part of Bransfield Strait (Antarctic Peninsula) in late October 1983. This indicates either considerable variability of the hatching season with latitude, or a very extended spawning season. Juveniles were reported as by-catch of semi-commercial krill trawls off Anvers Island in February (Slosarczyk & Rembiszewski, 1982).

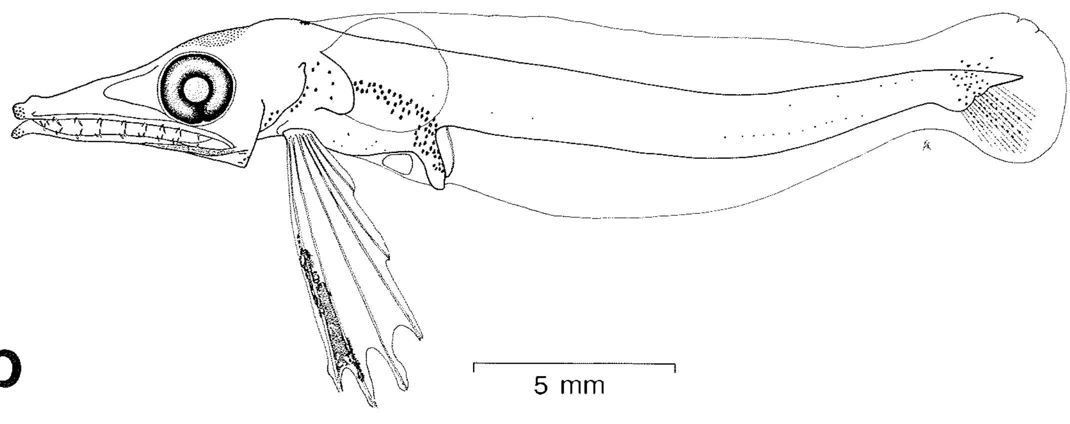
Distinguishing characters of similar, co-occurring species

Chaenocephalus aceratus: There are 61 - 62 myotomes in larvae of 21 - 26 mm SL; pectoral fin base only pigmented on upper anterior part.

Fig. 15: ***Chionobathyscus dewitti***. a) Larva with yolk, 20.9 mm SL; "Polarsirkel", St. 230-2, 12 February 1981, Weddell Sea. b) Larva with remains of yolk, 25.4 mm SL; "Polarstern", St. 118, 29 October 1983, Antarctic Peninsula.



a



b

3.16 *Chionodraco rastrospinosus* DeWitt & Hureau, 1979

Description of early stages

The basic pigmentation pattern consists of a short anterior dorsal row and of 2 - 6 dorsolateral and 2 - 6 ventrolateral rows along the postanal section (Fig. 16). There is pigment on the tip of the jaws, along the jaws, on the snout, on the jaw angle, on the occipital and lateral head regions, along the posterior opercular margin, on the pectoral fin base, on the pelvic fin between the spine and the first soft ray and along the other soft rays, on the dorsal and lateral part of the abdomen, on the caudal peduncle and caudal fin ray bases. Ventral abdominal melanophores are present. In early larvae (Fig. 16a), there are two dorsolateral and two ventrolateral pigment rows along most of the postanal section, with one single row each on the posterior part and a third row each on the anterior part of the cauda, extending to above the abdomen. In transforming larvae (Fig. 16b) there are up to six of these rows on the anterior part of the cauda and 1 - 2 on the posterior part. Melanophores of these rows are placed along the myosepta at all stages. Specimens of 50 - 66 mm SL had the fin ray counts D_1 IV - VI, D_2 37 - 41, A 34 - 36, P 22 - 24, and the complete number of vertebrae V 16 - 18 + 42 - 43 = 59 - 61 (n = 11).

Spatial and temporal distribution

Larval hatch was estimated to occur in late winter and spring (Kellermann, 1986). In the Antarctic Peninsula region, larvae with yolk were caught throughout Bransfield Strait and adjacent waters, with lengths of 20 - 36 mm SL between late October and early December (Kellermann, 1986, 1989). Hatch and larval distribution in spring coincide with that of larval nototheniids, especially *Nototheniops larseni* and *Trematomus newnesi*. In summer and fall, larvae and juveniles are frequently associated with aggregations or swarms of the Antarctic krill (Slosarczyk & Rembiszewski, 1982). The pelagic phase is extended over the winter months at least until the following spring.

Food

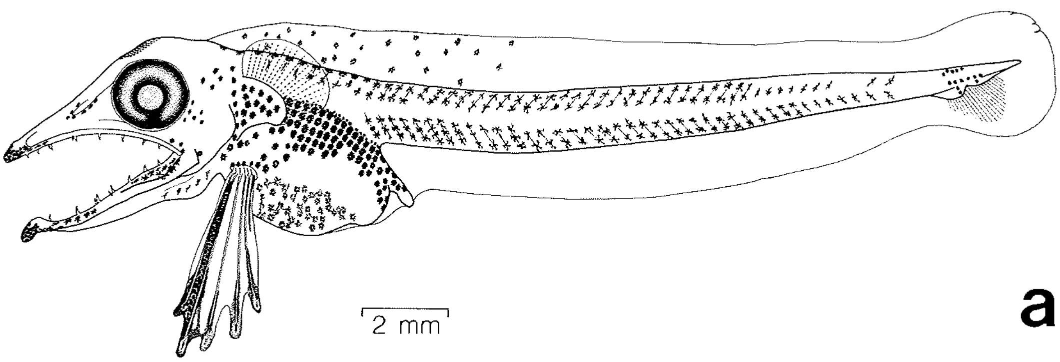
Larval prey in spring are late furcilia stages of *Euphausia superba* and newly hatched nototheniid larvae of *Nototheniops larseni* and *Trematomus newnesi*. The summer diets consist of mostly juvenile *E. superba*, *Thysanoessa macrura* and nototheniid larvae, with varying proportions of euphausiid and fish prey in different years. Euphausiids are the staple food in fall (Kellermann, 1986, 1986b).

Distinguishing characters of similar, co-occurring larvae

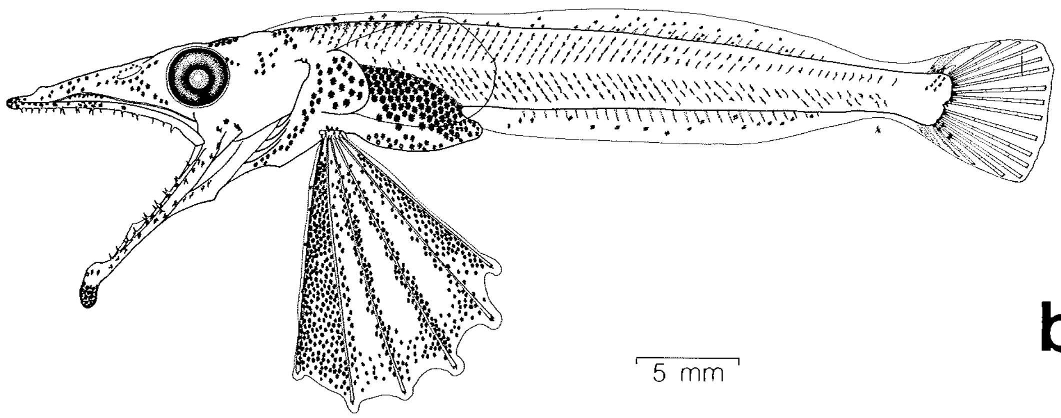
Chaenodraco wilsoni: Pelvic fin ray counts I, 4; no more than three dorso- and three ventrolateral postanal pigment rows at 30 - 40 mm SL.

Cryodraco antarcticus: Black blotch at the tip of the pelvic fin in small larvae, pelvic fin reaching far beyond the anus; no more than three dorso- and three ventrolateral postanal pigment rows.

Fig. 16: *Chionodraco rastrospinosus*. a) Larva with yolk, 24.5 mm SL; "Polarstern", St. 96, 3 November 1987, Antarctic Peninsula. b) Transforming larva of 47.0 mm SL; "Walther Herwig", St. 298, 29 March 1985, Antarctic Peninsula.



a



b

3.17 *Cryodraco antarcticus* Dollo, 1900

Description of early stages

The basic pigmentation pattern consists of a short anterior dorsal row and of 1 - 3 dorsolateral and 1 - 3 ventrolateral rows along the postanal section (Fig. 17). There is pigment on the tips of the jaws and along the jaws, on the lateral parts of the snout, on the jaw angle, on the occipital and parietal head regions, along the posterior opercular margin, on the pectoral fin base and above, on the base of the pelvic fin, on the caudal peduncle, and on the dorsal and lateral parts of the abdomen. Ventral abdominal pigment is present. In small larvae (Fig. 17a), there is a black pigment blotch on the distal pelvic fin with some melanophores along the soft rays. At all stages, the fin membrane is pigmented between the spine and the first soft ray. There is one dorsolateral and one ventrolateral pigment row along the cauda in small larvae (Fig. 17a), supplemented by a second row each on the anterior section. In transforming larvae (Fig. 17b), there are two rows each on the posterior part, and three rows on the anterior part of the postanal section. Melanophores of these rows are placed on the myosepta, and a fourth melanophore along a myoseptum may occur. Specimens of 68 - 83 mm SL had the fin ray counts D_1 IV - V, D_2 46, A 39 - 40, P 24 - 25, and the complete number of vertebrae V 24 - 27 + 42 - 45 = 68 - 71 (n = 4).

Spatial and temporal occurrence

In the Antarctic Peninsula region, larvae in spring were caught in shelf and slope waters of Bransfield Strait and Elephant Island; in late October/early November (1983) these were larvae of 27 - 39 mm SL, and in mid November to early December (1977) they were of 32 - 44 mm SL (Kellermann, 1986, 1989). Larval hatch may be assumed to occur during winter. In summer and fall, late larval and juvenile fishes are frequently associated with aggregations or swarms of the Antarctic krill; length ranges were 38 - 80 mm SL in late December/early January and 76 - 90 mm in March (Slosarczyk, 1986, 1987). In late summer, juvenile fishes of about the latter length range were caught in pelagic as well as in bottom trawls (South Orkney Islands; Permitin, 1969). Early stages are also reported from the eastern Weddell Sea and from Prydz Bay (Hubold, 1989; Williams, 1985).

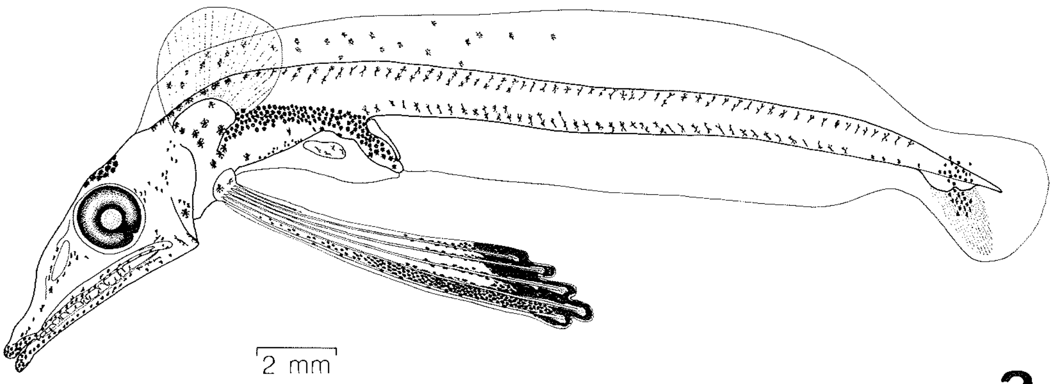
Food

Larval food in spring consisted of late furcilia larvae of *Euphausia superba*, and of *Thysanoessa macrura* (Kellermann, 1986). The summer food (February) was chiefly *T. macrura*, with juvenile *E. superba* and larval nototheniid fish taken occasionally (Kellermann, 1986, 1986b).

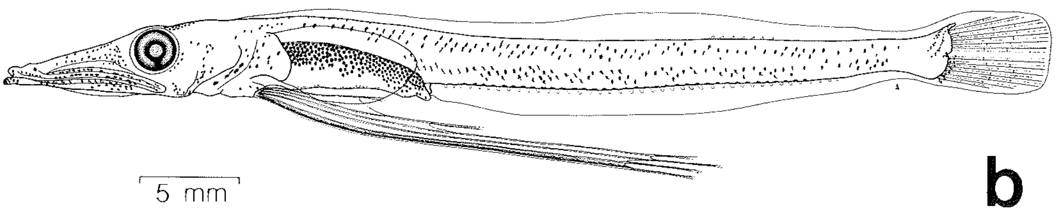
Distinguishing characters of similar, co-occurring species

Chionodraco rastrospinosus :	Pelvic fin not reaching far beyond the anus level; more than three dorso- and three ventrolateral anterior postanal pigment rows.
Chaenodraco wilsoni:	Pelvic fin ray counts I, 4, pelvic fin not reaching far beyond the anus level; more than three ventrolateral anterior postanal pigment rows may be present at more than 40 mm SL.
Chaenocephalus aceratus:	A single dorso- and a single ventrolateral pigment row on postanal section.

Fig. 17: ***Cryodraco antarcticus.*** **a) Larva with yolk remain, 29.0 mm SL; "Polarstern", St. 147, 17 November 1987, Antarctic Peninsula. b) Transforming larva of 48.9 mm SL; "Polarstern", St. 133, 7 February 1983, Weddell Sea.**



a



b

3.18 *Dacodraco hunteri* Waite, 1916

Description of early stages

The basic pigmentation pattern consists of a short anterior dorsal row and two vertical bands on the postanal section (Fig. 18). There is pigment on the tips of the jaws, along the lower jaw and on the jaw angle, on the lateral snout region, on the occipital and parietal head regions, along the posterior opercular margin, on the pectoral fin base, on the pelvic fin base and on the fin membrane between the spine and the first soft ray, along the other soft rays and on the caudal peduncle. There are melanophores on the dorsal and lateral abdomen, ventral abdominal pigment is present. In small larvae (Fig. 18a), there are a few dorsolateral melanophores above the abdomen which in early juvenile fishes develop into a further vertical pigment band; another vertical band is formed by the pigment on the caudal peduncle (Fig. 18b). The specimen of 46.7 mm SL had the fin ray counts D_1 III, D_2 32, A 31, P 26, and the complete number of vertebrae V 20 + 35 = 55. The description of larvae is identical with the *Cryodraco* sp. of Regan (1916); his myotome counts for the positions of the vertical pigment bands were confirmed by the present material with some variation.

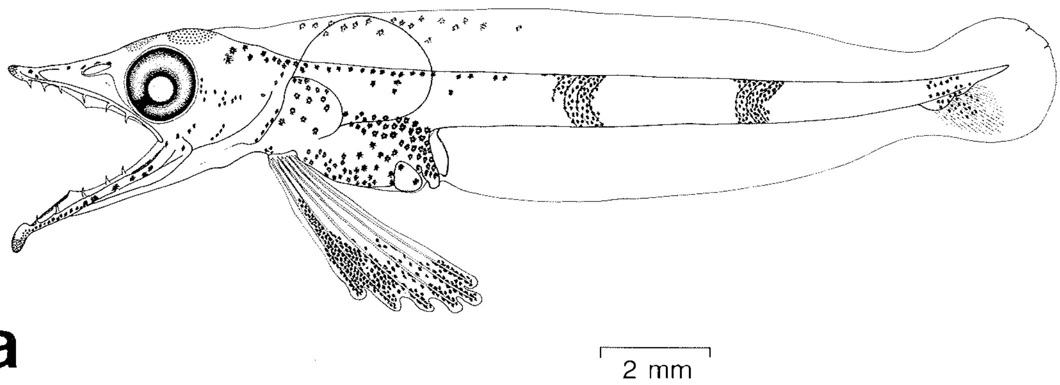
Spatial and temporal occurrence

Larvae of 17 - 28 mm SL, the smallest with yolk remains, were captured in the southern and eastern Weddell Sea in January and February (Hubold, 1989). Larval hatch may thus be assumed to occur in summer. The larvae reported by Regan (1916) from the Ross Sea were of 16 - 21 mm SL, and were presumably caught in summer. In the Antarctic Peninsula region, only single juvenile fishes were taken in late May (46.7 mm), and in late October (65.8 mm), which may point to a pelagic life mode throughout the first winter.

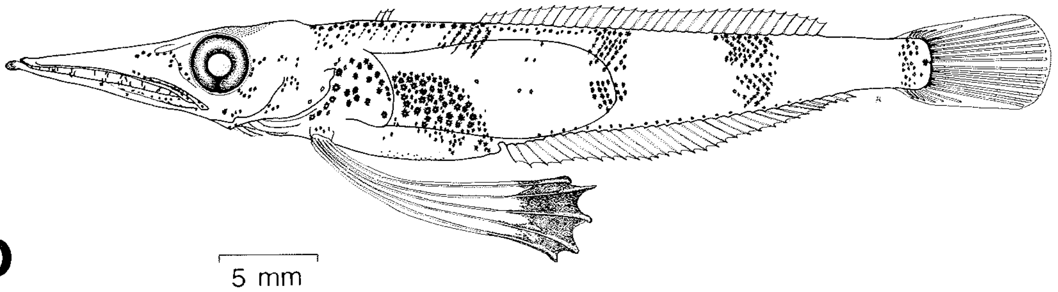
Distinguishing characters of similar, co-occurring species

Early stages of *D. hunteri* can be distinguished from other icefish species by the vertical pigment bands on the postanal section.

Fig. 18: *Dacodraco hunteri*. a) Larva with yolk, 19.7 mm SL; "Polarstern", St. 298/29, 5 February 1985, Weddell Sea. b) Juvenile fish of 46.7 mm SL; "Polarstern", St. 84, 22 May 1986, Antarctic Peninsula.



a



b

3.19 ***Pagetopsis macropterus*** **(Boulenger, 1907)**

Description of early stages

The basic pigmentation pattern of larvae (Fig. 19) consists of a dense cover of the anterior part of the body, and of dorsolateral and ventrolateral series of melanophores along the myosepta above the abdomen and on the anterior post-anal section. There are single melanophores on the myotomes between these series. A short anterior dorsal pigment row is present. The pelvic fin membrane is entirely covered with pigment, which may desintegrate due to preservation. There is pigment on the caudal peduncle and on the forming caudal fin rays. The abdomen is covered with melanophores and ventral abdominal pigment is present. Judging from the drawings of small larvae of 14 - 19 mm SL given by Regan (1916), and from the description of a 54.5 mm SL juvenile fish by Efremenko (1983), the dorsolateral and ventrolateral pigment series extend caudally during development. Larvae of 23 - 36 mm SL had 52 - 54 myotomes. Specimens of 50 - 57 mm SL had the fin ray counts D_1 XII - XIII, D_2 27 - 30, A 23 - 27, P 23 - 24, and the complete number of vertebrae V 18 + 36 = 54 (n = 2). Fin rays in the D_1 (IV+ - IX+) were already forming in larvae of 30 - 36 mm SL.

