Early larvae of *Schedophilus maculatus* (Teleostei, Centrolophidae)

by

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ABSTRACT. - Four larval stages of the poorly known centrolophid genus *Schedophilus* are described based on 18 specimens caught off northern Namibia. The largest larvae were definitely identified as *S. maculatus* Günther, 1860 and the smallest larvae were consistent in pigment pattern and morphology with this species. Its morphology and development were described from yolk-sac larvae to flexion. Larvae, which were collected only in the upper 50 m of the water column, were geographically confined to the Walvis Ridge, and the area south of it.

RÉSUMÉ. - Jeunes larves de *Schedophilus maculatus* (Teleostei, Centrolophidae).

Quatre stades de développement d'une espèce peu connue du genre *Schedophilus* (Centrolophidae) sont décrits d'après 18 larves capturées au large de la Namibie septentrionale. Les larves les plus grandes ont été identifiées comme *S. maculatus* Günther, 1860, et les plus petites possédaient une pigmentation et une morphologie correspondant à cette espèce. Les larves sont décrites depuis le stade du sac vitellin jusqu'à celui de la flexion vertébrale. Elles ont été capturées dans les 50 m supérieurs de la colonne d'eau, au niveau de la ride Walvis et au sud de cette zone.

Key words. - Centrolophidae - *Schedophilus maculatus* - ASE - Northern Namibia - Larval description - Distribution.

The last comprehensive revision of the family- and species-rich suborder Stromateoidei was written by Haedrich, 1967. Referring here exclusively to the centrolophid genus *Schedophilus* Cocco, 1839, this genus currently comprises worldwide 9 species (FishBase: www.fishbase.org), but it is probably not a phylogenetic unit (McDowall, 1982). The larval development has been described so far only for flexion and postflexion stages of *S. medusophagus* (Aboussouan, 1983; John and Karrer, 1985). Juveniles have been figured for 6 species: *S. huttoni* and *S. maculatus* (Ahlstrom *et al*., 1976), *S. medusophagus* (Lütken, 1880; Aboussouan, 1983), *S. pemarco* (Haedrich and Cervigón, 1969), *S. ovalis* (Padoa, 1956) and *S. velaini* (Ahlstrom *et al*., 1976 as *S. labyrinthicus*). From a recent fish larval survey off northern Namibia and southern Angola 18 early larvae became available, of which the larger ones showed morphological similarity with *S. medusophagus* of similar size, but otherwise a pigment pattern, and some meristics, as described for juvenile *S. maculatus*. The early larval development will be described below.

MATERIAL AND METHODS

German RV "Alexander v. Humboldt" carried out a CTD/ichthyoplankton survey off northern Namibia and southern Angola (Cruise AHAB, leg 08, 15.0-23.0°S, mid-shelf to 08.0°E, Fig. 1) during May 2004. Ichthyoplankton was sampled by 51 oblique tows with a Hydro-Bios multinet, mesh size 300 µm, sampling speed 1 m/s, overall depth range generally 200-0 m, but split into 5 depth intervals monitored in realtime.

The entire zooplankton catch was preserved on board in a buffered 4% formaldehyde/seawater solution. Fish larvae were extracted from the zooplankton in the period September to December 2004, transferred into a 2% formaldehyde/Steedman solution, and identified until April 2005. The material is deposited in Zoologisches Museum Hamburg (ZMH). Table I lists the collection labels (of which the first digits stand for haul no./net step), sizes in notochord length (NL), and respective catch data. Measurements expressed in percent of NL were made with an ocular micrometer, division 0.1 mm. Preflexion larvae were softbodied and often contorted and/or damaged.

