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Eggs of pelagic fish from the Sargasso Sea with special reference to Anguilliformes

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ABSTRACT: Pelagic fish eggs from IKMT hauls, taken during the 1979 Sargasso Sea Expedition, were sorted and classified according to structural aspects. 13 types were distinguished, one of them classified as exocoetid, two of them as anguilliform. One of the anguilliform egg types could be determined as belonging to *Derichthys serpentinus*.

INTRODUCTION

During the 1979 Sargasso Expedition of the FRV "Anton Dohrn" (Tesch, 1982), further information was expected to be acquired on the reproduction of anguilliform fish, especially of the European eel *(Anguilla anguilla)* in its suspected spawning area. The examination of fish eggs from plankton catches, conducted routinely in the Sargasso Sea, was an opportunity to obtain some indications of the reproductive activities in anguilliform species.

Developing eggs of the European eel have up to now been obtained and described only from hormone-treated parental fish following artificial insemination (Boëtius & Boëtius, 1980; Yamamoto & Yamauchi, 1974). Eggs of *Anguilla* spp. have not yet been found in their spawning grounds; previous reports of Fish (1927) and Yevseyenko (1974) dealing with such observations could not be confirmed. Information on early life history stages of other anguilliform fish is also scarce.

MATERIAL AND METHODS

The fish eggs examined were obtained from plankton collections made during the second part of the cruise 210 of FRV "Anton Dohrn" from March 19 to May 9, 1979 to the Sargasso Sea area (within 25 and 29° N and 50 and 69° W). An account on the hydrography of the area investigated is given by Wegner (1982).

Sampling was carried out with an Isaac Kidds Midwater Trawl (opening 6 m^2, 0.5 mm mesh size, 0–200 m oblique hauls). The eggs described in this paper were received as by-catch from these IKMT-hauls. The samples were taken predominantly in

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the supposed spawning area of *Anguilla anguilla*, within 22 and 30° N and 48 and 65° W (Schmidt, 1922). Immediately following the haul, the sample was preserved on board with borax buffered seawater-formaldehyde (4 %).

From a total of 50 plankton hauls, 37 were examined and a total of 7 312 eggs were isolated (Table 1). All measurements (diameter of eggs and yolk) were made to the nearest hundredth millimeter with a calibrated micrometer caliper, using an inverse microscope and a modified type of roto-compressor (Heunert, 1973; Stibane & Schulz, 1983).

Myomere counting for further identification was only possible for well-developed embryos of egg type *L* (see below). Geographical distribution is given according to the maximum of occurrence of each distinguished egg type (Table 1).

RESULTS AND CONCLUSIONS

Thirteen different egg types (*A–M*) could be distinguished from the preserved material. They were classified according to (1) egg size, (2) character of chorion of the egg capsule, (3) character of yolk, (4) presence or absence of oil globule(s), and (5) width of the perivitelline space. However, taxonomic identification was limited to three egg types: two of them (*H* and *K*) were determined to orders and one type (*L*) was identified at the species level.

Type *K* (Fig. 1a) was identified as belonging to the order Atheriniformes (exocoetid eggs) because of the size, 2.17 ± 0.08 mm (n = 85), the narrow perivitelline space (19 % of the egg volume), the homogeneous yolk without oil globule(s), and the numerous and

Table 1. Morphological features and geographical distribution of different egg types (*A–M*) collected during the 1979 cruise of the FRV "Anton Dohrn" to the Sargasso Sea. ● characteristics damaged by fixation (4 % buffered seawater-formaldehyde)

Egg type	Mean egg diameter (mm)	Number of eggs	Width of perivitelline space narrow (n), wide (w)	Yolk homogeneous (h), segmented (s)	Oil globule (s), presence (+), absence (−)	Position of maximum occurrence W	N	Percent of total catch at positions of maximum occurrence
A	0.77±0.10	705	n	h	−	55°31′	25°12′	32.9
B	0.80±0.06	828	n	s	+	55°31′	25°12′	29.8
C	0.88±0.05	347	n	s	+	57°00′	25°10′	14.8
D	0.90±0.05	135	n	s	+	59°56′	25°09′	19.1
E	1.12±0.11	1922	●	●	●	58°10′	19°51′	83.7
F	1.15±0.07	651	n	s	+	55°30′	28°31′	43.2
G	1.64±0.15	210	n	s	+	58°10′	19°51′	4.8
H	2.01±0.16	1279	w	s	+/−	67°39′	25°08′	63.5
I	2.01±0.05	540	●	●	●	58°10′	21°50′	30.2
J	2.10±0.15	22	n	h	+	59°56′	25°09′	6.0
K	2.17±0.08	85	n	h	−	58°59′	25°32′	4.4
L	2.33±0.12	421	w	s	+	59°56′	25°09′	23.0
M	3.11±0.15	167	n	h	−	58°16′	25°08′	5.7