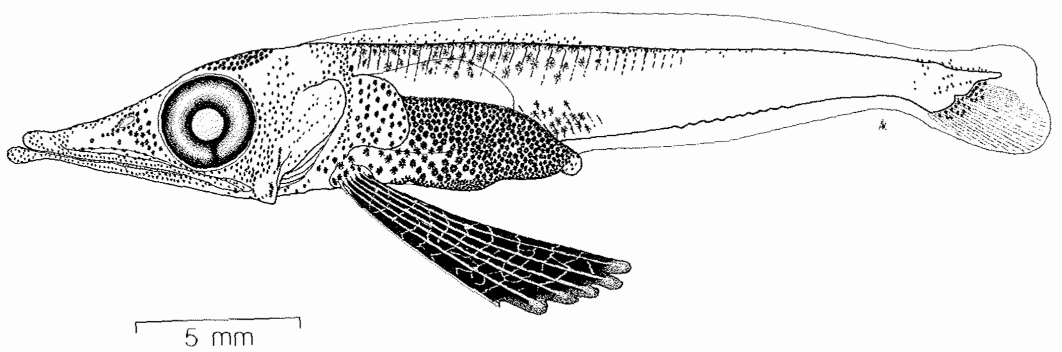
Spatial and temporal occurrence

Hatching is likely to occur in winter (May onward), as suggested by the yolk sac larvae of Regan (1916) which were caught in the Ross Sea in May/June. This is also indicated by the advanced stage of larvae of 23 - 36 mm SL caught on the shelf of Joinville Island (Antarctic Peninsula) in late November/early December (Kellermann, 1989). Larvae of similar length are also reported from the eastern Weddell Sea in November (Hubold, 1989). Juveniles of 42 - 45 mm SL occurred as by-catch of semi-commercial krill trawls in Bransfield Strait and adjacent waters in summer (Rembiszewski *et al.*, 1978; Slosarczyk, 1986).

Distinguishing characters of similar, co-occurring species

Pagetopsis maculatus:	Larvae with 49 - 51 myotomes; dorsolateral pigment series along myosepta extending beyond the anus level in larvae from 17 - 20 mm SL onward; barred pigmentation pattern of pelvic fin present from about 52 mm SL onward.
Pseudochaenichthys georgianus:	Dorsolateral pigment series along the myosepta do not reach more than half way to the abdomen in larvae and early juveniles.
Neopagetopsis ionah:	Larvae are probably very similar but have not yet been described.

Fig. 19: ***Pagetopsis macropterus*****. Larva of 28.8 mm SL; "Polarstern", St. 140, 16 November 1987, Antarctic Peninsula.**


5 mm

3.20 *Pagetopsis maculatus* Barsukov & Permitin, 1958

Description of early stages

The basic pigmentation pattern of larvae (Fig. 20) consists of a dense cover of the anterior part of the body, and of dorsolateral series of melanophores along the myosepta above the abdomen. These series extend beyond the anus level in larvae from 17 - 20 mm onward. A short anterior dorsal row of melanophores is present. The pelvic fin membrane is entirely covered with pigment which may desintegrate due to preservation. There is pigment on the caudal peduncle and on the forming caudal fin rays. The abdomen is covered with melanophores and ventral abdominal pigment is present. Larvae of 15 - 21 mm SL had 49 - 51 myotomes. Specimens of 52 - 74 mm SL had the fin ray counts D_1 X - XIII, D_2 25 -26, A 22 - 23, P 23 - 24 (n = 3), and the complete number of vertebrae V 17 + 32 = 49 (n = 1).

Spatial and temporal occurrence

In the Weddell Sea, hatching is likely to occur in summer which is suggested by larvae of 13 - 21 mm SL taken in January/February (Hubold, 1989). In the Antarctic Peninsula region, larvae are much less common than in the high Antarctic seas, and records were confined to shelf areas with water masses of Weddell Sea origin (Kellermann, 1989); larvae of 14 - 24 mm were captured between mid January and early March, with yolk remains present in specimens of 14 - 18 mm SL. A single juvenile fish of 52 mm SL was taken in early December, and in the Weddell Sea juveniles of 68 and 74 mm SL were taken in summer (Hubold, unpubl. data).

Food

The larvae are piscivorous. The staple food in the Weddell Sea in summer are larval *Pleuragramma antarcticum* (Hubold, 1985), and larval *Nototheniops larseni* in the Antarctic Peninsula region (Kellermann, unpubl. data).

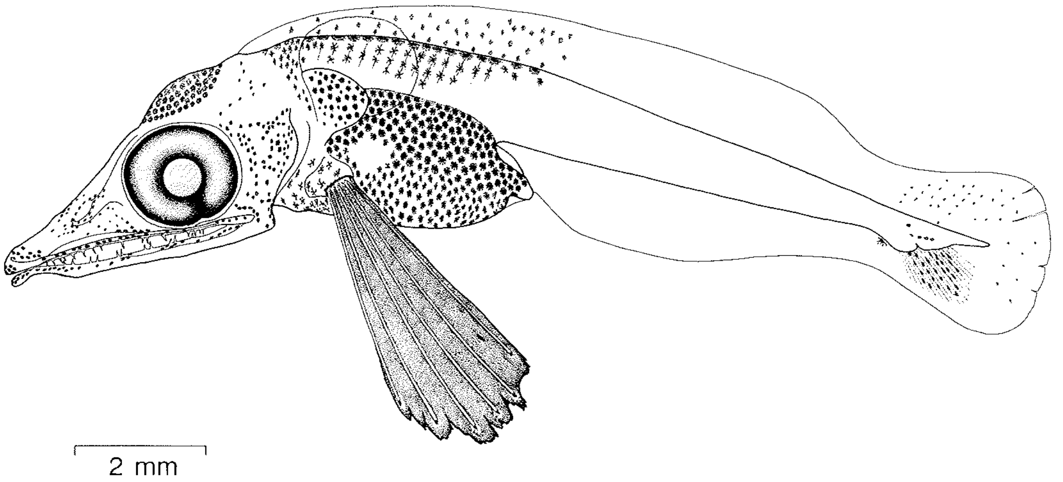
Distinguishing characters of similar, co-occurring species

Pagetopsis macropterus: Larvae with 52 - 54 myotomes; dorsolateral pigment series along myosepta not extending beyond the anus level in larvae smaller than 23 mm; pelvic fin membrane entirely black in late larvae and juveniles.

Pseudochaenichthys georgianus: Dorsolateral pigment series along the myosepta do not reach more than half way to the abdomen in larvae and early juveniles.

Neopagetopsis ionah: Larvae are probably very similar but have not yet been described.

Fig. 20: *Pagetopsis maculatus*. Larva with yolk, 15.3 mm SL; "Polarstern", St. 173, 17 February 1983, Weddell Sea.


2 mm

3.21 *Pseudochaenichthys georgianus* Norman, 1937

Description of early stages

The basic pigmentation pattern consists of a short anterior dorsal row, and a dense cover of the anterior part of the body (Fig. 21). There are a few, short dorsolateral series of melanophores along the myosepta. The dorsal row extends caudad during development. The pelvic fin membrane is entirely covered with pigment which may desintegrate due to preservation. There is pigment on the caudal peduncle and on the forming caudal fin rays. The abdomen is covered with melanophores and ventral abdominal pigment is present. Specimens of 35 - 40 mm SL had the fin ray counts D_1 X, D_2 30, A 29 - 30, P 23 - 24, and the complete number of vertebrae V 14 - 16 + 38 - 39 = 53 - 54 (n = 4).

Spatial and temporal distribution

Hatching at South Georgia is from July until September (North & White, 1987). Larvae were of 15 - 20 mm SL in July and of 19 - 32 mm SL in September (North, pers. comm.). In December (1975, 1977), larvae and juveniles of 23 - 47 mm SL were captured in shelf waters of 86 - 260 m bottom depth around South Georgia. Early stages occurred as a by-catch in semi-commercial krill trawls from spring throughout fall (Rembiszewski *et al.*, 1978; Slosarczyk, 1983a). In the Antarctic Peninsula region, so far only one single juvenile fish of 40.0 mm SL was reported (Kellermann, 1989), although the species is likely to spawn there (Kock, 1981).

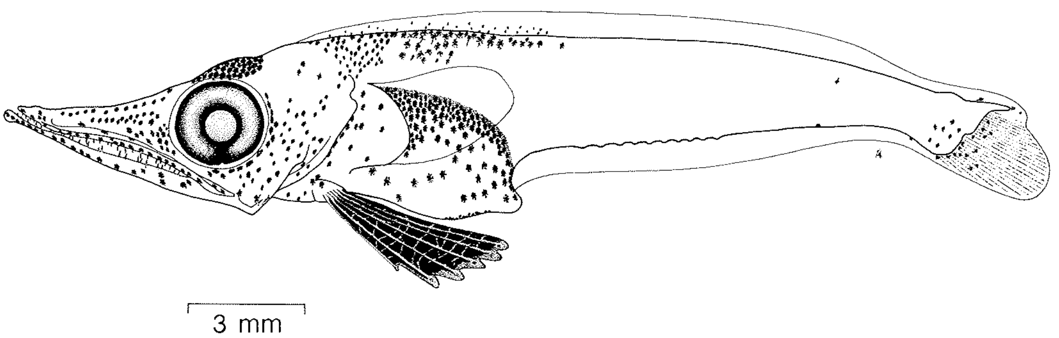
Food

Larvae and early juvenile fishes are piscivorous. Diets of specimens of 23 - 47 mm SL caught in December (South Georgia) consisted of larval *Notothenia gibberifrons, Champsocephalus gunnari* and *Nototheniops larseni.* Cannibalism was occasionally observed in larger specimens of 36 - 46 mm SL.

Distinguishing characters of similar, co-occurring species

Pagetopsis spp.: Dorsolateral and ventrolateral pigment series along myosepta present on the postanal section in larvae; dorsolateral series above the abdomen extend more than half way to the peritoneal pigment.

Fig. 21: *Pseudochaenichthys georgianus.* Larva of 26.9 mm SL; "Walther Herwig", St. 69, 27 December 1975, South Georgia.



3.22 *Harpagifer antarcticus* Nybelin, 1947

Description of early stages

The basic pigmentation pattern consists of a dorsal pigment row, a vertical band of melanophores and ventrolateral pigment groups on the postanal section (Fig. 22). There is pigment on the upper snout, on the occipital and parietal head regions, on the abdomen and on the pectoral fin base. Ventral abdominal pigment is present. The complete set of fin rays is present in specimens of 24.5 - 27.0 mm (see Efremenko, 1983).

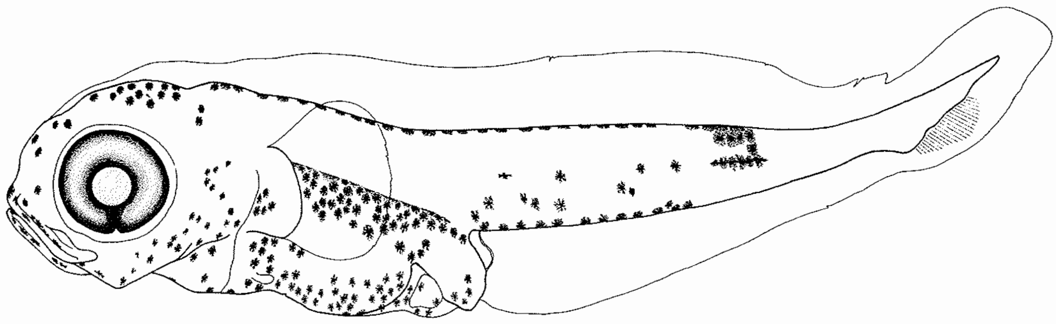
Spatial and temporal occurrence

Antarctic Peninsula: Larvae of 5 - 12 mm SL were caught in Bransfield Strait and adjacent waters from late October onward; yolk sac larvae were of 5 - 10 mm SL. Most records were made in coastal waters of 70 - 490 m water depth, but also dispersal into oceanic waters was obvious (Kellermann, 1986; 1989). Small larvae of 5 - 14 mm SL occurred yet in January/February which agrees with the extended spawning period observed by Daniels (1978). Long hatching seasons covering most of the winter and spring months were also reported from the South Orkney Islands (Everson, 1968). Transforming larvae and juvenile fishes of 14 - 25 mm SL were recorded in late summer and fall indicating that the pelagic development is concluded within one summer season (see Everson, 1968).

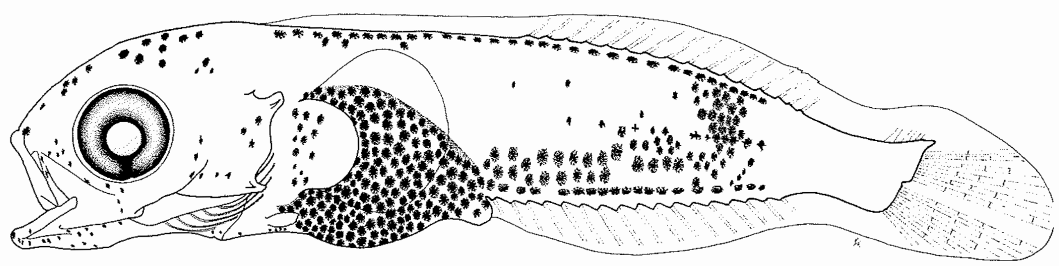
Distinguishing characters of similar, co-occurring species

Early stages of *H. antarcticus* can be distinguished from other larvae with a vertical bar on the postanal section such as *Notothenia kempi* or *Dissostichus eleginoides* by the presence of a dorsal pigment row and by their compact, deep body in contrast to the slender shape of the nototheniid species. Other species of the genus *Harpagifer* are confined to their specific islands, though the larvae are similar.

Fig. 22: *Harpagifer antarcticus*. a) Larva with yolk, 9.2 mm; "Polarstern", St. 133, 14 November 1987, Antarctic Peninsula. b) Transforming larva of 15.4 mm SL; "Walther Herwig", St. 168/360, 10 February 1976, Antarctic Peninsula.



a 2 mm



b 2 mm

3.23 *Aethotaxis mitopteryx* DeWitt, 1962

Description of early stages

The basic pigmentation pattern consists of a dense dorsal band and a dense lateral melanophore coverage on the postanal section (Fig. 23a, b), which develops into lateral pigment series in transforming larvae (Fig. 23c). There is pigment on the upper snout, on the jaws, on the occipital and parietal head regions, on the cleithral symphysis and along the posterior opercular margin, on the pectoral fin base and on the caudal peduncle and the caudal fin rays. Parietal head pigment is formed by a line of melanophores running from the opercular region to along the ventral margin of the orbit. The dorsal and lateral abdominal regions are pigmented in early larvae whereas in transforming larvae pigment is present only on the dorsal part of the gut. Ventrolateral abdominal pigment was present in specimens around 20 mm SL (Fig. 23b). A subcutaneous ventral pigment row developped in transforming larvae (Fig. 23c). The number of fin rays in a specimen of 36.9 mm SL was D_1 VI, D_2 36, A 31, P 26 and the vertebrae count was V 18 + 34 = 52.

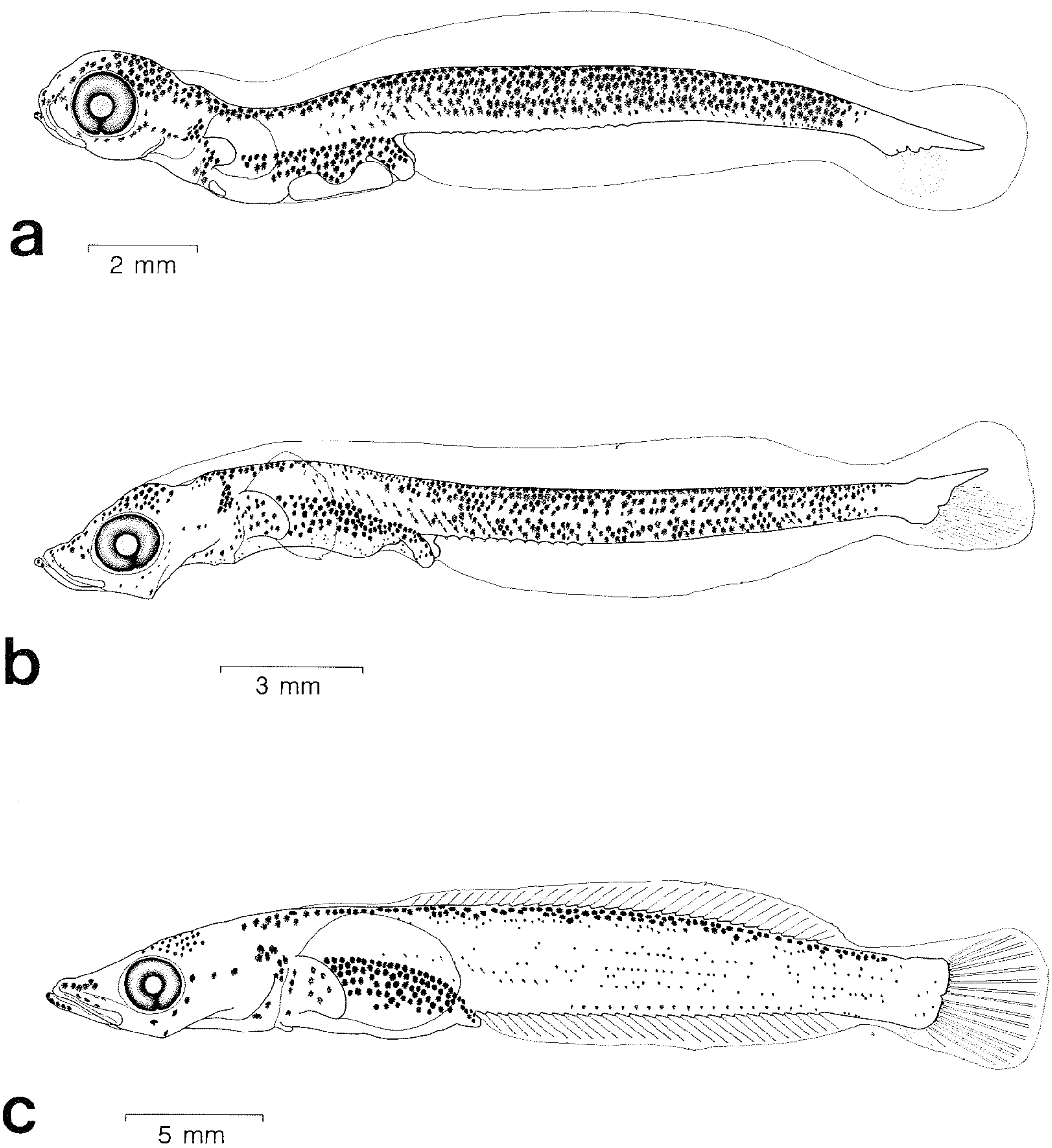
Spatial and temporal occurrence

Larvae have been recorded in the Weddell Sea, and off the South Shetland Islands (Efremenko, 1983). Hatching is likely to occur in spring which is suggested by catches of yolk sac larvae (Fig. 23a) in the Weddell Sea in November (Hubold, 1989). Larval lengths in summer vary between 15 and 32 mm in January, and 28 - 36 mm in February (Hubold, unpubl. data). Late transforming larvae of 38 - 43 mm caught in the Antarctic Peninsula area in April (Efremenko, 1983) may indicate that larval development is concluded by the end of the first summer.

