original scientific paper

UDC 597.3/.5:591.16(262.3-11)

EARLY LIFE HISTORY STAGES OF FAMILY CENTROLOPHIDAE IN THE EASTERN ADRIATIC

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ABSTRACT

Use of early life history stages of fish in systematic and ecological studies has increased in recent years. It is now recognized that eggs, larvae and juveniles present a wide array of characters that are largely independent of adult characters and suitable for a systematic analysis. Fisheries recruitment studies focus on the survival of eggs and larvae as the most important factor influencing variations in population abundance. A requisite to these studies is detailed infomation on the appearance of fish eggs and larvae in order to identify them in plankton samples. This paper reviews all available information on the early developmental stages of the family Centrolophidae found in the eastern Adriatic.

Key words: early developmental stages, Centrolophidae, eastern Adriatic

INTRODUCTION

The importance of early-life-history studies to fisheries investigations and phylogenetic research has increased dramatically during the last decade. Early-life-history stages are now routinely used in fisheries studies to investigate the interannual variation in recruitment (Wooster, 1983), and in studies of the phylogeny of fishes (Moser *et al.*, 1984). The study of fish eggs, larvae and juveniles is a key component in research into the biology, systematics and even population dynamics of fishes, in that it provides information on spawning areas and periods of many species. By combining the location of eggs, larvae, juveniles and adults of a species with information on the surrounding environment, possible environmental effects on spawning (egg and larval transport, *etc.)* can be inferred. Studies of this type contribute to our understanding of the early stages of development of fishes, which for certain species are still completely unknown. Consideration of the factors that affect egg and larval survival is fundamental, since it is the early stages of development that will eventually determine the existence of good or bad year classes. This is one of the main thrusts of ichthyoplankton studies in those areas in which the requisite basic information is available (egg and larval surveys in spawning areas during the spawning season, *etc.)* for the species of interest.

The object of this paper is to compile and present all available information on both the early development stages of the eggs and larvae of the family Centrolophidae found in the eastern Adriatic and possible spawning areas and seasons of some species of the family.

MATERIAL AND METHODS

The present paper sets out descriptions of the eggs, yolk-sac larvae, larvae and juveniles of the family Centrolophidae likely to be collected in plankton samples in the eastern Adriatic, together with information on the possible spawning areas and seasons for some species. The egg and larval descriptions have mostly been taken from the existing literature. In some cases the descriptions were done by the author himself based on material collected during surveys; in other instances the descriptions were published by other researchers, either for eggs, larvae and juveniles actually collected in the eastern Adriatic itself or for egg and larval material collected in other areas but for species that also inhabit the waters of the eastern Adriatic. Notochord (NL) length was measured for preflexion and standard length (SL) for flexion larvae, and total length for larvae and juveniles (TL).