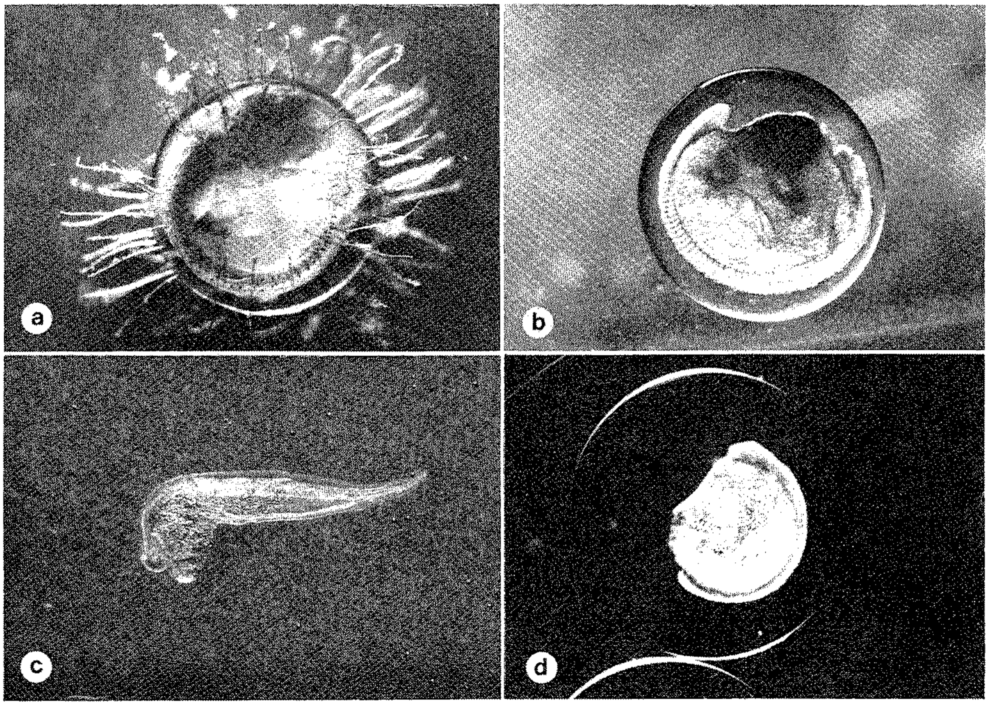

Fig. 1. Different eggs and one dissected larva fixed in buffered 4 % seawater-formaldehyde from plankton collections of the 1979 Sargasso Sea Expedition. (a) Egg type *K* (exocoetid egg) with a diameter of 2.17 ± 0.08 mm, a narrow perivitelline space, homogeneous yolk without oil, long and numerous chorionic filaments. The embryo is well developed (embryo > 270° around the yolk, pigmentation beginning). (b) Egg type *L (Derichthys serpentinus)* with a diameter of 2.33 ± 0.12 mm, wide perivitelline space and segmented yolk. The embryo is well developed (the myomeres are distinguishable). (c) Dissected larvae of egg type *L (Derichthys serpentinus)* with a total length of 5.5 mm. (d) Egg type *H*, unidentified anguilliform egg, with a diameter of 2.01 ± 0.16 mm. The embryo is in an early stage of development

extended (n = 40–80; 0.7–0.9 mm) threads attached to the surface of the egg capsule. Maximum abundance of these eggs occurred in samples taken in the middle of the supposed spawning area of the European eel, *Anguilla anguilla* (Table 1).

The egg type *L* (Fig. 1b) with egg diameters of 2.33 ± 0.12 mm (n = 421) could be identified as *Derichthys serpentinus* by myomere countings (Smith, 1979: 126–134 myomeres) in 6 well-developed embryos (121–129 myomeres; see Fig. 1c). The maximum occurrence of *L* was in the middle of the supposed spawning area of *A. anguilla.*

The maximum occurrence of the other anguilliform egg type *H* was far west of this supposed spawning area (Table 1). Because of their anguilliform characters (Ahlstrom & Moser, 1980), such as segmented yolk and wide perivitelline space, this egg type could be considered as belonging to Anguilliformes species. The embryos of *H* were not so well developed as to allow identification by myomere counts (Fig. 1d). For these eggs, the diameter was the only distinguishing feature in the early stages of development (Ehrenbaum, 1911a, b; Simpson, 1956; Hiemstra, 1962).

Comparable data on anguilliform egg diameters are available only for hormone-treated specimens of *Anguilla* spp. from artificial spawning experiments (Yamamoto & Yamauchi, 1974; Boëtius & Boëtius, 1980). Comparisons of the diameter of eggs from these two sources (hormone-induced spawning and spawning in the natural environment) with extremely different conditions showed that the diameter of the anguilliform egg type *H* is twice that of *Anguilla* spp. reported from hypophysis experiments. Considering the variability of other marine pelagic fish eggs with diameter differences up to 150% (Ehrenbaum, 1911a, b; Bagenal, 1971), no further classification than "anguilliform" is possible for egg type *H*.

The identification of egg type *L* as *Derichthys serpentinus* was supported by the simultaneous occurrence of small *D. serpentinus* larvae and running ripe females in the same area (Tesch et al., 1979).

From a total of about 7000 eggs obtained in the supposed spawning area, no *Anguilla* eggs could be determined. This may be due to the fact that these young developmental stages cannot be identified because of the lack of information on pelagic fish eggs from this area. With regard to the identification of all egg types, reference is made to the remarks of Boëtius & Boëtius (1980): "Identification of Atlantic eel eggs at sea must, however, remain guesswork until we possess complete developmental series."

The fish eggs were obtained together with the eel larvae collections, but the simultaneous presence of more or less young eel larvae is not an indispensable condition for the occurrence in the same habitat of eel eggs with their fast development (38–45 h at a water temperature of 23 °C: Yamamoto & Yamauchi, 1974).

To complete the present insufficient knowledge of the early life history of the eel, it is desirable that, during the course of further Atlantic expeditions, observations with regard to time, place, depth, as well as gear and effort of sampling are concentrated on naturally spawned eggs of *Anguilla* species, too.

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