Distinguishing characters of similar, co-occurring species

Prionodraco evansii:	Dorsal pigment not reaching the pectoral fin base level; dorso- and ventrolateral rows of spiny scales present in transforming larvae from about 21 mm SL onward.
Notothenia neglecta:	Ventrolateral pigment on postanal section represented by a row of melanophores in early larvae; body not long and slender in transforming larvae, black blotch at the tip of the pectoral fin.
N. rossii:	Ventrolateral pigment on postanal section represented by groups of melanophores, dorsal band less deep in early larvae; body not long and slender in transforming larvae.

Fig. 23: ***Aethotaxis mitopteryx*. a) Larva with yolk, 17.4 mm SL; "Polarstern", St. 101, November 1986. b) Larva of 21.5 mm SL; "Polarsirkel", St. 127, January 1981. c) Transforming larva of 34.1 mm SL; "Polarsirkel", St. 101/264, February 1980. All specimens from the Weddell Sea.**


a
2 mm
b
3 mm
c
5 mm

3.24 *Dissostichus eleginoides* Smitt, 1898

Description of eggs and larvae

The eggs (Fig. 24a) measured 4.3 - 4.7 mm in diameter with a mean of 4.5 ± 0.16 (n = 8). They contained embryos at an advanced stage of development (Fig. 24b) with total lengths around 14 mm. The pigmentation of the embryos consists of melanophores along the abdominal region, a pigment band on the posterior post-anal section, the dorsolateral part of which extends further towards the head, and occipital melanophores on the brain. There are single pigment spots below the developing pectoral fin. There are no teeth in the jaws. Larvae of 19.8 - 22.1 mm SL have the same basic pigment pattern and the lower jaws carry well developed canine teeth (Fig. 24c).

Ciechomski & Weiss (1976) described larvae of *D. eleginoides* of 11.0 - 28.0 mm total length which have a very similar pigmentation. Early juvenile fishes of 49.3 - 62.0 mm SL were described by Efremenko (1979b). The basic pigment pattern remains unchanged during larval development except for a ventral row of melanophores developing from the posterior pigment band towards the anus, as present in specimens of 28 mm total length (Ciechomski & Weiss, 1976).

Spatial and temporal occurrence

The eggs (Fig. 24a) were caught on 5 - 7 November 1977 north and northwest of South Georgia (52 - 53°S, 36 - 38°W). They occurred in the top 140 m of the water column over water depths of 2200 - 3700 m suggesting that at least the final phase of development is pelagic, if not the total incubation period. The larvae (Fig. 24c) were captured on 3 - 7 December 1975 northwest of South Georgia (52°30 - 55°59S, 39°59 - 46°29W). They were found at the sea surface at night and in the top 200 m in catches during daytime. Water depths ranged between 3800 and 4300 m. The temporal occurrence of larvae and eggs with advanced embryos suggests that hatching in the area occurs in November. Specimens reported from the Burdwood Bank area at similar latitudes by Ciechomski & Weiss (1976) were captured from November onward.

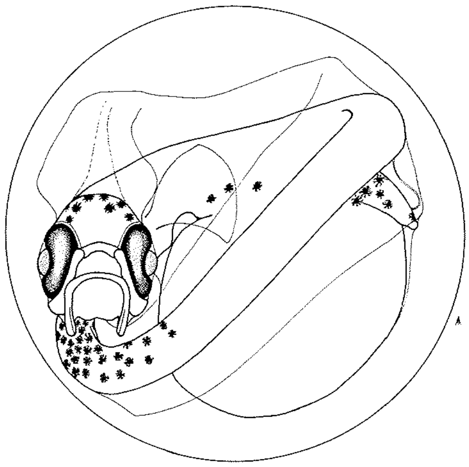
Distinguishing characters of similar, co-occurring species

Early stages of *D. eleginoides* may be similar to those of *D. mawsoni* which have not yet been described, but these are likely to occur further to the south. Larvae of *D. eleginoides* can be confused with larval *Notothenia squamifrons atlantica* and *N. kempi*.

N. squamifrons atlantica: No obvious teeth present in larvae; pelvic fin well developped and reaching behind the pectoral fin base already at about 30 mm SL; dorsolateral row of melanophores above the abdomen (Efremenko, 1984). Complete ventral row of melanophores present in larvae smaller than 28 mm SL (Camus, pers. comm.).

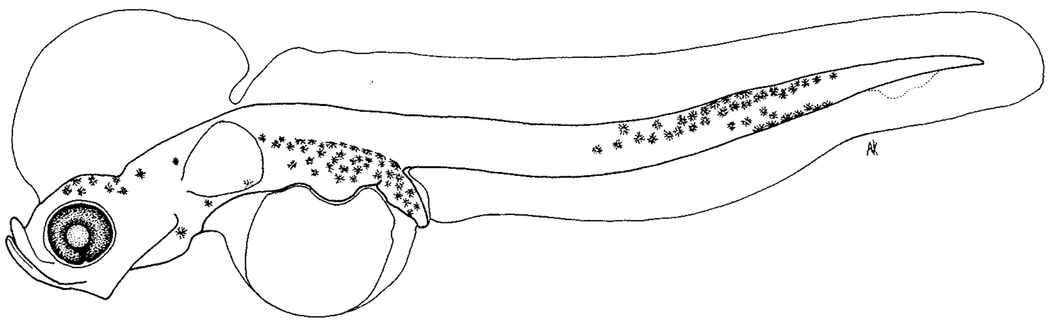
N. kempi: No obvious teeth present in larvae; dorsolateral group of melanophores above the abdomen; no pigment on the occipital region at 15 - 25 mm SL.

Fig. 24: ***Dissostichus eleginoides*. a) Egg with embryo, 4.61 mm in diameter; "Walther Herwig", St. 1/2, 5 November 1977. b) Embryo of 13.1 mm SL, removed from egg of 4.49 mm diameter; "Walther Herwig", St. 3/9, 5 November 1977. c) Larva of 20.5 mm SL; "Walther Herwig", St. 27/115, 7 December 1975. Eggs and larvae caught north and northwest of South Georgia.**



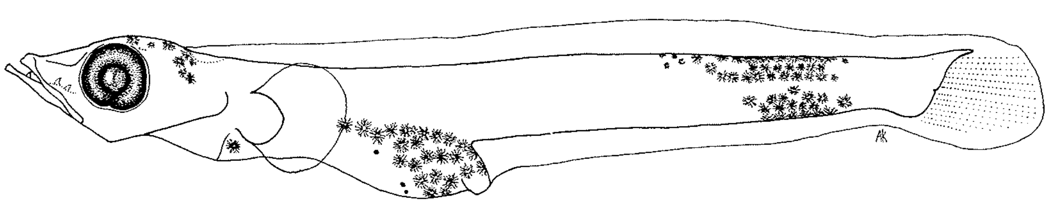
a

1 mm



b

2 mm



c

5 mm

3.25 *Notothenia angustifrons* Fischer, 1885

Description of early stages

The basic pigmentation pattern consists of a ventral row and of a short dorsal row above the pectoral fin base formed by three melanophores (Fig. 25). At 10 - 20 mm SL, a faint or sometimes discontinuous dorsal pigment row is forming on the postanal section (Fig. 25b). There is pigment on the upper snout, on the occipital and parietal head regions, below the pectoral fin base and along the posterior opercular margin, on the dorsal part of the abdomen and on the forming caudal fin rays. Ventral abdominal melanophores are present. The specimen of Fig. 25c had the fin ray counts D_1 VI, D_2 31, A 30, P 20, and the complete number of vertebrae V 14 + 29 = 43. The juvenile barred pigmentation is initiated by single lateral groups of melanophores.

Spatial and temporal occurrence

Early stages are only known from South Georgia. Dense shoals of yolk sac larvae of 5.0 - 7.5 mm total length were observed in nearshore surface waters in November/December, indicating that hatching occurs in spring (North, pers. comm.). Late larvae and early juvenile fishes were recorded in fall, and they occurred in shallow waters near the surface (North, pers. comm.).

Distinguishing characters of similar, co-occurring species

Early stage *N. angustifrons* were not observed in the Antarctic Peninsula area. Off South Georgia, four species with larvae of similar appearance are present:

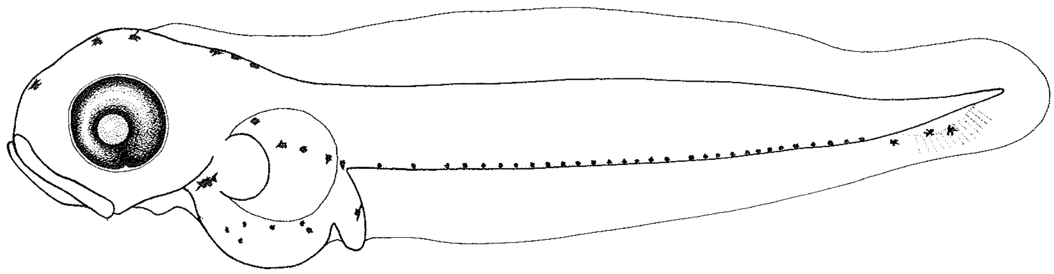
Nototheniops larseni: No ventral abdominal melanophores; no dorsal pigment above the pectoral fin base.

Nototheniops nudifrons: No dorsal row of melanophores in specimens smaller than 30 mm SL; dorsolateral pigment row on the postanal section.

Notothenia gibberifrons: Dorsal row of melanophores continuous; lateral pigment always present in larvae smaller than 20 mm SL.

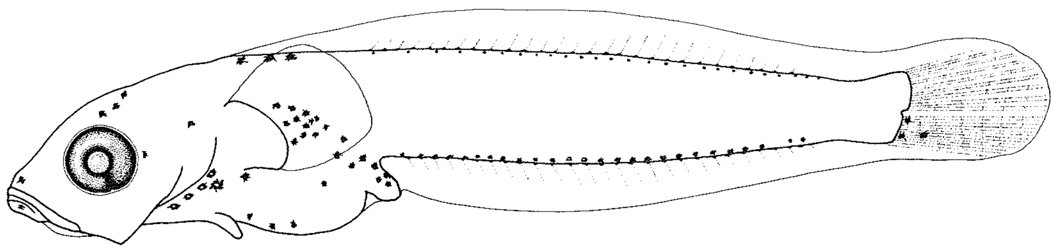
Pagothenia hansoni: No dorsal row of melanophores; no ventral abdominal pigment; abdominal pigmentation consists of five or less melanophores.

Fig. 25: ***Notothenia angustifrons*. a) Larva of 6.5 mm SL. b) Transforming larva of 12.4 mm SL. c) Juvenile fish of 27.7 mm SL. All specimens from BAS collection, caught inshore at South Georgia.**



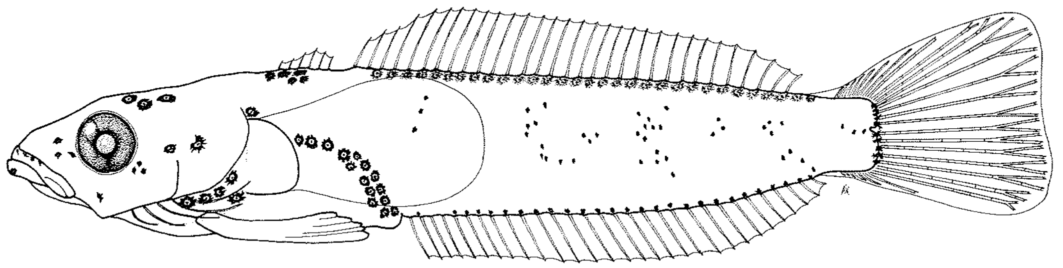
a

1 mm



b

2 mm



c

5 mm

3.26 *Notothenia gibberifrons* Lönnberg, 1905

Description of larvae and juveniles

The basic pigmentation pattern consists of a dorsal and a ventral, partly subcutaneous row of melanophores, and dorso- and ventrolateral pigment rows on the postanal section (Fig. 26). There is pigment on the snout, in the occipital region, along the edge of the operculum and below the pectoral fin base. Ventral abdominal melanophores are present and the dorsal region of the abdomen is densely pigmented. The description agrees with that of Efremenko (1979b); however, there are no melanophores on the pectoral fin base in larvae ('unformed larvae', Efremenko, 1979b). The specimen described by Everson (1968) as *Notothenia rossii marmorata* is probably *N. gibberifrons*. The juvenile, barred pigment pattern on the postanal section appears from about 30 mm SL onward, as well as the complete number of fin rays and vertebrae: D_1 IV - VII, D_2 31 - 33, A 30 - 33, V 16 + 34 - 35 = 50 - 51 (n = 4).

Spatial and temporal occurrence

South Georgia: Smallest larvae of 8.5 - 11.5 mm SL were recorded in September (Efremenko, 1979b). In mid-December (1975), larvae of 9 - 18 mm SL were chiefly confined to the northern and north-western shelf of the island at water depths of 86 - 260 m. Shoals were observed in Cumberland East Bay (North, pers. comm.). Larval dispersal was highest in January/February (1978) and specimens of 26 - 32 mm SL occurred in shelf waters of up to 330 m water depth. By the end of March, pelagic juvenile fishes of 30 - 34 mm SL were confined to nearshore waters of less than 140 m depth. Hatching can be assumed to occur in late winter/spring and the pelagic development is concluded at the end of the first summer.

Antarctic Peninsula: Larvae of 7.4 - 9.2 mm SL, smallest with yolk, were captured in shelf waters of eastern Bransfield Strait in November/December (1984), suggesting that larval hatch occurs in November, and hence later than at South Georgia. In summer (February 1976, 1981), larvae of 18 - 26 mm SL occurred mostly in slope and oceanic waters, and late larvae and juveniles of 22 - 36 mm SL were caught in fall (Kellermann, 1986; Kellermann & Kock, 1984; Sinque *et al.*, 1986). Diel vertical migrations occur in summer; larvae shoal at the surface at night and are dispersed in the water column at daytime (Woerner & James, 1981). In well stratified waters south of Elephant Island, most larvae were found in the top 50 m above the thermocline (Kellermann, 1986).

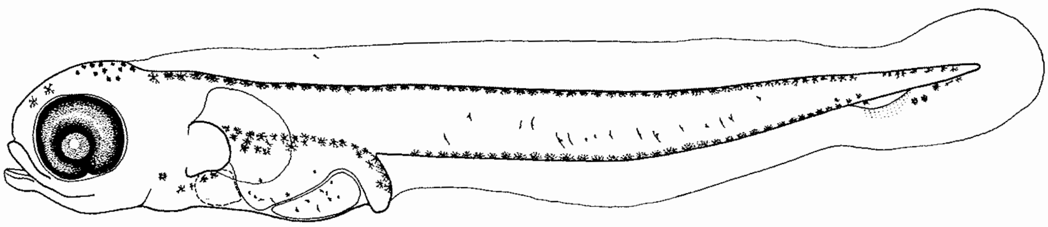
Food

The summer food of larvae (21 - 26 mm SL) consisted of a variety of taxa including copepods, amphipods, polychaetes, eggs, calyptopis and furcilia larvae of euphausiids, and copepod eggs and nauplii with a prey length range of 0.5 - 4.0 mm. Most larvae had ingested copepodites of *Calanoides acutus* and of *Calanus propinquus*, and eggs of the Antarctic krill.

Distinguishing characters of similar, co-occurring species

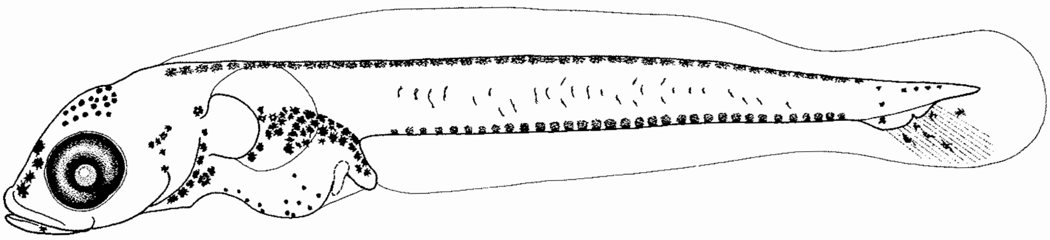
Notothenia angustifrons:	Dorsal row of melanophores intermittent; isolated dorsal pigment group above the pectoral base; no lateral pigment on postanal section at less than 20 mm SL.
Trematomus newnesi:	Dorso- and ventrolateral pigment on postanal section in lines along myosepta, more than two lateral lines present.
Trematomus eulepidotus:	No dorsal pigment row at less than 18 - 20 mm SL; ventrolateral pigment restricted to posterior postanal section at 21 - 29 mm SL, not reaching the anus level.