RESULTS

Identifications

For the larger larvae investigated, a morphological similarity with similarly sized *S. medusophagus* was found. For the area in question, a maximum of four species of *Schedophilus* can be expected, namely *S. huttoni, S. maculatus, S. pemarco* and *S. velaini*. Earlier records for *S. ovalis*

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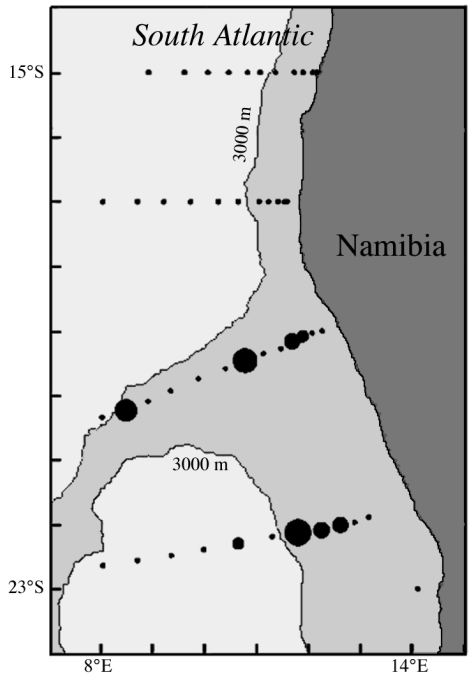

Figure 1. - The plankton-station grid of cruise AHAB-08 (small dots) and occurrences of *Schedophilus maculatus* larvae (larger dots, dot sizes represent 1 to 6 specimens per station). The southernmost nearshore station had been sampled five times. *[Grille des stations de capture du plancton pendant la campagne AHAB-08 (petits points) et présence des larves de* Schedophilus maculatus *(gros points, 1 à 6 spécimens par station). La station la plus méridionale et la plus proche de la côte a été échantillonnée cinq fois.]*

(Haedrich, 1986; Bianchi *et al*., 1993) refer correctly to *S. velaini* (Andrew *et al*., 1995; Heemstra, 1995). We could corroborate for 6 of our larger larvae a definite vertebrae count of 29, for 3 smaller larvae an obviously incomplete number of 25 to 27 vertebrae, and for one small larva an apparently definite count of 30 (Tab. I). This ruled out the species *S. pemarco* and *S. velaini* (VS = 25, rarely 26), but conforms to *S. maculatus* (Ahlstrom *et al*., 1976; Haedrich, 1986). According to these authors (plus Olivar and Fortuño, 1991), *S. huttoni* has 30 to 32 vertebrae. The largest and best developed larva showed furthermore a developing anal fin with one spine, followed by 26 anal ray-bases. The total count of 27 elements in combination with VS 29 is unique for *S. maculatus* (A III, 23-25). The larvae showed a consistent pigment pattern of 4 dorsal blotches, found in juvenile *S. maculatus*, whilst *S. huttoni* has 5 (dorsally more diffuse) blotches. On basis of the conformity of vertebrae counts, morphology and pigmentation between the definitely identified specimen and the smallest larvae, the small ones can be assigned to *S. maculatus*, too.

Description

Yolk-sac and preflexion larvae were generally slender. The maximum body depth was generally located at the head with 21.4 ± 2.8% of NL. Early larvae had a straight gut, folding later. The anus was situated at midbody (53.8 ± 4.0%) and the head is short (23.4 ± 2.3%). No allometric growth was found during preflexion for these proportions. In the largest specimen relative body depth, head length and pre-

Table I. - Collection labels, larval numbers and sizes, vertebrae counts and catch data concerning the 18 studied larvae. *[Numéros de collection, nombre de larves, tailles, nombre de vertèbres et données de capture des 18 spécimens étudiés.]*

Collection label	N larvae	Length NL (mm)	Latitude S	Longitude E	Date ddmmyy	Depth (m)	Vertebrae	Comments
3/5(b1)	1	2.6	22.00°	12.53°	080504	0-25	> 27	illustrated
3/5(b2)	1	2.8	22.00°	12.53°	080504	0-25	-	yolk remains
4/5(d1)	1	5.3	22.08°	12.12°	080504	0-25	29	damaged
4/5(d2)	1	5.7	22.08°	12.12°	080504	0-25	-	damaged
5/4(c)	1	ca. 3.4	22.12°	11.72°	080504	25-50	-	contorted
5/5(b1)	1	4.1	22.12°	11.72°	080504	0-25	> 25	illustrated
5/5(b2)	4	ca. 3.0 - 3.8	22.12°	11.72°	080504	0-25	-	contorted
7/4(c)	1	7.1	22.29°	10.58°	090504	25-50	29	illustrated
13/4(d1)	1	8.2	20.23°	8.44°	100504	25-50	29	illustrated
13/4(d2)	1	4.7	20.23°	8.44°	100504	25-50	29	-
13/5(g1)	1	4.7	20.23°	8.44°	100504	0-25	29	damaged
13/5(g2)	1	4.4	20.23°	8.44°	100504	0-25	> 26	damaged
18/4(d1)	1	5.7	19.46°	10.71°	110504	25-50	29	-
18/4(d2)	1	ca. 4.6	19.46°	10.71°	110504	25-50	-	contorted
18/5(a)	3	ca. 3.2 - 4.0	19.46°	10.71°	110504	0-25	-	damaged
21/4(a1)	1	5.2	19.16°	11.61°	120504	25-50	-	-
21/4(a2)	1	3.7	19.16°	11.61°	120504	25-50	-	-
22/5(a)	1	ca. 4.4	19.08°	11.81°	120504	0-25	30	-