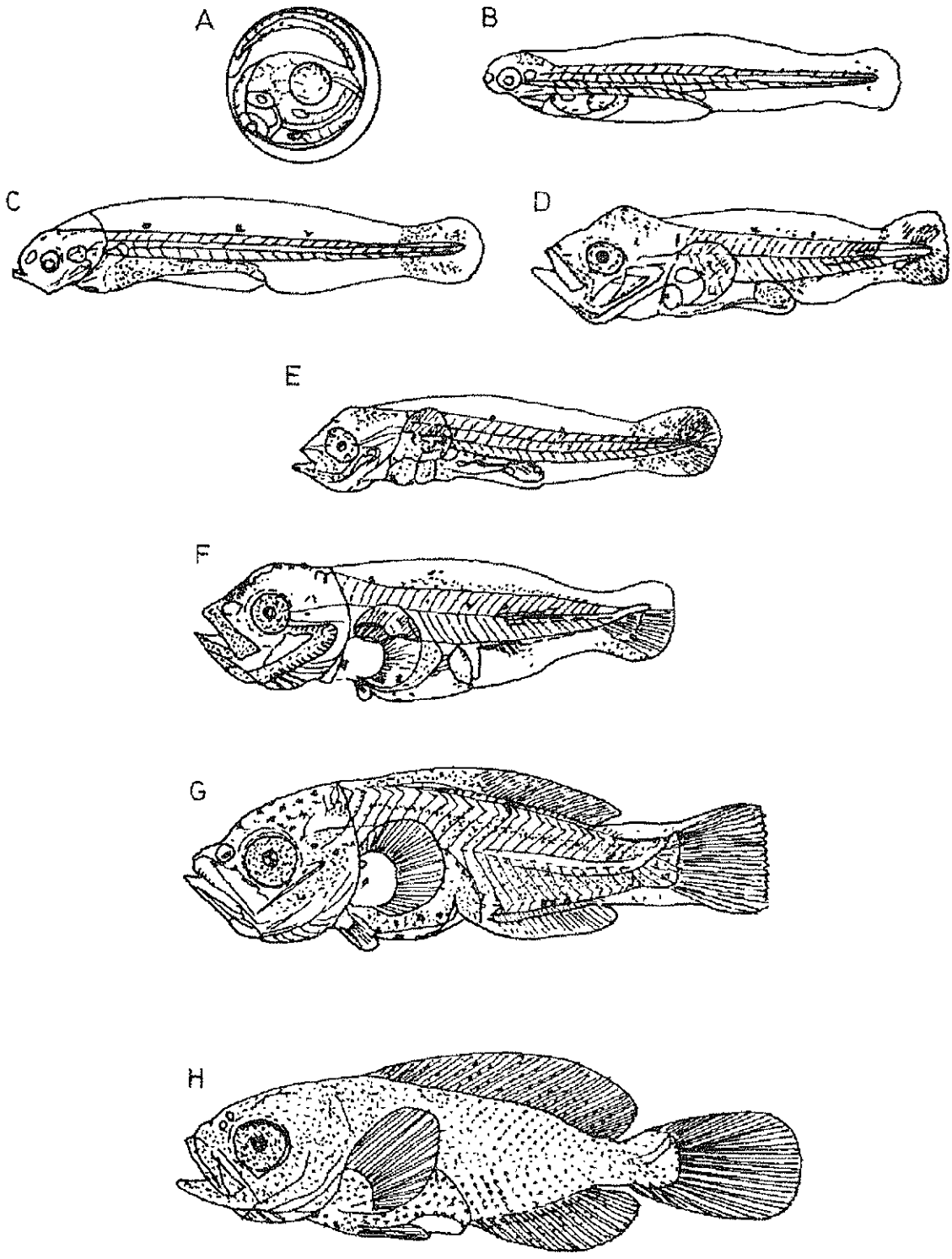

Fig. 1: *Centrolophus niger* ***(Gmelin, 1789). (A) egg; (B) yolk-sac larva, 4.4 mm TL; (C) larva, 5.0 mm TL; (D) larva, 5.4 mm TL; (E) larva, 5.6 mm TL; (F) larva, 6.7 mm TL; (G) larva 8.3 mm TL; (H) early juvenile, 17.2 mm TL (after Sanzo, 1932).***

Sl. 1: *Centrolophus niger* ***(Gmelin, 1789). (A) ikra; (B) larva z rumenjakovo vrečko, 4,4 mm TL; (C) larva, 5,0 mm TL; (D) larva, 5,4 mm TL; (E) larva, 5,6 mm TL; (F) larva, 6,7 mm TL; (G) larva 8,3 mm TL; (H) mladostni osebek v zgodnji fazi, 17,2 mm TL (po Sanzu, 1932).***