Fig. 26: ***Notothenia gibberifrons*. a) Larva with yolk, 8.1 mm SL; "Polarstern", St. 203, 3 December 1984. b) Larvae with trace of yolk, 12.7 mm SL; "Barão de Teffé", PRO·ANTAR, No. 6. c) Transforming larva of 17.3 mm SL; "Barão de Teffé", PRO·ANTAR, No. 12. All specimens from the Antarctic Peninsula.**



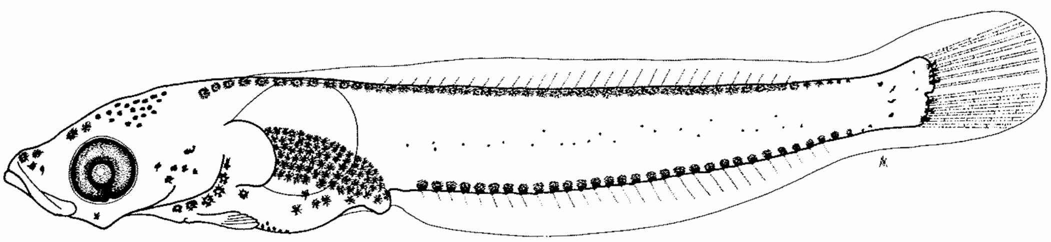
a

2 mm



b

2 mm



c

2 mm

3.27 *Notothenia kempi* Norman, 1937

Description of early stages

The basic pigmentation pattern consists of a vertical band of melanophores on the posterior part of the postanal section, and a group of pigment cells above the abdomen (Fig. 27). The posterior part of the abdomen is pigmented. During larval development, melanophores appear on the occipital region. In juveniles (Fig. 27), a ventral pigment row is forming towards the anus, and there are melanophores on the lateral part of the postanal section, on the pectoral fin base, on the operculum and along its posterior margin, on the parietal head region, and on the snout. There are pigment cells on the bases of the caudal fin rays. Specimens of 37 - 40 mm SL had the fin ray counts D_1 V - VI, D_2 35 - 37, A 32 - 33, P 25 - 26, and the complete number of vertebrae V 19 + 35 = 54 (n = 3).

Spatial and temporal occurrence

Hatching in the Antarctic Peninsula area occurs in summer, from early January onward throughout February. The larvae occur along the shelf break west of the Antarctic Peninsula and along the South Shetland Islands up to Elephant Island; west of the Peninsula, hatching sites are located in a large cyclonic gyre system, which transports and retains the larvae over shelf areas (Kellermann, 1986; Kellermann & Kock, 1988). During hatching in January/February, larvae were of 7 - 14 mm SL with yolk remains present up to 10 mm SL. Larvae caught in March/April were of 15 - 25 mm SL. Larval development extends throughout winter, and transforming larvae of 35 - 38 mm SL were captured in November/December. Early juvenile fishes of 37 - 41 mm SL were taken in near surface waters in February, and the transition to the demersal habit is likely to occur in fall (Kellermann, 1986).

Food

The staple food of larvae in January and February was eggs and nauplii of calanoid copepods and cyclopoid copepods, mostly *Oithona* spp.; prey length varied between 0.16 - 0.80 mm. Diets in early winter consisted chiefly of *Oithona* spp. and *Ctenocalanus* sp. of 0.8 - 1.0 mm in length (Kellermann, unpubl. data; Balbontin *et al.*, 1986).

Distinguishing characters of similar, co-occurring species

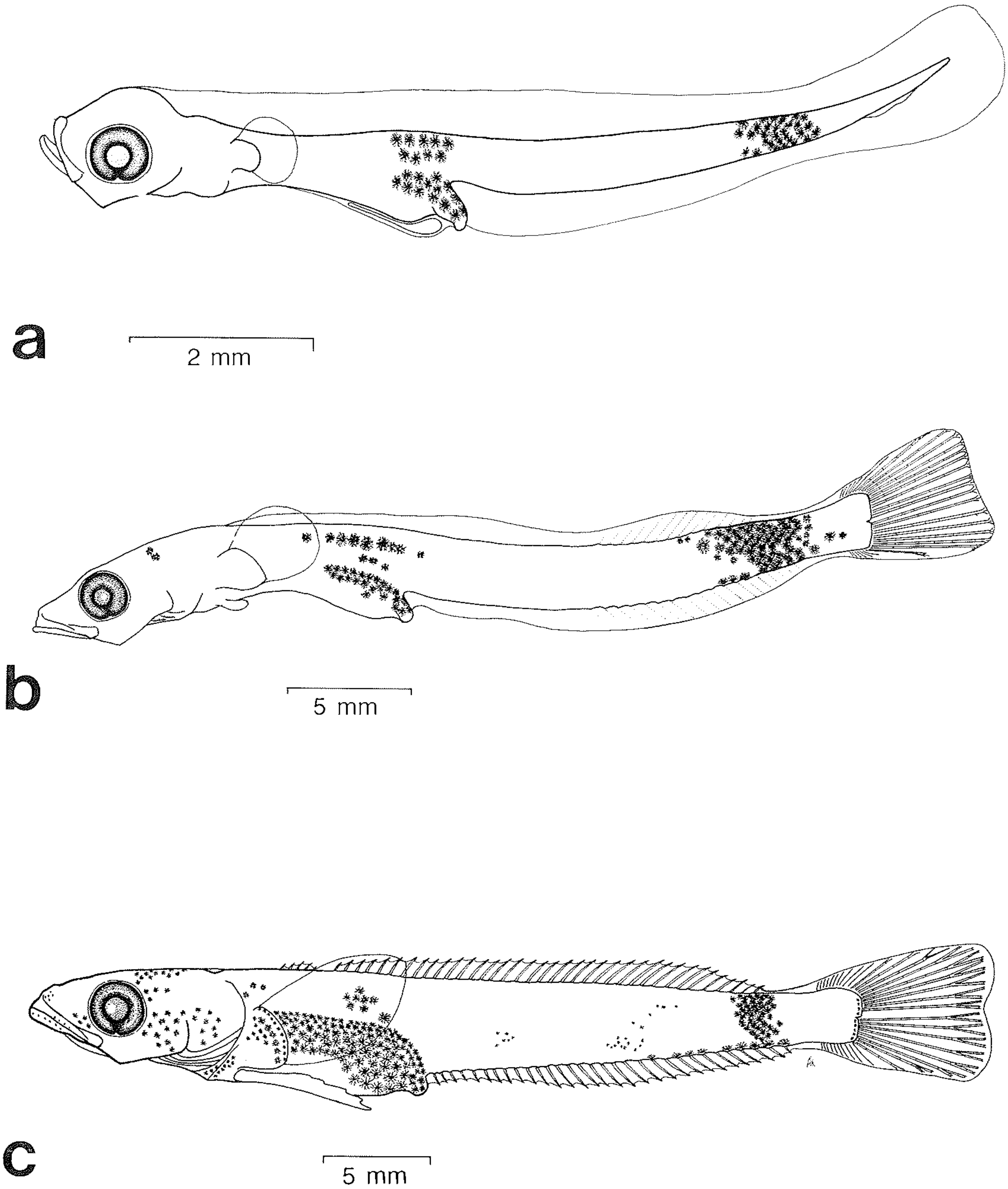
Juvenile fishes similar to the above description and to that of Efremenko (1979b) were identified as *Pagothenia bernacchii* by Slosarczyk (1983). However, a larva of *P. bernacchii* described by Moreno (1980) is fairly different from that in Fig. 27a. Similar larvae of the following species may occur with those of *N. kempi*:

Dissostichus eleginoides: Prominent canine teeth present in the lower jaws of larvae from at least 20 mm onward; no dorsolateral pigment above the abdomen; pigment present in the occipital region in larvae smaller than 25 mm SL.

Notothenia squamifrons atlantica: Complete ventral row of melanophores present at 29.5 - 30.8 mm SL (Efremenko, 1984), but also in smaller specimens (Camus, pers. comm.).

Racovitzia glacialis: Ventrolateral pigment band along postanal section. No dorsolateral pigment group above the abdomen.

Fig. 27: ***Notothenia kempi*. a) Larva with yolk, 9.9 mm SL; "John Biscoe", St. 1154/50, February 1982. b) Larva of 32 mm SL; "Polarstern", St. 127, 4 June 1986. c) Juvenile fish of 38.5 mm SL; "John Biscoe", St. 1098, February 1982. All specimens from the Antarctic Peninsula.**


a
2 mm
b
5 mm
c
5 mm

3.28 *Notothenia neglecta* Nybelin, 1951

Description of early stages

Field caught eggs (Fig. 28a) were 4.3 - 4.7 mm in diameter (mean; 4.53 ± 0.25 mm). They contained embryos similar to the early larvae given in Fig. 28b. The basic pigment pattern is a deep dorsal band of serial, vertical melanophore rows, a ventrolateral row or band of melanophores, and dense pigment on the dorsal part of the abdomen. There are melanophores on the occipital and parietal head regions, on the upper jaws and below the pectoral fin base. At 16 - 20 mm SL, a pigment blotch appears on the tip of the pectoral fin, and the transforming larvae acquire an increasingly heavier pigmentation all over the body (Fig. 28c). Pelagic juvenile fishes are dark blue on the back with silvery sides (Norman, 1938).

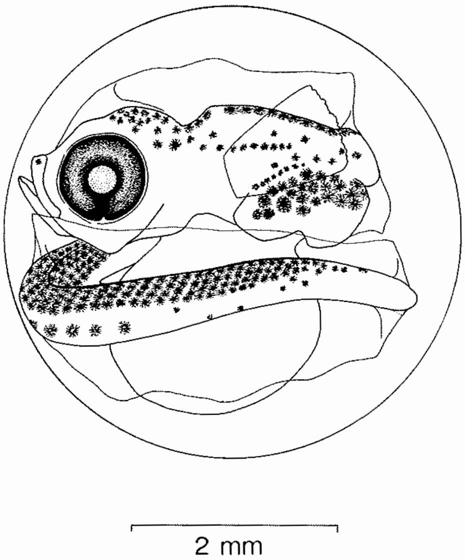
Spatial and temporal distribution

Spawning occurs in May/June and egg development takes between 15 and 21 weeks according to locality (White *et al.*, 1982). In the Antarctic Peninsula area, eggs are neutrally buoyant before hatch and eggs and larvae occur in the neuston. In spring, eggs were found dispersed over Bransfield Strait and adjacent waters. Newly hatched yolk sac larvae were captured around Elephant Island from late November onward. Length at hatch varied between 12.2 and 16.3 mm SL (fresh length). During the summer months, larvae of 16 - 29 mm SL were found dispersed across the Scotia Sea by the prevailing wind driven currents to the north-east. Fingerling stages were frequently collected far off-shore in the Scotia Sea at South Georgia (White *et al.*, 1982). The pelagic phase extends throughout the winter months and transition to demersal life occurs in spring, in the Antarctic Peninsula area, as well as at South Georgia (North, pers. comm.).

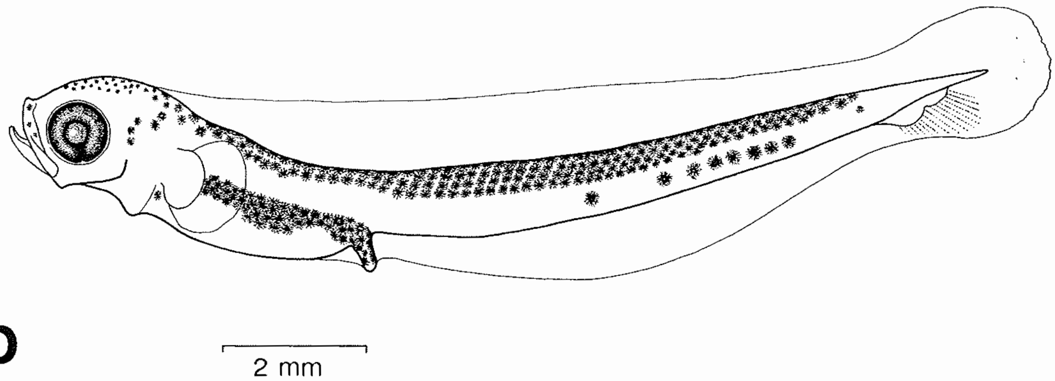
Distinguishing characters of similar, co-occurring species

Notothenia rossii: No black blotch on the tip of the pectoral fin in transforming larvae and juveniles, pectoral fin rounded, not elongated; no pigment on the snout present in early larvae (*N. rossii rossii*; Camus & Duhamel, 1985).

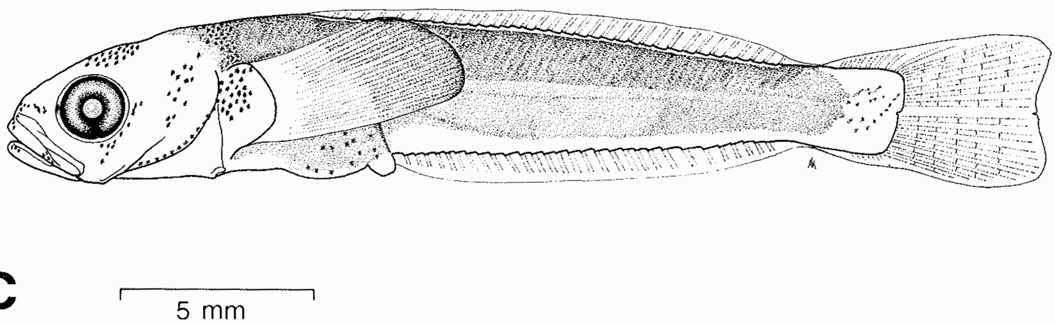
Fig. 28: ***Notothenia neglecta*. a) Egg of 4.42 mm diameter, with advanced embryo; "Polarstern", St. 189, 20 November 1984, Antarctic Peninsula. b) Larva with yolk, 14.5 mm SL; "Polarstern", St. 125, December 1984, Antarctic Peninsula. c) Transforming larva, 23.0 mm SL; "Walther Herwig", St. 307/397, 1 February 1978, Scotia Sea.**



a



b



c

3.29 *Notothenia rossii marmorata* Fischer, 1885

Description of early stages

Larvae of 17 - 29 mm SL are densely covered with pigment except the ventral region of the postanal section, the caudal peduncle, the pectoral fin base, the parietal head region, and the snout in small larvae (Fig. 29). Judging from the drawing of a larva of *N. rossii rossii* given by Camus & Duhamel (1985), early larvae may have a dorsal pigment band, scattered ventrolateral melanophores on the postanal section and dorsal abdominal pigment. Pelagic juvenile fishes (blue phase fingerlings; Burchett, 1983) are entirely pigmented with lighter zones along the dorsal and ventral fins (see Norman, 1938).

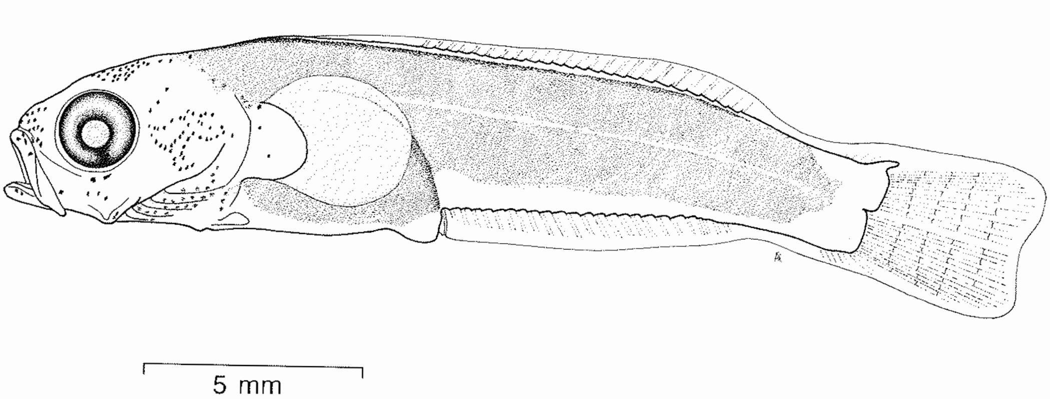
Spatial and temporal occurrence

Larvae of 15 - 23 mm SL occurred in the neuston north-west and west of South Georgia in December (1975). This indicates that hatching is in spring (late October/November). In the same area, epipelagic larvae and early juveniles of 23 - 33 mm SL were caught in January (1976), and juveniles of 45 - 54 mm SL were taken in late March of the same year. The pelagic blue phase fingerlings develop into mainly demersal brown phase fingerlings which in nearshore waters settle to the demersal life in fall (Burchett, 1983).

Distinguishing characters of similar, co-occurring species

Notothenia neglecta: Pigment on the snout present in early larvae; black blotch on the tip of the pectoral fin forming between 16 - 20 mm SL.

Fig. 29: *Notothenia rossii marmorata.* Transforming larva, 19.0 mm SL; "Walther Herwig", St. 26/84, 3 December 1975, South Georgia.


5 mm

3.30 ***Nototheniops larseni*** (Loennberg, 1905)

Description of early stages

The basic pigmentation pattern consists of a ventral row, and of a dorsolateral row of 40 or more melanophores on the postanal section (Fig. 30) which may consist of a variable number of melanophores or it may be lacking. There is pigment on the occipital region, below the pectoral fin base, on the dorsal abdominal region, and along the urostyle and the base of the caudal fin rays respectively. In transforming larvae (Fig. 30c) and early juveniles there is also pigment on the jaws, the parietal head regions, along the posterior opercular margin and on the cleithral symphysis. Specimens of 35 - 40 mm SL had the fin ray counts D_1 V, D_2 39, A 36 - 38, P 23 - 25, and the complete number of vertebrae V 16 + 38 - 39 = 54 - 55 (n = 4).

Spatial and temporal occurrence

Antarctic Peninsula: Larvae with yolk of 7 - 14 mm SL occurred between late October and early December, and hatching is likely to occur from late September throughout early November (Kellermann, 1986). In spring, larvae are dispersed over larger parts of Bransfield Strait and adjacent waters, whereas in summer the main larval distribution coincides with shelf spawning areas of the Antarctic krill at Joinville Island and Elephant Island (Kellermann, 1986). Distribution in fall is similar, but may vary considerably between years (Kellermann & Kock, 1988). The larval stage extends throughout most of the winter, and pelagic juveniles of 38 - 50 mm SL with completely formed fins were taken in spring.

South Georgia: Smallest larvae of 8.5 - 11.2 mm SL were caught between mid November and mid December (Efremenko, 1979b). Records are mostly confined to the northern shelf. Larvae were found over bottom depths of 90 - 260 m in spring, occurred widely dispersed in summer (160 - 330 m bottom depths), and were confined to the shallower waters of 95 - 140 m in fall (Kellermann, unpubl. data). Pelagic juvenile fishes with a barred pigment pattern occurred already in mid-winter (Efremenko, 1979b).