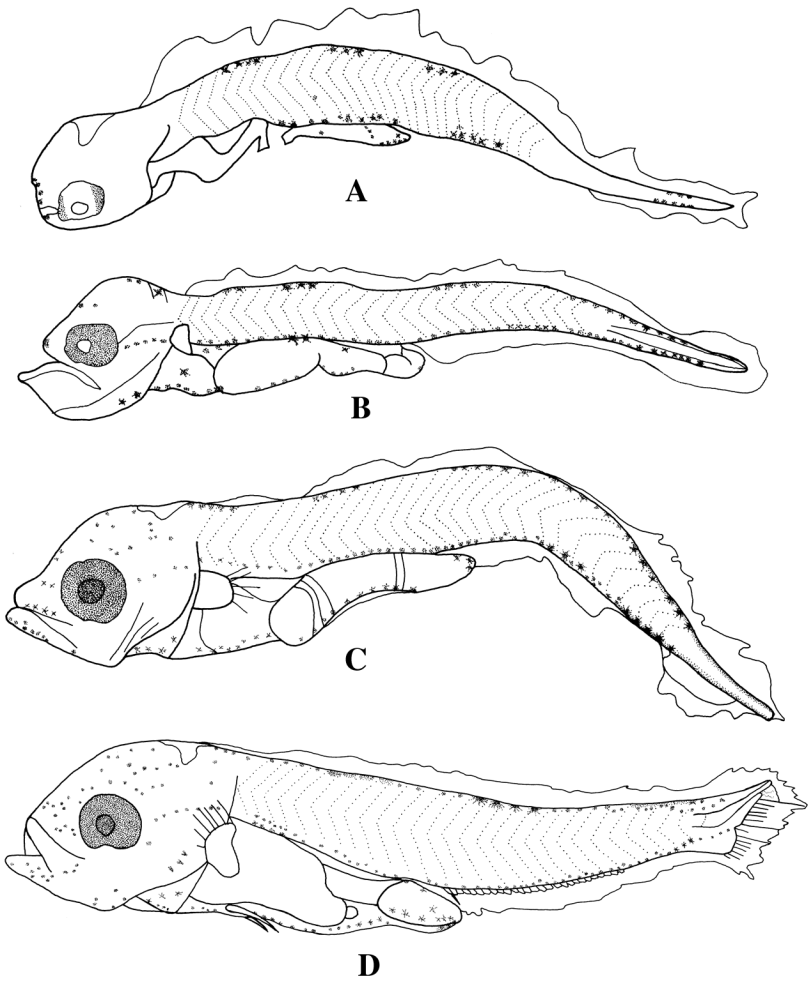

Figure 2. - Four larval stages of *Sche - dophilus maculatus*. **A**: Yolk-sac larvae 2.6 mm NL, slightly damaged. **B**: Early preflexion larva 4.1 mm NL. **C**: Late preflexion larva 7.1 mm NL. **D**: Flexion larva 8.2 mm. *[Quatre stades larvaires de* Schedophilus maculatus. ***A** : larve avec sac vitellin, notocorde de 2,6 mm de longueur (LN), légèrement endom - magée. **B** : larve au stade préflexion, 4,1 mm LN. **C** : larve au stade préflex - ion tardif, 7,1 mm LN. **D** : larve au stade flexion, 8,2 mm LN.]*