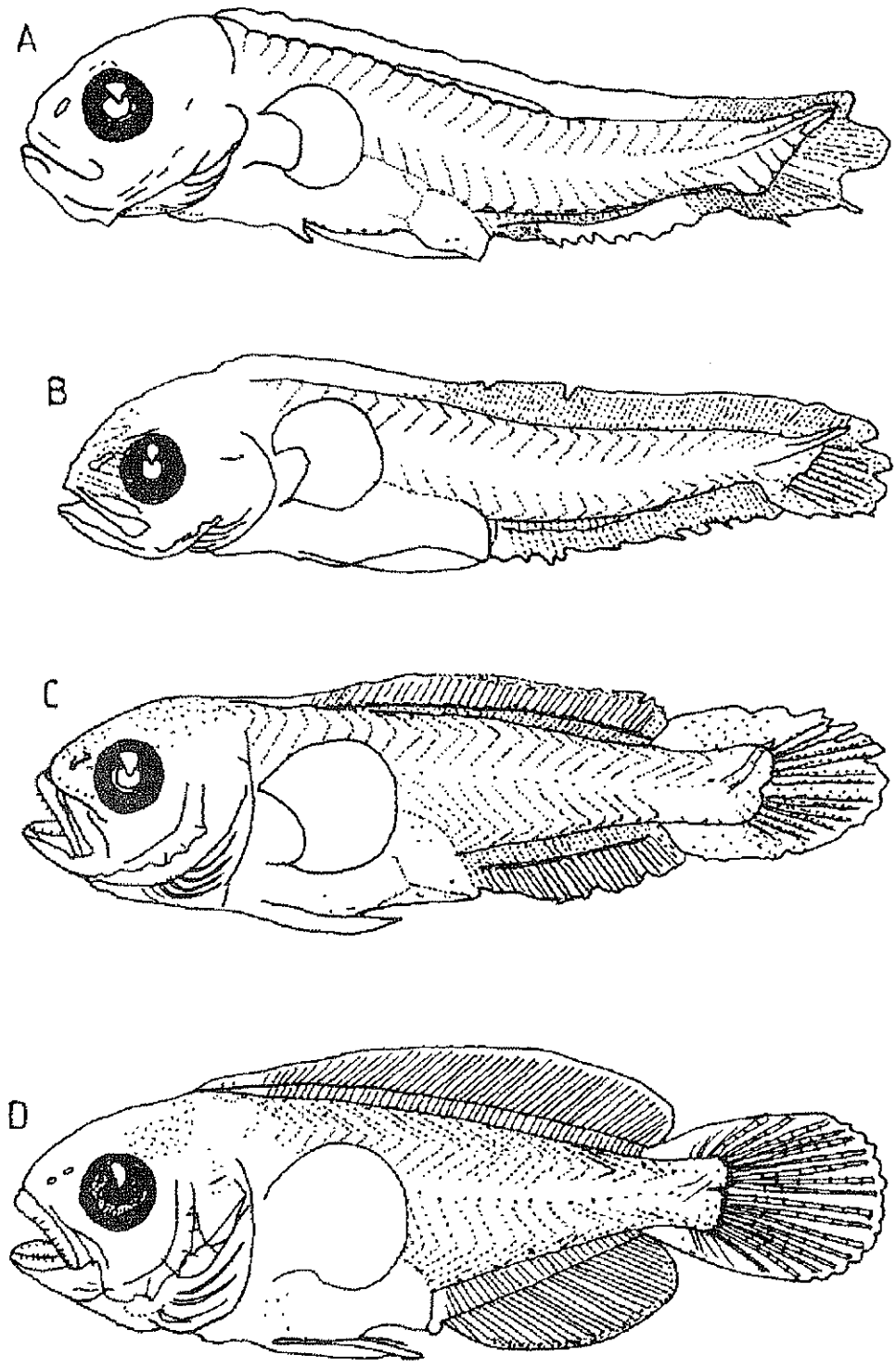

Fig. 2: Schedophilus medusophagus Cocco, 1839. (A) larva, 8.6 mm SL (after John & Karrer, 1987); (B) larva, 9.7 mm SL (original drawn by author); (C) larva, 11.8 mm SL (original drawn by author); (D) larva, 16.8 mm SL (after John & Karrer, 1987).

Sl. 2: Schedophilus medusophagus Cocco, 1839. (A) larva, 8,6 mm SL (po Johnu & Karrerju, 1987); (B) larva, 9,7 mm SL (izvirna risba je avtorjeva); (C) larva, 11,8 mm SL (izvirna risba je avtorjeva); (D) larva, 16,8 mm SL (po Johnu & Karrerju, 1987).