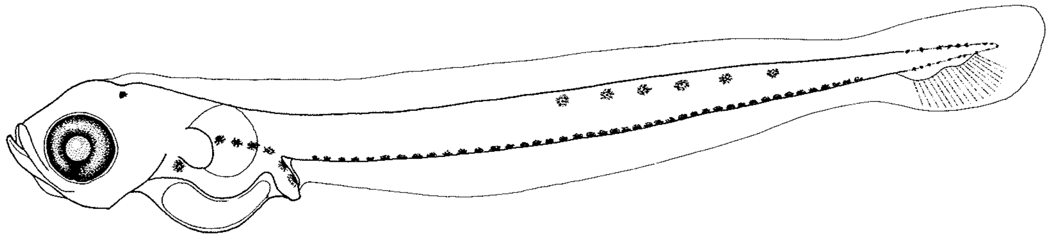
Food

Early larvae commence feeding on copepod eggs and nauplii, and cyclopoid copepods (*Oncaea* spp.) before yolk absorption is completed. Prey length at first feeding ranges between 0.13 - 0.33 mm. Summer diets are cyclopoid copepods, calanoid copepodites and eggs of *Euphausia superba*. Krill eggs may be the staple food in spawning areas of *E. superba*. The staple food in fall consists of copepods with increasing proportions of calanoid copepodites (Kellermann, 1986; see also Balbontin *et al.*, 1986). Calanoid copepods are the principal food of one year old juveniles.

Distinguishing characters of similar, co-occurring species

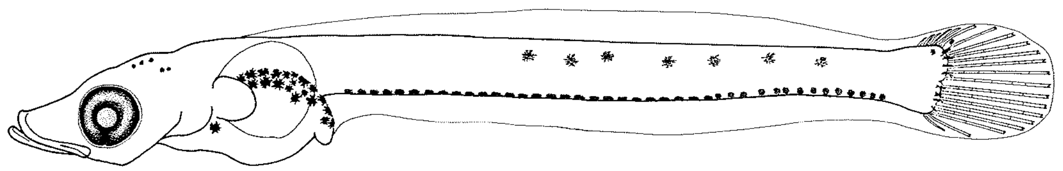
Nototheniops nudifrons:	Ventral abdominal pigment present; post-flexion larvae from about 15 - 17 mm SL onward; 35 or less ventral pigment cells along postanal section.
Pagothenia hansoni:	No dorsolateral pigment on postanal section; five or less melanophores on dorsal abdominal region.
Trematomus scotti:	Ventral abdominal pigment present; a single dorsal subcutaneous medial melanophore on the neck region.
Trematomus lepidorhinus:	Ventral abdominal pigment present; more than 30 dorsolateral melanophores on postanal section. 2 - 4 dorsal melanophores above pectoral fin base.

Fig. 30: ***Nototheniops larseni*. a) Larva with yolk, 9.8 mm SL; "Polarstern", St. 219, 15 November 1984. b) Larva of 22.1 mm SL; "Walther Herwig", St. 294, March 1985. c) Transforming larva, 30.2 mm SL; "Polarstern", St. 125, 3 June 1986. All specimens caught off the Antarctic Peninsula.**



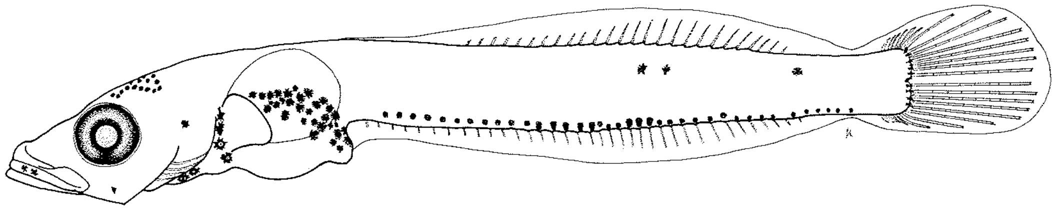
a

2 mm



b

2 mm



c

5 mm

3.31 *Nototheniops nudifrons* (Loennberg, 1905)

Description of early stages

The basic pigmentation pattern consists of a ventral, partly subcutaneous row and a dorsolateral row on the postanal section (Fig. 31). There may be a few melanophores on the occipital region, and there is pigment along the posterior margin of the operculum, on the dorsal abdominal region, and on the bases of the lower caudal fin rays. Ventral abdominal pigment is present, but it may be weak and inconspicious or even lacking in early larvae (Fig. 31a). In transforming larvae, the anterior, subcutaneous part of the ventral pigment row is found at higher levels than the posterior part (Fig. 31b), or only single ventral melanophores are found at higher levels. Specimens of 30 - 35 mm SL had the fin ray counts D_1 V, D_2 36 - 38, A 34 - 35, P 22 - 23, and the complete number of vertebrae V 15 - 16 + 34 - 37 = 49 - 52 (n = 9). At about that length range, the juvenile barred pigment pattern develops with the dorsolateral melanophores still being visible.

Spatial and temporal occurrence

Larvae of 7 mm total length are reported to hatch from eggs of 2.0 - 2.5 mm diameter, which are laid in nests and guarded during incubation (Hourigan & Radtke, 1989). Peak hatching in the Antarctic Peninsula area and at South Georgia probably occurs in late winter/spring, but spawning may occur during longer periods of the year (Hourigan & Radtke, 1989). In both areas, length frequencies recorded in summer are polymodal or span a wide length range (Kellermann, 1986 and unpubl. data). In waters of the Antarctic Peninsula, larvae were recorded from the Palmer Archipelago to off Elephant Island. Length ranges were 13 - 19 mm SL in November and 18 - 22 mm in January of the same season. In February (1982), there were two length groups present at 15 - 20 mm SL and 23 - 27 mm SL (see Kellermann, 1986, 1989). At South Georgia, larvae were mostly confined to nearshore waters of up to 280 m water depth in spring and summer, and of up to 140 m in fall. Transition to the juvenile stages and to a demersal life mode were observed in fall (April) for part of the larval population (see also Efremenko, 1983).

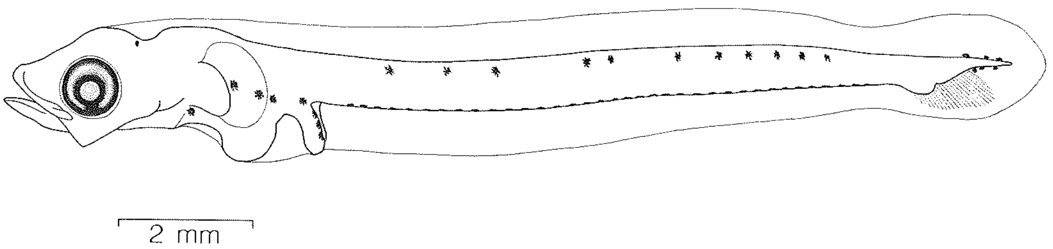
Food

Summer diets of 15 - 27 mm SL larvae consisted of cyclopoid copepods, copepodite stages of calanoid copepods and eggs of *Euphausia superba*. Prey length varied between 0.3 - 3.2 mm. Krill eggs may be the staple food in spawning areas of *E. superba*.

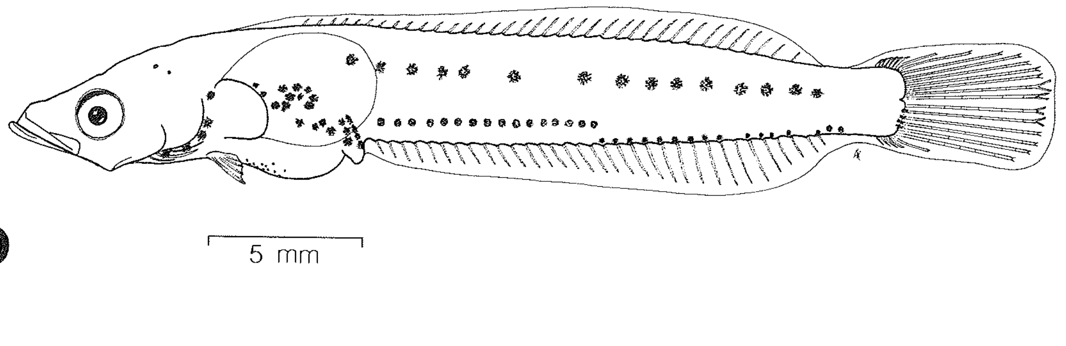
Distinguishing characters of similar, co-occurring species

Nototheniops larseni:	No ventral abdominal melanophores; no post-flexion larvae until 18 - 20 mm SL; 40 or more ventral pigment cells along postanal section.
Pagothenia hansoni:	No ventral abdominal melanophores; no dorsolateral pigment on postanal section; five or less melanophores on dorsal part of abdomen.
Trematomus scotti:	A single dorsal, subcutaneous medial melanophore present on the neck region.
Trematomus lepidorhinus:	Dorsolateral pigment row on postanal section with more than 30 melanophores; 2 - 4 dorsal melanophores above pectoral fin base.

Fig. 31: *Nototheniops nudifrons*. a) Larva of 15.1 mm SL; "Polarstern", St. 137, 15 November 1987. b) Transforming larva of 29.2 mm SL; "Meteor", St. 391, February 1981. All specimens from the Antarctic Peninsula.



a



b

3.32 *Pagothenia borchgrevinki* (Boulenger, 1902)

Description of early stages

The pigment pattern of 30.0 - 33.0 mm SL juvenile fishes consists of a dorsal band and a ventral row. There is pigment on the upper snout, on the occipital and parietal head regions, on the dorsal part of the abdomen and on the bases of the caudal fin rays (Fig. 32). There are no ventral abdominal melanophores. Specimens of 38.2 - 43.0 mm SL had the barred juvenile pigmentation along the cauda. The fin ray counts D_1 V - VI, D_2 34 - 37, A 31 - 33, P 23 - 24, and the complete number of vertebrae V 19 - 20 + 32 - 34 = 51 - 54 (n = 5) were recorded in specimens from 33.0 mm SL onward. The dorsal pigment band is formed by numerous small pigment cells which indicates a secondary pattern not present at earlier stages. Larvae may thus be assumed to have only a ventral pigment row on the postanal section with dorsal abdominal, but no ventral abdominal pigment present.

Spatial and temporal occurrence

Specimens of 30 - 33 mm SL were captured in November in pack-ice in shelf waters to the east of Joinville Island. In summer, pelagic juvenile fishes of 38 - 65 mm SL were frequently encountered in the vicinity of the pack-ice edge in the north-western Weddell Sea, most of them were taken with aggregations of the Antarctic krill (Kellermann & Kock, 1984). Juveniles of 38 - 49 mm SL were taken in winter from underneath fast ice (Hoshiai & Tanimura, 1981), which is the habitat of adult fishes. Considerable differences of developmental timing between regions are obvious from these data, but there may also be some variability of growth rates associated with habitats such as krill swarms or fast ice.

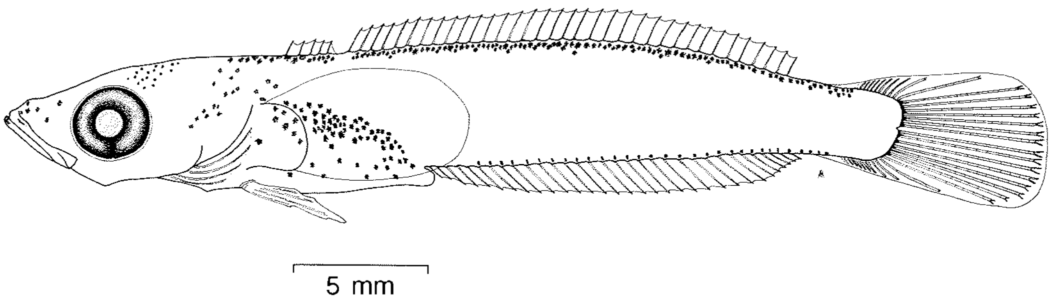
Food

Juvenile fishes of 38 - 49 mm SL from a fast ice community had fed on copepods, mostly *Oithona similis*, and copepod nauplii (Hoshiai & Tanimura, 1981).

Distinguishing characters of similar, co-occurring species

Pagothenia brachysoma: Ventral abdominal melanophores present; lateral abdominal region pigmented in juveniles of 32 - 39 mm SL.

Fig. 32: *Pagothenia borchgrevinki*. Juvenile fish of 33.0 mm SL; "Polarstern", St. 207, 10 November 1983, Antarctic Peninsula.


5 mm

3.33 *Pagothenia brachysoma* (Pappenheim, 1912)

Description of early stages

Juveniles of 32 - 39 mm SL (Fig. 33) have a dorsal pigment band and a ventral row of melanophores, and the juvenile barred, chess board like pigmentation pattern on the postanal section. The dorsal pigment band consists of numerous small melanophores. There are pigment cells on the dorsal and lateral parts of the abdomen, the pectoral fin base, on the occipital and parietal head regions, on the upper and lower jaws and on the upper snout. There are ventral abdominal melanophores on the medial part of the abdomen. Fin ray and vertebrae counts were: D_1 V, D_2 31, A 30, P 23, V 16 + 30 = 46 (n = 1). The dorsal pigment band is formed by numerous small pigment cells which indicates a secondary pattern not present at earlier stages. Larvae may thus be assumed to have only a ventral row on the postanal section with dorsal and ventral abdominal pigment present.

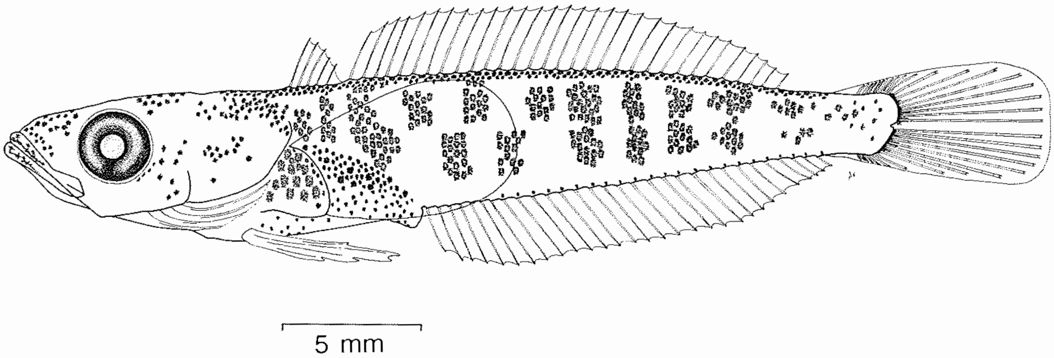
Spatial and temporal occurrence

The juvenile of 32.3 mm SL was captured in December north of Anvers Island (Antarctic Peninsula). Another specimen of 39.7 mm SL was taken in January off Vestkapp in the eastern Weddell Sea. Juvenile fishes are apparently associated with aggregations of the Antarctic krill in summer. Juvenile fishes of 51 - 88 mm SL were obtained as by-catch of semi-commercial krill fishing off the Balleny Islands (Pacific Sector; Slosarczyk, 1983), and off Elephant Island (Atlantic Sector; K. Skora, pers. comm.; see also Kellermann & Kock, 1984).

Distinguishing characters of similar, co-occurring species

Pagothenia borchgrevinki: No ventral abdominal melanophores present; no pigment on the lateral abdominal region present in specimens of 30 - 39 mm SL.

Fig. 33: ***Pagothenia brachysoma*. Juvenile fish of 32.2 mm SL; "Meteor", St. 140, December 1980, Antarctic Peninsula.**


5 mm

3.34 *Pagothenia hansoni* (Boulenger, 1902)

Description of early stages

The basic pigment pattern consists of a ventral row and of a few melanophores on the hindgut and anus in larvae (Fig. 34a, b) and along the dorsal abdominal region in late larvae and early juvenile fishes (Fig. 34c). There is pigment below and on the pectoral fin base, and melanophores appear on the occipital and parietal head regions during transformation (Fig. 34c). There is no ventral abdominal pigment. Specimens of 35 - 47 mm SL had the fin ray counts D_1 IV - VI, D_2 36 - 38, A 33 - 35, P 21 - 30, and the complete number of vertebrae V 18 - 20 + 34 - 36 = 51 - 54 (n = 9).

Spatial and temporal occurrence

At South Georgia, larvae of 12 - 25 mm SL were captured in nearshore waters at the south-eastern coast in early April. Smaller, yet unpigmented larvae of 11 - 13 mm SL were found inshore from May through July (North, pers. comm.). These findings suggest an extended hatching period from March throughout July. Larvae develop during winter, and late larval and early juvenile fishes of 27 - 47 mm SL occurred on the northern shelf of South Georgia from November until late January. Large shoals were observed there in nearshore kelp forests (North, pers. comm.), but also in offshore surface waters at water depths of up to 330 m (Kellermann, unpubl. data). Early stages were not recorded in the Antarctic Peninsula region and in the Weddell Sea.