anal distance were in the upper range of the above given values, but the data set did not reveal any statistically significant increase in comparison with the total. One contorted specimen (2.8 mm NL) showed rudiments of a yolk-sac, which was heavily pigmented. The illustrated smallest specimen (2.6 mm, Fig. 2A) was damaged in the gular and opercular region, but the breakage of its originally straight gut occurred only later during the drawing process. Both these smallest specimens just started to develop pigment in their eyes, and to develop a mouth. All larger larvae had pigmented eyes and a functional mouth (Figs 2B-D). Except for the specimen with 30 vertebrae (ca. 4.4 mm) the urostyle, respectively the still undifferentiated part of the notochord, was long in these early larvae. Reliable vertebrae counts of 29 could be obtained from 4.7 mm onwards. The gut started to develop horizontal folds in the 4 mm size-class, with an associated increase in body depth at about the foregut. The first developing P-rays were discernible only in the second largest specimen of 7.1 mm. This specimen was not yet in flexion, and did not show any bases of dorsal, anal and pelvic fins, either. The largest flexion specimen showed 7 P-rays, pelvic fin buds, and one anal spine followed by 26 anal ray-bases. There were some few developing dorsal ray-bases at midbody. The caudal fin was not yet completely developed (C 7 + 8 principal rays instead of 9 + 8 for *S. maculatus* and most congeners), and had an undifferentiated mass at the upper margin of the hypural plate. This flexion specimen showed 3 small spinules at the edge of the preopercle, when examined from ventro-laterally.

Consistent pigment patterns in all larvae were a pigment blotch in the ventral middle of the caudal peduncle, and dorsal plus ventral pigment blotches at the tail, except for the tail-tip proper. Furthermore along the dorsal midline 3 anterior pigment blotches occurred (exceptionally 4 in the specimen with 30 vertebrae), located above the nape, the hindgut, and shortly behind the vertical through the anus. These blotches appeared inconspicuous when viewed exactly from laterally, but were obvious when viewed from ventrally, respectively dorsally. From the 3 mm size-class onwards the entire ventral body contour showed a closely spaced series of small melanophores, continuing supraintestinally interiorly and internally in the head. Additionally melanophores

appeared along the ventral midline of the gut. Dorsally the 4 pigment blotches started to become interconnected by small melanophores also. This development started from the hindmost blotch anteriad and became complete with the largest larva at hand. However, both the ventral and dorsal blotches remained discernable as such by a denser and more lateral spread of melanophores.

DISCUSSION

The morphology of the larger larvae was very similar as described for flexion and postflexion in *S. medusophagus* (Aboussouan, 1983; John and Karrer, 1985). Early larvae, characterised by a straight gut, have not previously been described for any species of this genus. Characteristic for *S. maculatus* larvae in all stages is the presence of generally 4 dorsal and 2 ventral pigment blotches. The posterior blotches oppose each other just before the tail-tip. This conforms to the pigment pattern illustrated for juvenile *S. maculatus* by Ahlstrom *et al*. (1976). The above mentioned larva with VS = 30 had a total of 5 dorsal blotches as shown for a juvenile *S. huttoni* (for which Ahlstrom *et al*., 1976 also illustrated 2 prominent blotches along the anal fin base, contrasting with the deviating specimen discussed here) and appeared somewhat more slender than the remainders. Due to the otherwise conforming pigment pattern it is regarded as a slightly aberrant *S. maculatus*, rather than *S. huttoni*.

Adult *Schedophilus maculatus* is said to be a pelagic species of the Southern Ocean, spreading northwards up to southern Africa (FishBase, *op. cit*.; Haedrich, 1986). It was not listed for Namibia (Bianchi *et al*., 1993). These larvae were caught along the two southern transects only, but neither during the transect along the Angolan-Namibian border (17°S), nor off southern Angola (Fig. 1). Occurrences coincided with the continental slope, respectively with the Walvis Ridge. The area where larvae did not occur, albeit sampled with comparable intensity as further south, conformed to the Angola-Benguela Frontal Zone (ABFZ). The ABFZ separates tropical surface and mesopelagic waters from the cooler Benguela Regime and forms a biogeographical boundary (John *et al*., 2001). The larvae were exclusively caught in the upper 50 m, i.e. above and within the thermocline. The average sampled area per haul was 1.7 m^2 ± 0.55.

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