RESULTS AND DISCUSSION

Centrolophus niger (Gmelin, 1789)

Eggs

The eggs are spherical and measure 1.20-1.24 mm in diameter, with an oil globule 0.32 mm in diameter. The yolk is segmented, the perivitelline space narrow, and the chorion smooth. Melanophores are visible over the surface of the oil globule after the embryo has formed, and a series of pigment patches are present on the embryo itself (Fig. 1A) (Sanzo, 1932). No eggs attributable to this species have been collected during any of the survey carried out in the eastern Adriatic.

Larvae

Regner (1982) found *C. niger* larvae at the station Stončica (43°00'N, 16°20'E) in the middle Adriatic in October and November with frequency 0.08%.

Morphology

The body is rather slender during the early stages, with body depth increasing with development. Body depth at the base of the pectoral fin is 13% of NL at 4.36 mm, 30% of SL at 8.32 mm TL, and 21% of SL at 17.2 m TL (Figs. 1B, G, H). The gut is quite narrow and straight in the early stages, extending to 57% of NL in newly hatched larvae and to 59% of SL at 8.32 mm TL; gut diameter also increases with growth. Head length also increases as development progresses, representing 20% of NL in first-feeding larvae and 33% of SL in postflexion larvae and early juveniles. Unlike other stromateoid species, the larvae of this species bear no spines on the preopercle.

Pigmentation

The basic pigmentation pattern in all stages of development consists of some stellate melanophores on the top of the head, melanophores along the dorsal and ventral margins of the body, a row of melanophores below the gut, and a cluster of pigment spots on the caudal tip. This latter pigmentation on the caudal tip is located on the finfold in preflexion larvae, but becomes embedded inside the body in postflexion larvae. In newly hatched larvae measuring 4.4 mm TL (Fig. 1B), there are 4 large pigment patches on the dorsal margin of the body and another 4 on the ventral margin, somewhat staggered with respect to the former. With growth these pigment spots on the contours of the body become smaller, particularly the ventral ones, which turn into a rather continuous series of small spots. In a 5.4 mm TL specimen (Fig. 1D) a longitudinal row of pigment spots begins to develop medially on the lateral walls of the tail. Pigmentation in early juveniles 17.2 mm TL (Fig. 1H) consists of small punctiform melanophores that spread over the entire body and on the proximal portion of the dorsal and anal fin rays.

Notochordal flexion

Notochordal flexion had already commenced in a 6.72 mm TL larvae (Fig. 1F) described by Padoa (1956).

Fin development

The rays of the caudal fin are the first to develop completely, followed by those of the dorsal, anal, pelvic, and pectoral fins. All the rays in the caudal, dorsal, anal, and pelvic fins were fully developed in a 8.32 mm TL specimen (Fig. 1G), but formation of the rays in the pectoral fins was still not complete even in a 17.2 mm TL specimens. Pelvic fin buds appeared in a 6.72 mm TL specimen (Padoa, 1956). There are 25 myomeres, 11 preanal and 14 cadual.

Juvenile

The specimen of the juvenile stage of the *C. niger* was found by west of Island of Vis, in the area of the Stončica observation station (43°00'N, 16°20'E). This was the first juvenile stage of this species found in the middle Adriatic (Karlovac, 1974). Measuring 27.99 mm in total length, it was caught on November 8th, 1971 by a vertical haul of the Helgoland type of plankton net, hauled from a depth of 75 m to the surface. Owing to the greater depth of its body, the juvenile specimen is rather squat, with the following properties: the standard length is 2.68 times as large as the depth of body (at the beginning of the dorsal fin base), and 2.56 time as large as the head length. Numerical values of rays in the various fins are the following: the caudal fin rays are somewhat shorter in the middle, comprising altogether 15 bifurcating and 2 simple ones; additional few rays are on the sides. The dorsal fin omprises 7 shorter and 33 longer rays, totalling 40 rays (Karlovac, 1974). The anal fin extends from the vicinity of anus to the end of the caudal peduncle, where ends at the same level as the dorsal fin. It comprises 3 shorter rays followed by 20 longer ones, totalling 23 rays. The pectoral fins are rounded, covering a larger part of the body's depth. Each of the fins has 18 rays. The ventral fins extend as far as the anus. The pigmentation of the preserved specimen is the following: four transverse wide black belts are conspicuous. The first belt is on the fore part of the body, just behind the gill cover; the second begins before the anus, extending headwards; the third is located between the caudal peduncle and anus, while the fourth, of a lesser intensity, comprises the caudal peduncle (Karlovac, 1974).