Distinguishing characters of similar, co-occurring species

Larvae of these species can be distinguished from *P. hansoni* by the presence of more than five melanophores on the dorsal part of the abdomen, and each species by the characters listed below:

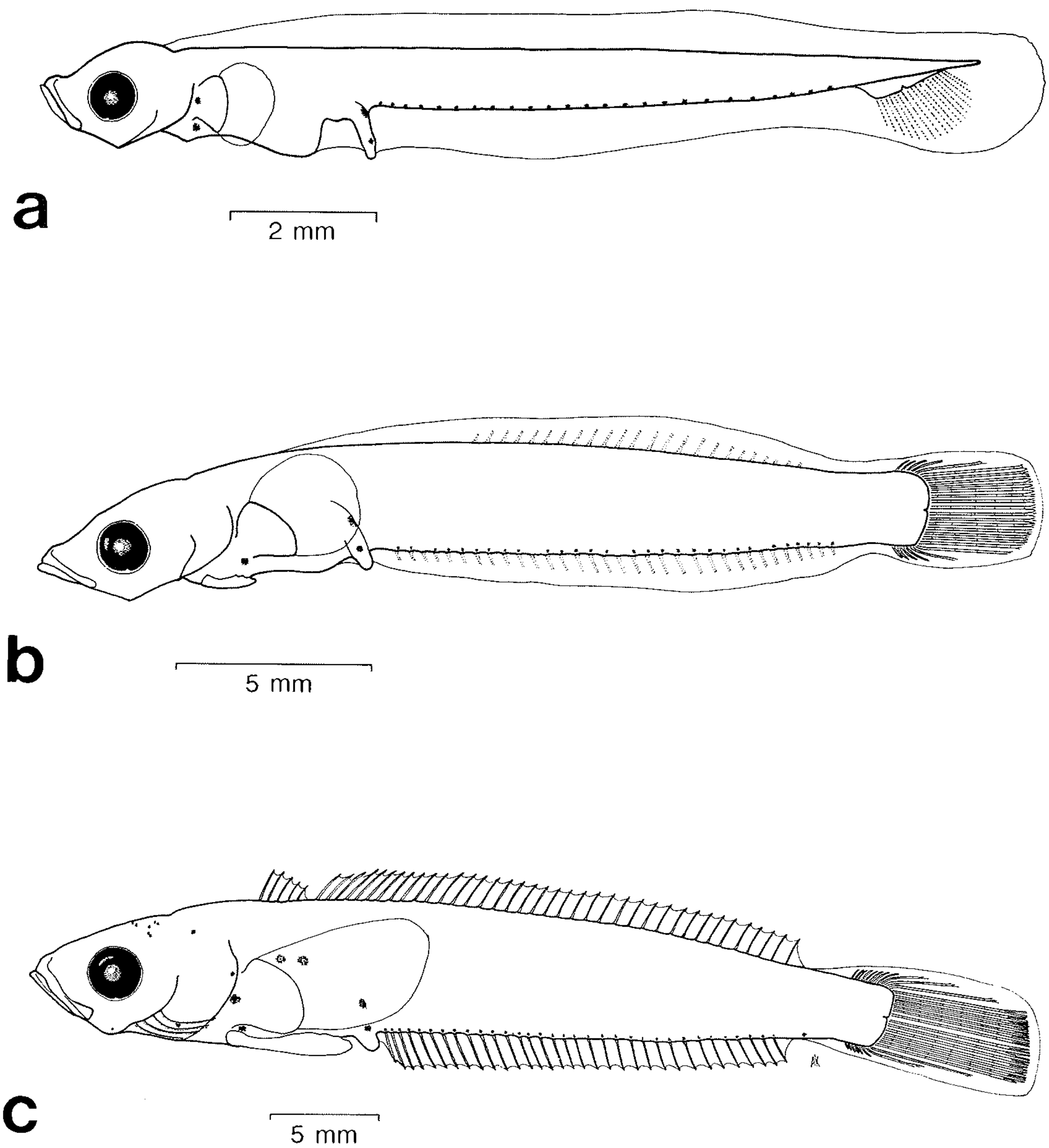
Nototheniops larseni: Dorsolateral row of melanophores may be present on postanal section.

Nototheniops nudifrons: Dorsolateral row of melanophores present on postanal section; ventral abdominal pigment present.

Trematomus scotti: Dorsolateral melanophores may be present on postanal section; ventral abdominal pigment present; 1 - 3 dorsal pigment cells near the caudal peduncle.

Trematomus lepidorhinus: Dorsolateral row of melanophores on postanal section; ventral abdominal pigment present; 2 - 4 dorsal melanophores above the pectoral fin base.

Fig. 34: *Pagothenia hansoni*. a) Larva of 15.1 mm SL; "Walther Herwig", St. 493, 2 April 1978. b) Transforming larva of 25.2 mm SL; "Walther Herwig", St. 493, 2 April 1978. c) Juvenile fish of 39.8 mm SL; "Walther Herwig", St. 84/67, 31 December 1975. All specimens from South Georgia.


a
2 mm
b
5 mm
c
5 mm

3.35 *Pleuragramma antarcticum* Boulenger, 1902

Description of early stages

The basic pigment pattern consists of a dorsal and a ventral row on the postanal section, and a pigment row along the dorsal abdominal region (Fig. 35). The dorsal pigment row runs towards a dorsolateral position on the anterior part of the postanal section. A second dorsal row is forming in transforming larvae (Fig. 35b). There is pigment along the anterior margin of the pectoral fin base and on the occipital head region (not present in early larvae, see Keller, 1983), and there is pigment on the upper snout, along the jaws, on the parietal head regions, on the lateral abdominal region and on the caudal fin rays in transforming larvae. Medio-, dorso- and ventrolateral pigment series located along the myosepta appear on the postanal section in specimens of about 40 mm SL onward (Fig. 35c). The complete number of fin rays is present in specimens of about 35 mm SL onward (see also Keller, 1983): D_1 V - IX, D_2 36 - 38, A 37 - 40, P 19 - 22 (Antarctic Peninsula; n = 43), though the pelvic fin is yet rudimentary. The number of vertebrae is complete from about 50 mm SL onward: V 52 - 55 (n = 15).

Spatial and temporal occurrence

Hatching areas are apparently confined to sea areas adjacent to major continental ice shelves. Larvae and juveniles are abundant in high Antarctic waters of the Davis Sea, Weddell Sea, Ross Sea and Prydz Bay (Pappenheim, 1912; Hubold, 1984; DeWitt & Tyler, 1960; Williams, 1985), but also in the Antarctic Peninsula region in summer and fall (Kellermann, 1986a). Hatching occurs in November/December (Hubold, 1989; Kellermann, 1986) with a mean larval length in the Weddell Sea of 9 mm (Hubold, 1989). In the eastern Weddell Sea, larvae are transported by the coastal current to the south-west where they may be retained over shelf areas by a gyre system (Hubold, 1984). To the Antarctic Peninsula area larvae are transported from adjacent spawning grounds in the Bellingshausen Sea and northwestern Weddell Sea (Larsen ice shelf), and larval occurrence in summer was related to the respective water masses (Kellermann, 1986, 1986a). Late larvae and small juvenile stages are common and may be locally abundant in the Weddell Sea (Hubold, 1984), whereas off the Antarctic Peninsula they form an abundant and frequent component of the ichthyoplankton and pelagic fish fauna (Kellermann, 1986; Slosarczyk, 1986; Asencio & Mujica, 1986).

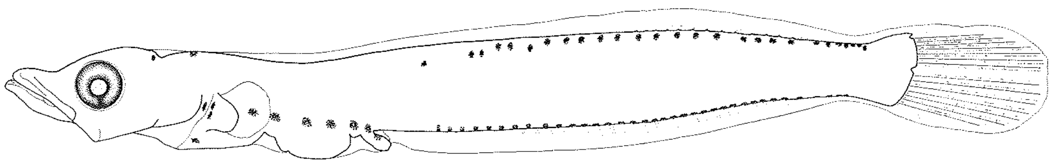
Food

Summer and fall diets of larvae in the Antarctic Peninsula area consisted of copepod eggs, cyclopoid and calanoid copepods and tintinnids with prey length ranges of 0.15 - 1.86 mm in summer, and of 0.15 - 2.80 mm in fall; late larvae and small juvenile fishes (age group 1) fed mostly on calanoid copepods in spring and summer (Kellermann, 1987). Larval stages of the Antarctic krill formed major portions of juvenile diets in Prydz Bay (Williams, 1985).

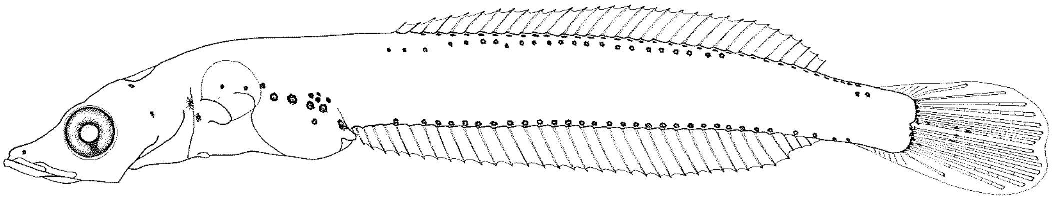
Distinguishing characters of similar, co-occurring species

Trematomus newnesi:	Ventral abdominal pigment present; dorsal pigment row reaching beyond the anus level. Lateral pigment on postanal section present in larvae.
Aethotaxis mitopteryx:	Anterior part of abdomen pigmented; melanophores present on pectoral fin base.

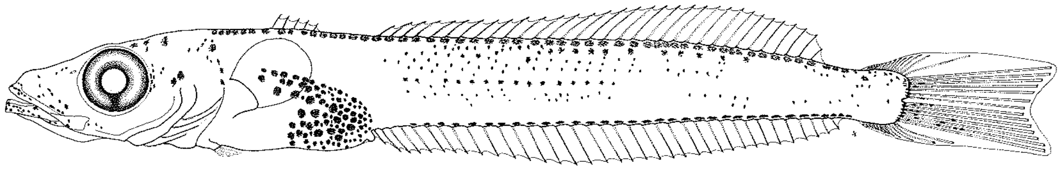
Fig. 35: ***Pleuragramma antarcticum.*** **a) Larva of 17.5 mm SL; "John Biscoe", St. 1250/67, 23 February 1982. b) Transforming larva, 28.2 mm SL; "Polarstern", St. 84/2, 22 May 1986. c) Juvenile fish, 47.6 mm SL; "Polarstern", St. 118, 5 November 1987. All specimens from the Antarctic Peninsula.**



a 2 mm



b 3 mm



c 5 mm

3.36 *Trematomus centronotus* Regan, 1914

Description of early stages

The basic pigment pattern consists of a ventral row, a dorsal row which may be weak or intermittent above the abdomen, and a dorso- and a ventrolateral pigment row along the postanal section (Fig. 36). There is pigment on the occipital head region, on the neck region, along the anterior margin of the pectoral fin base, on the dorsal part of the abdomen, on the caudal peduncle and on the developing caudal fin rays in larvae (Fig. 36a, b). Ventral abdominal pigment is present. In late larvae and early juvenile fishes (Fig. 36c), further dorsolateral pigment rows develop and there is pigment on the snout, on the jaws, and on the parietal head region, and a pigment row along the posterior opercular margin, which is covered by operculum and cleithra. Specimens of 29.2 - 30.2 mm SL had the fin ray counts D_1 IV - V, D_2 32, A 31, P 24 - 25, and the complete number of vertebrae V 18 + 32 = 50 (n = 2).

Spatial and temporal occurrence

Larvae of 18.8 - 21.9 mm SL were taken in waters along the ice shelves of the eastern Weddell Sea between mid January and mid February. Most larvae occurred in surface waters in the immediate vicinity of the ice shelf (Hubold, unpubl. data). Early larvae around 18 mm SL occurred in November/December, while early juvenile fishes of 29 - 30 mm SL were taken in February (Hubold, 1989; unpubl. data). Larval lengths indicate that hatching may occur in spring/early summer, however, they also indicate considerable variations in hatching periods or developmental rates.

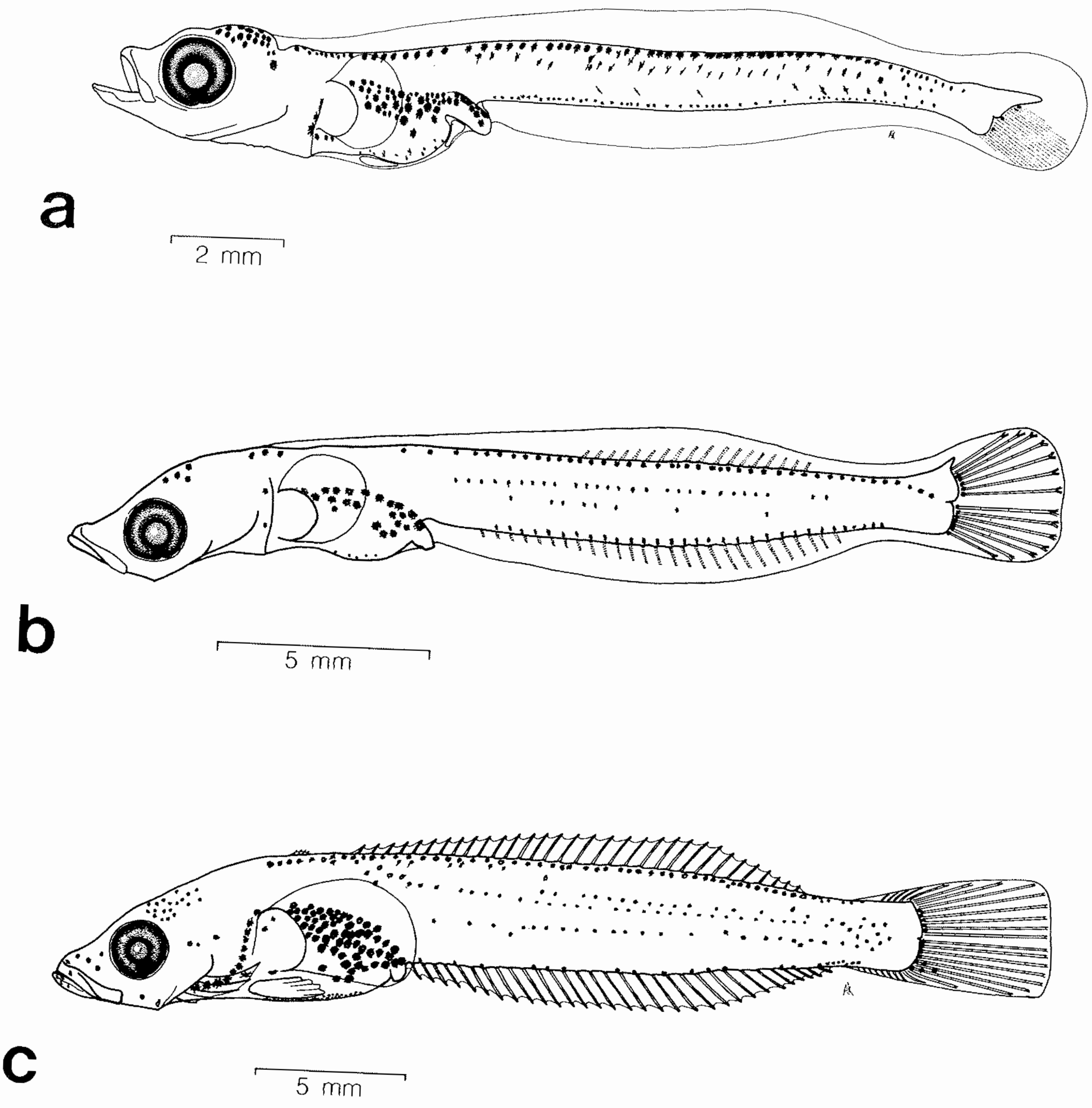
Distinguishing characters of similar, co-occurring species

Trematomus eulepidotus: Melanophores present on most of the pectoral fin base in larvae from 21 mm SL onward; ventrolateral row on postanal section not reaching anus level; pelvic fin small at 21 - 45 mm SL.

Trematomus newnesi: More than two lateral pigment rows on postanal section, and pigment present on upper snout in larvae; dorsal pigment row always continuous, not intermittent.

Trematomus nicolai: No ventral abdominal pigment; lateral pigment on postanal section restricted to posterior part.

Fig. 36: *Trematomus centronotus*. a) Larva with yolk, 16.5 mm SL; "Polarstern", 21 October 1986. b) Transforming larva of 21.7 mm SL, "Polarsirkel", St. 62/193, January 1980. c) Juvenile fish, 29.2 mm SL; "Polarstern", St. 132, February 1983. All specimens from the Weddell Sea.


a
2 mm
b
5 mm
c
5 mm

3.37 *Trematomus eulepidotus* Regan, 1914

Description of early stages

The basic pigment pattern consists of a dorsal and a ventral row, and lateral pigment series along the postanal section (Fig. 37). The dorsal row forms at 18 - 20 mm SL, and it may be weak or intermittent above the abdomen. The dorsolateral row may extend half to two thirds of the postanal length (Fig. 37a), or may reach the anus level and beyond in later stages (Fig. 37b). The ventrolateral row is usually shorter, or even restricted to a short series on the caudal peduncle. There is pigment on the snout, on the occipital and parietal head region, along the posterior opercular margin, on the upper part or on the entire pectoral fin base, on the dorsal and lateral abdominal region, on the caudal peduncle, and at the bases of the caudal fin rays. Ventral abdominal pigment is present. In juveniles (Fig. 37b), there is pigment on the upper snout, along the jaws and along the ventral margin of the orbit, and there is a second dorsal row of small melanophores above the primary row. Further lateral pigment series develop on the postanal section, and the abdomen is entirely covered by melanophores, having a black appearance in preserved larvae. Specimens of 34 - 49 mm SL had the fin ray counts D_1 V - VII, D_2 34 - 38, A 34 - 35, P 26 - 28, and the complete number of vertebrae V 17 - 20 + 37 - 38 = 54 - 57 (n = 10).

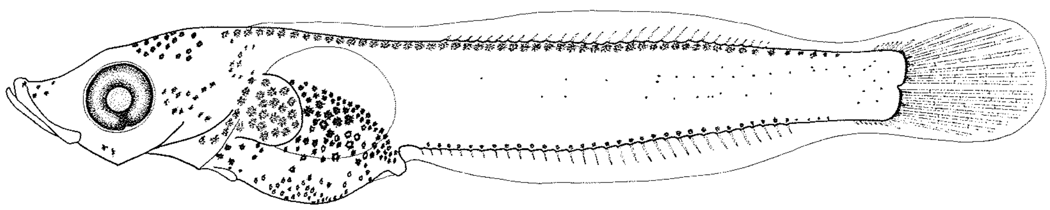
Spatial and temporal occurrence

Larvae reared from field caught eggs (Weddell Sea) hatched in May/June at lengths of 11 - 15 mm SL (Ekau, 1989). They were similar to larvae given in Fig. 37a, except that they were lacking a dorsal pigment row and ventral abdominal melanophores (Ekau, 1989). In the Antarctic Peninsula area, transforming larvae of 21.3 - 25.6 mm SL were caught in southern Bransfield Strait and around Joinville Island in November/December (Kellermann, 1989). This suggests that early larval development occurs during winter. A wide larval dispersal was indicated by records in oceanic waters far off the South Orkney Islands and in the north-western Weddell Sea in spring and summer. Late larvae of 30 - 39 mm SL were encountered in epipelagic shelf and near-slope waters from Adelaide Island to the pack-ice edge east of Joinville Island in February and mid March (Kellermann & Kock, 1984; Kellermann, 1989). Length ranges in the Weddell Sea were 41 - 49 mm SL in late summer (Hubold & Ekau, 1987).

Distinguishing characters of similar, co-occurring species

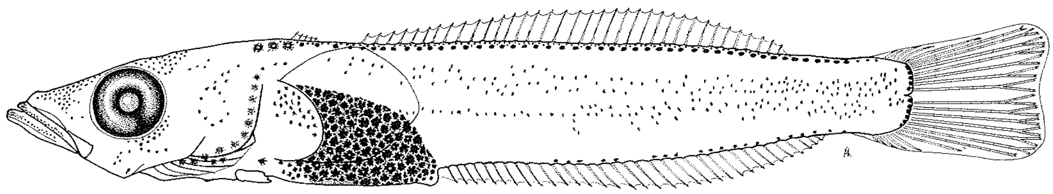
Trematomus newnesi:	More than two lateral pigment rows on the postanal section in larvae; lateral pigment in lines along myosepta.
Trematomus centronotus:	No pigment on the snout and on the pectoral fin base in larvae of 16 mm SL and larger; dorsolateral pigment row always reaching the anus level.
Trematomus nicolai:	No ventral abdominal pigment present; no pigment on the snout; lateral pigment restricted to posterior postanal section.
Notothenia gibberifrons:	Dorsolateral pigment row always reaching close to the anus level; pelvic fin well developed at 17 mm SL; dorsal pigment row present below 18 - 20 mm SL.

Fig. 37: ***Trematomus eulepidotus*. a) Transforming larva, 24.9 mm SL; "Meteor", St. 140/17, 12 December 1980, Antarctic Peninsula. b) Juvenile fish, 43.1 mm; "Polarstern", February 1983, Weddell Sea.**



a

5 mm



b

5 mm

3.38 *Trematomus lepidorhinus* (Pappenheim, 1911)

Description of early stages

The basic pigment pattern consists of a ventral row, a dorsolateral row of 30 - 45 melanophores and short dorsal rows of 2 - 4 melanophores on the neck region and of 2 - 6 pigment cells near the caudal peduncle (Fig. 38). There is sparse pigment on the occipital head region, along the anterior margin of the pectoral fin base with one melanophore below the fin base, on the dorsal abdominal region, and on the caudal peduncle and the forming caudal fin rays. Ventral abdominal pigment is present. Single ventrolateral melanophores may occur on the postanal section in small larvae (Fig. 38a), whereas in transforming larvae (Fig. 38b), there is pigment on the snout and on the jaws, and the anterior ventral melanophores are subcutaneous and occur at a higher level. The description is similar to that of transforming larvae of 25.0 - 30.0 mm SL given by Efremenko (1984), which he identified as *Trematomus loennbergi*. However, fin ray and vertebrae counts of Efremenko's (1984) specimens fall into the ranges for *Trematomus lepidorhinus* from the Weddell Sea (Ekau, 1988). The number of myotomes in larvae of 20 - 25 mm SL was 49 - 53 (n = 8).

Spatial and temporal occurrence

A few yolk sac larvae of 8.7 - 11.0 mm SL were caught in southern Bransfield Strait (Antarctic Peninsula) in mid November (Kellermann, unpubl. data). Larvae of 14.5 - 18.0 mm SL were taken in the Weddell Sea in January, and transforming larvae in February were of 17.0 - 25.4 mm SL (Hubold, unpubl. data). The specimens described by Efremenko (1984) were caught in Bransfield Strait in March. Hatching is likely to occur in spring, and the pelagic phase may extend throughout part of the winter months.

Distinguishing characters of similar, co-occurring species

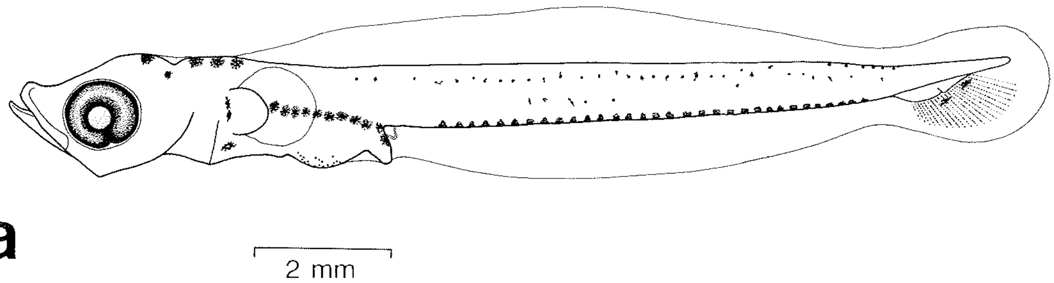
Larvae of these species can be distinguished by the lack of the short dorsal pigment row in the neck region, and each species by the characters listed below:

Trematomus scotti: Dorsolateral pigment row on postanal section with less than 30 melanophores; no more than three dorsal pigment cells near caudal peduncle.

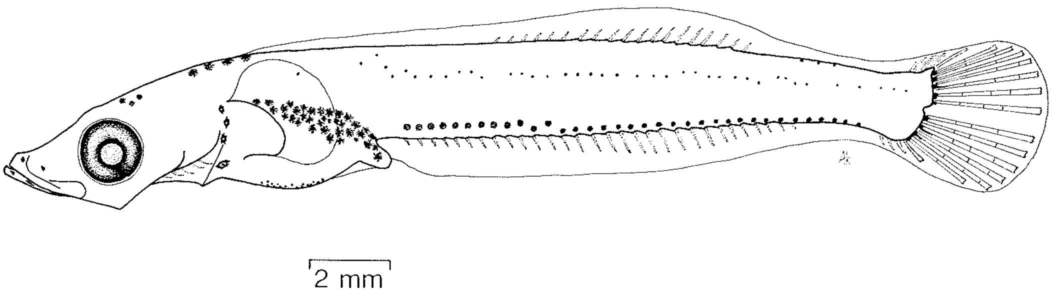
Nototheniops larseni: No ventral abdominal pigment; dorsolateral row on postanal section with less than 30 melanophores, not reaching anus level; no dorsal pigment near caudal peduncle.

Nototheniops nudifrons: Dorsolateral row on postanal section with less than 30 melanophores; no dorsal pigment near caudal peduncle.

Fig. 38: ***Trematomus lepidorhinus*. a) Larva of 14.5 mm SL; "Polarsirkel", St. 29, January 1980. b) Transforming larva of 23.0 mm SL; "Polarstern", St. 336/48, 16 February 1985. All specimens from the Weddell Sea.**



a



b

3.39 *Trematomus loennbergi* Regan, 1913

Description of early stages

The basic pigment pattern consists of an inconspicious and partly subcutaneous ventral row, of a dense dorsal group of melanophores in the neck and shoulder region, and a short dorsal row of 4 - 6 melanophores near the caudal peduncle (Fig. 39). Single dorsal melanophores are present in the specimen of 35.0 mm SL, but a complete row of small pigment cells may occur from 37 mm SL onward (Williams, unpubl. data). There is pigment on the snout, along the jaws, on the occipital and parietal head regions, along the posterior opercular margin, covered by the operculum, on the symphysis of the cleithra, on the pectoral fin base, on the caudal peduncle and at the bases of the caudal fin rays. The abdomen appears black due to its complete coverage with pigment cells. Single lateral pigment cells may be present. Specimens of 34 - 37 mm SL had the fin ray counts D_1 VI, D_2 36 - 37, A 35, P 28, and the complete number of vertebrae V 16 - 17 + 37 = 53 - 54 (n = 3). The description is similar to that of transforming larvae of 32.3 - 40.8 mm SL given by Efremenko (1984) which he identified as *Trematomus eulepidotus*. D_2 and A fin ray counts of his specimens are below, and vertebrae counts are slightly above the counts obtained from the present material.

Spatial and temporal occurrence

The transforming larvae were of 34.3 - 37.2 mm SL and were caught in surface waters of Prydz Bay in late February (Indian Ocean sector). Efremenko's (1984) specimens were captured in the Antarctic Peninsula area in March.

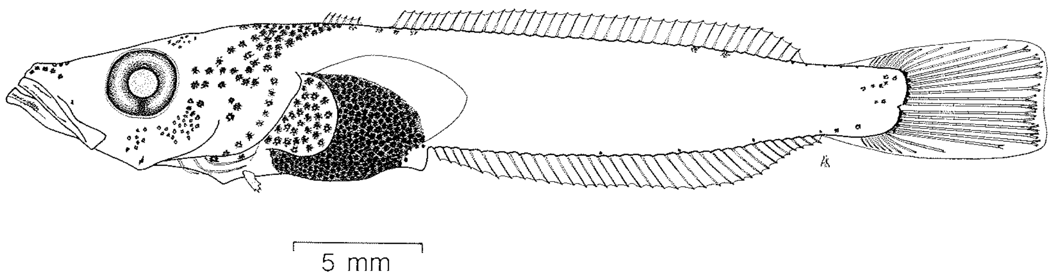
Distinguishing characters of similar, co-occurring species

Smaller larvae may be similar to *Trematomus eulepidotus* by the dense abdominal pigment and pectoral fin base pigmentation, and also to *Trematomus lepidorhinus* by the anterior and posterior dorsal pigment. These species can be distinguished by the following characters:

Trematomus eulepidotus: Lateral pigment on postanal section present in rows; dorsal pigment row present from 18 - 20 mm SL onward.

Trematomus lepidorhinus: Dorsolateral pigment row present on postanal section; no pigment on pectoral fin base until 30 mm SL.

Fig. 39: *Trematomus loennbergi*. Transforming larva, 35.0 mm SL; "Nella Dan", 28 February 1987, Prydz Bay.


5 mm

3.40 *Trematomus newnesi* Boulenger, 1902

Description of early stages

The basic pigment pattern consists of a dorsal and a ventral row, and of four intermittent dorso- and ventrolateral rows on the postanal section (Fig. 40). Particularly in early larvae, the melanophores of the lateral rows are arranged in lines along myosepta (Fig. 40a). There is pigment on the upper snout, on the occipital head region, on the jaw angle, along the anterior margin of the pectoral fin base and below the fin base, on the cleitral isthmus, on the dorsal abdominal region and on the caudal peduncle. Ventral abdominal pigment is present. In transforming larvae (Fig. 40c), there is further pigment on the lateral snout region, on the jaws, on the parietal head region, on the upper pectoral fin base and on the bases of the caudal fin rays, and there are further lateral rows along the postanal section. Specimens of 31 - 34 mm SL had the fin ray counts D_1 V - VI, D_2 34 - 36, A 32 - 34, P 24 - 26, and the complete number of vertebrae V 19 - 20 + 35 - 36 = 54 - 55 (n = 6).

Spatial and temporal occurrence

Larvae of 9 - 16 mm SL were captured in the Antarctic Peninsula area between mid October and mid November; 38 % of larvae had yolk sacs or yolk remains during that time (Kellermann, 1986, 1989). Otolith increment analysis suggested that hatching had occurred in early October (Radtke *et al.*, 1989). The main distribution area of larvae is the southern shelf of the Bransfield Strait and the shelf of Joinville Island. In spring and summer, larvae can be found in inshore waters as shallow as 2 m depth (Everson, 1968), but also widely dispersed over the shelf and slope (Kellermann, 1986). Transforming larvae of 30 - 34 mm SL caught in February/March indicate that the pelagic phase may be concluded during fall.

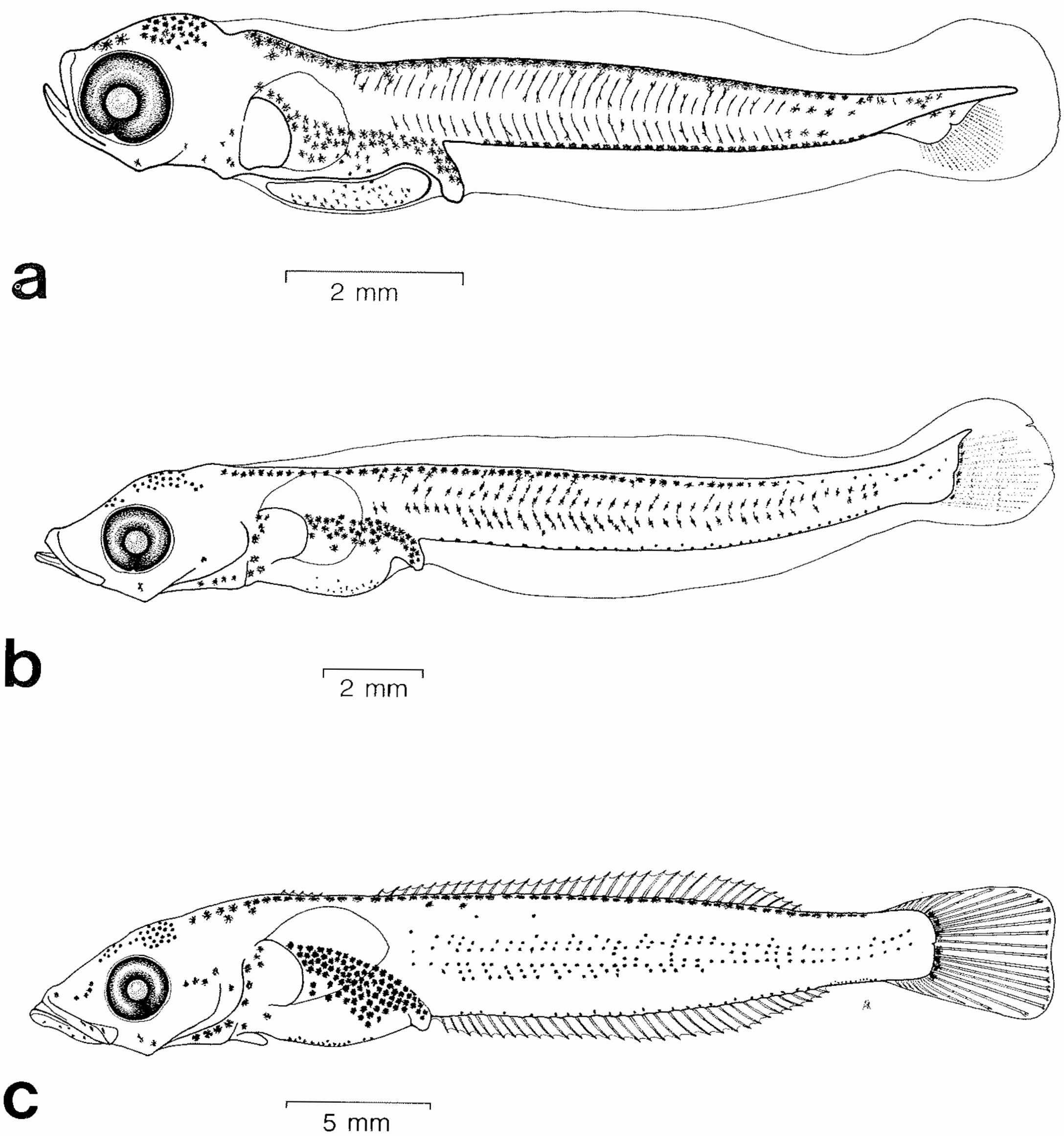
Food

The summer diets of larvae of 26 - 31 mm SL consisted chiefly of copepodite stages of calanoid copepods *Calanus propinquus*, and eggs of *Euphausia superba*. Prey length ranged between 0.56 and 4.30 mm (Kellermann, unpubl. data).

Distinguishing characters of similar, co-occurring species

Notothenia gibberifrons:	Two lateral pigment rows present on postanal section, melanophores not in lines along myosepta.
Trematomus centronotus:	Two lateral pigment rows present on postanal section, melanophores not in lines along myosepta; no pigment on the snout.
Trematomus eulepidotus:	Two lateral pigment rows present on postanal section; melanophores not in lines along myosepta; no dorsal pigment row in larvae smaller than 18 - 20 mm SL.

Fig. 40: *Trematomus newnesi*. a) Larva with yolk, 10.9 mm SL; "Polarstern", St. 128, 1 November 1983. b) Larva of 18.8 mm SL; "Walther Herwig", St. 83/96, December 1977. c) Transforming larva, 31.5 mm SL; "Meteor", St. 391/37, 19 February 1981. All specimens from the Antarctic Peninsula.


a
2 mm
b
2 mm
c
5 mm

3.41 *Trematomus nicolai* (Boulenger, 1902)

Description of early stages

The basic pigment pattern consists of a dorsal and a ventral row, and of lateral pigment cells on the posterior part of the postanal section (Fig. 41). The lateral pigment may be arranged in short dorso- and ventrolateral series not reaching beyond about half the postanal length. There is pigment on the occipital and parietal head regions, along the anterior margin of the pectoral fin base covered by the operculum, on the dorsal part of the pectoral fin base, on the dorsal and lateral abdominal region, and on the caudal peduncle. There is no ventral abdominal pigment present. Specimens of 29.2 - 31.8 mm SL had the fin ray counts D_1 V, D_2 36, A 32 - 33, P 28 - 29, and the complete number of vertebrae V 16 + 36 - 37 = 52 - 53 (n = 2).

Spatial and temporal occurrence

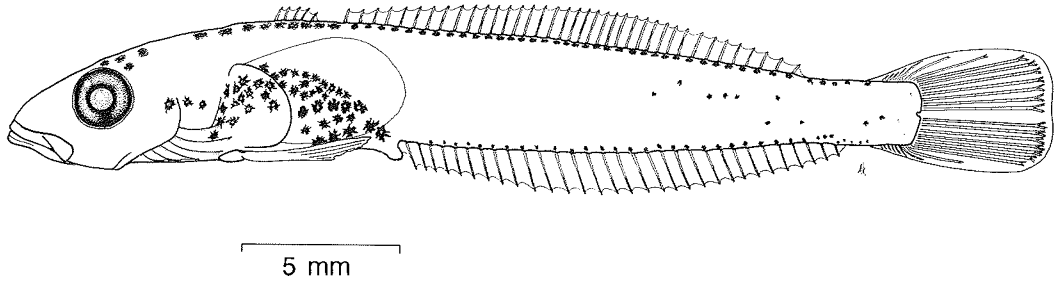
Juvenile fishes of 29.2 - 31.8 mm SL were captured in the eastern Weddell Sea in late February (Hubold, unpubl. data).

Distinguishing characters of similar, co-occurring species

Trematomus eulepidotus: Ventral abdominal pigment present; pigment on the snout; dorsolateral pigment row extending more than half way of the postanal section in larvae.

Trematomus centronotus: Ventral abdominal pigment present; lateral pigment rows on postanal section reaching close to the anus level or beyond.

Fig. 41: *Trematomus nicolai*. Juvenile fish of 29.2 mm SL; "Polarstern", St. 215, February 1983, Weddell Sea.