Schedophilus medusophagus (Cocco, 1839)

Eggs

No information available.

Larvae

Two larvae of this species were caught by a Hensen net at station Stončica on 21 June 1994, and this is the first larval record from the Adriatic Sea (Dulčić, 1998). After fixation in 4% seawater formalin, the standard lengths of larvae were 9.7 mm and 11.8 mm (Figs. 2B and 2C).

Morphology

The general morphology largely conforms to that of other stromateoid species. Body depth augments over the course of development. Maximum body depth is approximately 25% of length in larvae measuring 8.6 mm NL, 30% at larval lengths between 9.5 and 13 mm SL, and 30-35% of SL in larger postlarvae. In early juveniles maximum body depth represents a still larger proportion of SL, 47% in specimens 16.8 mm SL (Fig. 2D). Spines are visible on the margin of the preopercle in individuals larger than 9.5 mm SL, and become somewhat elongate and increase in number with body length (John & Karrer, 1987).

Pigmentation

The most outstanding feature of the pigmentation pattern is two series of internal stellate pigment dots along the dorsal and ventral contours of the body, ending at the caudal tip. The dorsal series starts at the body's first myomere, the ventral series starts on the walls of the peritoneum. A row of small melanophores is present below the gut in all stages of larval development. The dorsal portion of the head is covered by minute dots, which are less numerous to larval lengths smaller than 9.5 mm SL. At around 11 mm SL very light pigmentation is observable on the jaws and the angle of the lower jaw. Pigmentation also appears medially on the lateral walls of the body from approximately the first third of the body to the notochordal tip at around this same length. Pigmentation is usually present laterally at the end of the caudal peduncle, on the remnants of the finfold above and below the caudal peduncle, and on the anterior portion of the caudal fin. The pelvic fins are lightly pigmented at 10.9 mm SL

Notochordal flexion

Notochordal flexion takes place at between 8 and 9.5 mm SL (John & Karrer, 1987.

Fin development

The caudal fin is the first fin in which formation of the full complement of rays is complete. Pelvic fin buds were already visible in the smallest specimens described (around 8.5 mm in SL) (Fig. 2A).

ZGODNJI RAZVOJNI STADIJ RIB IZ DRUŽINE CENTROLOPHIDAE V VZHODNEM JADRANU

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POVZETEK

V zadnjih letih postaja vse pomembnejše preučevanje zgodnjih razvojnih stadijev v sistematičnem in ekološkem raziskovanju rib. Tako je danes že splošno uveljavljeno prepričanje, da ikre in larve pomenijo širok spekter bitij, ki so bolj ali manj neodvisna od odraslih bitij in kot taka primerna za sistematično analizo. Študije o prirastku ribjih populacij se osredotočajo na preživetje iker in larv kot najpomembnejšega dejavnika, ki vpliva na spremembe v številnosti ribjih populacij. Prvi pogoj za te študije so podrobne informacije o videzu iker in larv, da bi jih lahko identificirali v planktonskih vzorcih. V tem članku so zajeti vsi razpoložljivi podatki o zgodnjih razvojnih stadijih rib iz družine Centrolophidae v vzhodnem Jadranu.

Ključne besede: zgodnji razvojni stadiji rib, Centrolophidae, vzhodni Jadran

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