5 mm

3.42 *Trematomus scotti* Boulenger, 1907

Description of early stages

The basic pigment pattern consists of a ventral, partly subcutaneous row, a dorsolateral row on the postanal section, a dorsal, subcutaneous medial melanophore on the neck region, sometimes accompanied by 1 - 2 epidermal pigment cells, and 1 - 3 dorsal melanophores near the caudal peduncle (Fig. 42a, b). The dorsolateral row is variable in extent and sometimes represented by only one melanophore. There is sparse pigment on the occipital head region, and pigment is present at the anterior margin of and below the pectoral fin base, on the dorsal and lateral abdominal regions, and on the developing caudal fin rays. Ventral abdominal pigment is present. At about 28 mm SL, dorsal groups of small pigment cells appear which form a broad meandering dorsal band in late larvae and early juvenile fishes (Fig. 43c). These have further pigment on the snout, on the parietal region, on the pectoral fin base and the juvenile barred pigmentation is initiated by lateral pigment groups. The abdomen is entirely pigmented. Specimens of 23 - 40 mm SL had fin ray counts D_1 V, D_2 32 - 33, A 30 - 31, P 20 - 21, and the complete number of vertebrae V 14 - 16 + 32 - 34 = 46 - 48 (n = 8). The pelvic fin is forming at 29 mm SL. The description of larvae fits to a specimen of 14.5 mm SL described by Asencio & Mujica (1986) as *Notothenia* sp..

Spatial and temporal occurrence

In the Antarctic Peninsula region, larvae of 8 - 16 mm SL were caught in late January and February, with yolk present at 8 - 11 mm SL. Larval lengths in March and early April ranged between 12 - 19 mm SL. These data indicate that hatching occurs in summer (January throughout February). The main distribution area are the shelf west of the Antarctic Peninsula and the Palmer Archipelago with adjacent waters (Asencio & Mujica, 1986; Kellermann, 1989). Larval development extends throughout most of the winter though dorsal and anal fin formation is completed in early winter (see Fig. 42b). Pelagic juvenile fishes of 27 - 36 mm SL were captured in November in the surface waters (upper 50 m) near the pack-ice edge, and pelagic specimens of 30 - 48 mm SL occurred in southern Bransfield Strait until early February (Kelllermann, 1986). In the Weddell Sea, larvae are reported to occur from January onwards (Hubold, 1989).

Food

Larval diets in summer (11 - 17 mm SL) consisted chiefly of copepod eggs and copepodite stages of copepods (Balbontin *et al.*, 1986). Juvenile fishes in spring (32 - 38 mm SL) had fed on furcilia larvae of euphausiids and calanoid copepodite stages (Prydz Bay; Williams, 1985).

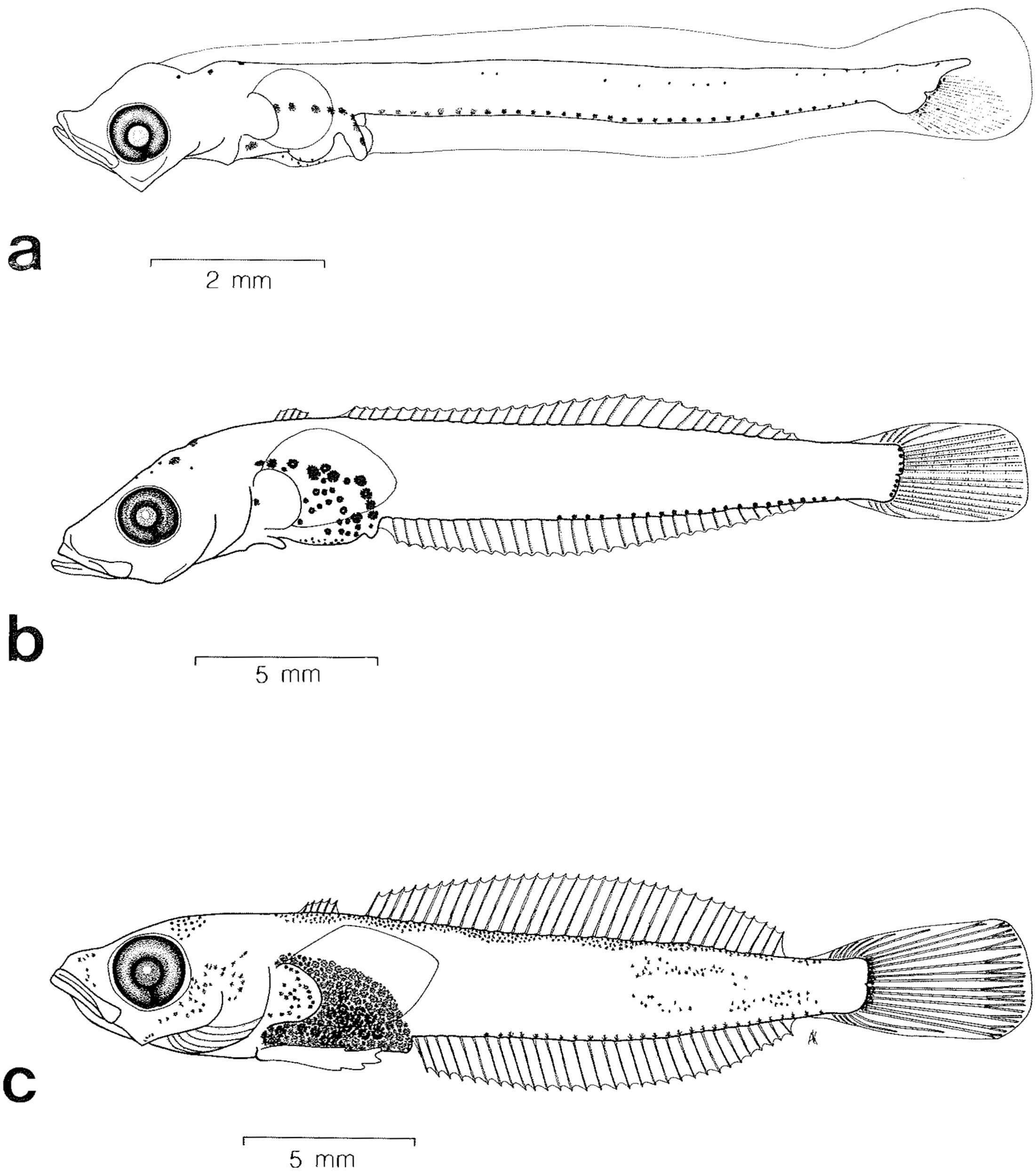
Distinguishing characters of similar, co-occurring species

Nototheniops larseni: No ventral abdominal pigment present; no dorsal pigment present near caudal peduncle.

Nototheniops nudifrons: Dorsolateral pigment row always present on postanal section, reaching the anus level or beyond; no dorsal pigment present near caudal peduncle.

Trematomus lepidorhinus: Dorsolateral pigment row always present on postanal section, consisting of more than 30 melanophores.

Fig. 42: *Trematomus scotti*. a) Larva of 10.6 mm SL; "Polarstern", St. 252/1, 23 January 1985, Weddell Sea. b) Transforming larva of 23.0 mm SL; "Polarstern", St. 126, 4 June 1986, Antarctic Peninsula. c) Juvenile fish, 32.0 mm SL; "Meteor", St. 140/17, 12 December 1980, Antarctic Peninsula.


a
2 mm
b
5 mm
c
5 mm

4. General aspects and conclusions

4.1 Development of eggs and larvae

The egg stage. Egg size after fertilization ranges from 2.0 mm in *Nototheniops nudifrons* to 5.0 mm in *Notothenia rossii rossii* (Hourigan & Radtke, 1989; Camus & Duhamel, 1985). Such data are available for a few species only, and in most fishes egg size has to be estimated from the size of ripe oocytes. This yields, however, a similar range of 1.6 - 5.0 mm. An increase in egg volume after fertilization due to the uptake of seawater is reported for some species, e.g. *Parachaenichthys georgianus*, whereas in other species eggs do not increase in size, e.g. *Notothenia neglecta* (White *et al.*, 1982). Due to their amount of yolk, oocyte (dry) weight may reach up to 700 - 1200 mg per 100 oocytes, as recorded for the channichthyid *Chionodraco rastrospinosus* (Kock, 1982). Because of the large egg size and the near zero environmental temperatures, incubation times are long, and may vary with latitude: 70 and 100 days for *N. rossii rossii* and *N. neglecta* eggs, respectively, reared at subantarctic localities, and up to 150 days for *N. neglecta* eggs incubated on Signy Island at lower ambient water temperatures (Camus & Duhamel, 1985; White *et al.*, 1982).

The eggs are presumably demersal in most species. Direct evidence is reported from fishes providing parental care such as *Harpagifer antarcticus* (Everson, 1968; Daniels, 1978), *Pagothenia bernacchii* (Moreno, 1980), and *Nototheniops nudifrons* (Hourigan & Radtke, 1989). Egg masses of *Trematomus eulepidotus* were found in a bottom trawl in the southern Weddell Sea (Ekau, 1989). Rearing experiments using artificially fertilized eggs of *N. neglecta* and *N. rossii rossii* pointed to a pelagic development of the eggs. Direct evidence from plankton tows is provided for *Dissostichus eleginoides* (see 3.24), and for *N. neglecta* in the Antarctic Peninsula region (see 3.28). Eggs of these fishes are pelagic at least during the last weeks before hatch.

The larval stage. Length at hatch is largely correlated with egg size and varies between 5 mm (*Harpagifer antarcticus*) and 21 mm (*Chaenocephalus aceratus*), as derived from field caught yolk sac larvae. Length at hatch is largest in channichthyids (12 - 21 mm), intermediate in bathydraconids (12 - 15 mm), and smallest in nototheniids (7 - 17 mm) and artedidraconids (7 - 10 mm). In all families, the larvae hatch with a functional mouth and pigmented eyes, teeth are present in channichthyids and in at least one bathydraconid, *Prilodraco breviceps* (North, pers. comm.). Conspicious teeth develop in larval *Dissostichus eleginoides* (Nototheniidae) and *Gymnodraco acuticeps* (Bathydraconidae). Small teeth may be present in transforming larvae of other bathydraconidae and of *Trematomus* spp. They may be indistinct and sometimes are only visible in cleared and stained specimens. A pelvic fin is present at hatch in all icefish larvae, except *Champsocephalus gunnari.* Small yolk supplies are present in nototheniids, and largest ones in channichthyids.

Fin formation in all families typically displays the sequence: pectoral fin - caudal fin - anal fin - second and first dorsal fin - pelvic fin. Calcification of the vertebral column is usually completed along with dorsal and pelvic fin formation. In channichthyids, pelvic fin formation is precocious, and in the genera *Pseudochaenichthys* and *Pagetopsis* the first dorsal fin develops along with the second dorsal fin, or is even more advanced. In these species, dorsal and anal fin rays occur at about 30 mm SL, whereas in most other icefish species they become visible at more than 40 mm SL. The full complement of vertebrae occurs before dorsal and anal fin formation is concluded in *Akarotaxis nudiceps* and *Trematomus scotti.*

Pigment patterns consist of various combinations of dorsal, ventral and lateral rows, groups or bands of melanophores. These are highly specific together with other characters such as snout pigment or ventral abdominal melanophores. The pigment pattern may undergo extensive changes during larval development, e.g. in *Aethotaxis mitopteryx* (see 3.23) or *Gerlachea australis* (see 3.6), but remains specific at each developmental stage. Changes of the pigmentation frequently involve the dorsal pigment. Dorsal melanophore rows lacking in early larvae may form along with the appearance of dorsal fin anlagen (e.g. *Trematomus eulepidotus, Notothenia angustifrons*), when fin formation is almost completed (e.g. *Trematomus loennbergi*) or at the onset of the juvenile pigment formation as in many other nototheniid species. The dorsal row may form gradually during larval development (e.g. *Gerlachea australis*, most channichthyids), or it appears within a narrow length range (e.g. *T. loennbergi, T. eulepidotus*). A secondarily formed dorsal row may be indicated when consisting of numerous minute pigment cells (e.g. *Trematomus scotti*).

Pelagic development including the larval and early juvenile stages takes between a few months and more than one year. It is short in the few species of artedidraconids investigated, in harpagiferids and in most bathydraconids and nototheniids, and spans one austral summer season or only slightly longer. An extended pelagic development lasting the austral summer and winter periods occurs in channichthyids, several nototheniids and in the bathydraconid *Racovitzia glacialis* (see 3.11). The larval development extends through the winter in *Notothenia kempi, Nototheniops larseni, Pagothenia hansoni, Trematomus eulepidotus* and in most icefishes. Transformation to the juvenile may be soon followed by transition to the demersal habit, or a pelagic or bentho-pelagic mode of life is maintained during the early juvenile stage.

4.2 Larval ecology

Within the different latitudinal zones of the Antarctic Ocean (Hempel, 1985), there is a temporal sequence of hatching periods of the notothenioid fish species throughout the year. This has been observed in the Antarctic Peninsula area (Kellermann, 1986, 1989), at South Georgia (North & White, 1987) and in the Weddell Sea (Hubold, 1989). Hatching periods may be completed within several weeks as indicated by unimodal and narrow length frequencies, e.g. in *Nototho-*

niops larseni and *Notothenia gibberifrons* (Kellermann, 1986), or larval hatch may extend during several months as in *Psilodraco breviceps* and *Pagothenia hansoni* (North, pers. comm., see 3.10, 3.34) and some channichthyids, or during larger periods of the year as in *Harpagifer antarcticus* (Everson, 1968). Multiple spawning events during the year are reported for *Nototheniops nudifrons* (Hourigan & Radtke, 1989), and length frequencies of field caught larvae were polymodal (Kellermann, 1986, 1989). A latitudinal shift of the hatching season could be detected so far for a few species only. Early larvae of *Champsocephalus gunnari* occurred much later in the austral summer season in the Antarctic Peninsula region than at South Georgia (Kellermann, 1989; Efremenko, 1979a; North & White, 1987), while in *Notothenia gibberifrons* a delayed hatching period in the Peninsula region was indicated by similar length ranges of early larvae at different months in spring (see 3.14, 3.26).

Yolk absorption may take three weeks in *Nototheniops nudifrons* (Hourigan & Radtke, 1989) or up to five weeks as reported for *Harpagifer antarcticus* (Daniels, 1978). Channichthyid larvae, having lower relative food requirements due to their large size at hatch, are likely to be able to survive even longer periods. Exogeneous feeding may commence before yolk absorption is completed as observed in *Nototheniops larseni* and *Chionodraco rastrospinosus* (Kellermann, 1986). Yolk remains in these larvae were observed over a wide length range and yolk absorption may be retarded due to early feeding. Thus, the duration of the yolk sac stage is yet species-specific and related to the quality of the egg, but may be independently determined by the nutritional environment. As hatching periods vary little between years, yolk reserves in spring hatching fish species appear feasible to compensate the temporal variability of the pack-ice retreat and the subsequent production cycle in the zone of seasonal pack-ice cover (Kellermann, 1989). In winter hatching fishes such as some icefishes or *Trematomus eulepidotus* (Ekau, 1989), the large maternal energy reserves enable the larvae to cope with food scarcity in the ice covered waters.

The diets of notothenioid larvae comprise a variety of zooplankters including various developmental stages of calanoid copepods and of the Antarctic krill *Euphausia superba*, cyclopoid copepods, protozooplankton such as tintinnids, small amphipods and fish larvae. Phytoplankton or faecal pellets have not been observed as food. With respect to food size, larvae can be assigned to two groups: Large particle feeders including the bathydraconid *Psilodraco breviceps* and most channichthyid larvae prey on larval and postlarval Antarctic krill and other euphausiids such as *Thysanoessa macrura* and on larval nototheniid fishes (Kellermann, 1986, 1986b; Rembiszewski *et al.*, 1978; Williams, 1985). Food consumed by yolk bearing *Chionodraco rastrospinosus* larvae in spring ranged between 7 and 15 mm length (Kellermann, 1986). Small particle feeders comprise the nototheniids and probably most bathydraconid larvae as well as *Harpagifer* spp.. Diets of small larvae of several nototheniids consisted of copepod eggs and nauplii and of cyclopoid copepods, with increasing frequencies of calanoid copepodite stages during subsequent larval development (Balbontin *et al.*, 1986; Kellermann, 1986, 1986a; this study). Food particles ingested by yolk sac larvae of *Nototheniops larseni* in spring were 0.13 - 0.33 mm in length (Kellermann, 1986). Larvae of both groups match the life cycle of the Antarctic krill at its different developmental stages: larvae of many nototheniid species prey on the eggs of *Euphausia superba* during the main spawning season in summer, while furcilia larvae and the small juvenile krill form important food components of icefish larvae in spring and summer (Antarctic Peninsula).

Hatching areas and nurseries are poorly documented for most fishes, and the analysis of larval drift and survival with respect to oceanographic features such as currents or stratification has been attempted for a few species only. Larval occurrence and length frequencies of *Notothenia kempi* indicated that hatching sites are located within a large cyclonic gyre to the west of the Antarctic Peninsula which transports larvae over shelf areas and which may thus function as a retention area (Kellermann & Kock, 1988). Larvae of *Pleuragramma antarcticum* in the eastern Weddell Sea are carried by the coastal current to the south where they may be accumulated by a similar current system (Hubold, 1984). Larval dispersal to open oceanic waters by wind driven surface currents was observed in *Notothenia neglecta* (see 3.28), *Trematomus eulepidotus* (Kellermann, 1989), and *N. kempi* off Elephant Island (Kellermann & Kock, 1984). It is, however, the early stages of commercially exploited species, e.g. *Notothenia rossii* or *Champsocephalus gunnari*, that still await studies directed towards the elucidation and understanding of recruitment processes.

Predation by channichthyid larvae is one of the sources of larval mortality for several nototheniid fish larvae. Channichthyid larvae appear to be associated with their specific prey in the different zones of the Antarctic ocean; larval *Pseudochaenichthys georgianus* with several nototheniids at South Georgia (see 3.21), *Chionodraco rastrospinosus* with *Nototheniops larseni* and *Trematomus newnesi* in the zone of seasonal ice cover off the Antarctic Peninsula (Kellermann, 1986; Kellermann & Kock, 1988), and *Pagetopsis maculatus* with *Pleuragramma antarcticum* in the zone of permanent ice cover in the Weddell Sea (Hubold, 1985). Also adult icefishes were reported to feed on larval notothenioids (Hureau, 1970; Kock, 1981). Potential planktonic predators include the gelatinous zooplankton such as scyphomedusae, ctenophores and siphonophores, but also euphausiids, amphipods and chaetognaths. Direct observations, however, are not reported in the literature.

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