REPRODUCTIVE BIOLOGY OF *CHLOROPHTHALMUS AGASSIZI* IN THE CENTRAL-WESTERN MEDITERRANEAN

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Abstract
160 specimens of *Chlorophthalmus agassizi* with total length between 6.6 and 18.8 cm were caught in the Sardinian Sea. Microscopic analysis showed six stages of oocyte development. Spawning occurred in Summer.

Key-words: Chlorophthalmus agassizi, hermaphroditism, reproduction, Mediterranean Sea

Introduction

Chlorophthalmus agassizi Bonaparte, 1840, shortnose greeneye, is a bathydemersal monoecious species (1). Though abundant in Mediterranean Sea where it has a rather wide geographic distribution (2, 3), the current knowledge on its biology is limited, especially on its reproductive cycle. This paper studied its reproductive period.

Materials and methods

Samples were caught with experimental trawl surveys (Autumn and Summer) carried out in the Sardinia Sea as part of national and international (2) projects in 2002, and from samplings in the months not covered by the experimental surveys. For each month, the gonads of several individuals were collected stratified based on size.

Stages of oocyte development were based on those proposed by Forberg (4) and adapted to the studied species. Oocytes were measured and counted by stage and the Nucleoplasmatic Ratio (NPR) was calculated: $NPR=Vn(Vc-Vn)^{-1}$, where Vn = nucleus volume and Vc = cytoplasm volume.

Results and discussion

The gonads were made up of two distinct components: the ovarian and the testicular components. The ovarian component presented a double sacciform structure elongated in the abdominal cavity. The oviduct is one and gathers the mature sexual products of both ovaries. The testicular portion, included in the median zone of each ovary, was made up of seminiferous tubules and ended in an ampoule.

Following histological analysis of the gonads of 160 specimens caught from March to November with a TL from 6.6 to 18.8 cm, six oocyte development stages were identified (Fig. 1):

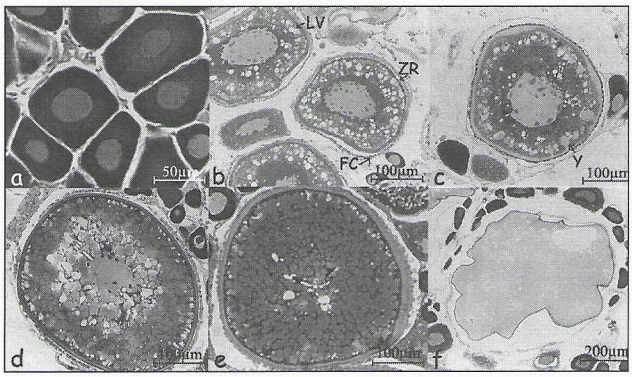

Fig. 1. Oocyte developmental stages: Basophils (a), Lipid vesicles (b), Primary vitellogenesis (c), Secondary vitellogenesis (d), Tertiary vitellogenesis (e), and Translucent (f).

B (***Basophils***): oocytes with a uniform cytoplasm, strongly basophilic and homogeneous. NPR=0.211; diameter=20-70 µm (Fig. 1a).

LV (***Lipidic Vesicles***): oocytes with weakly basophilic cytoplasm, which contained lipid vesicles. Follicular Cells (FC) and the "Zona Radiata" (ZR) appeared. NPR=0.187; diameter=70-210 µm (Fig. 1b).

Y1 (***Primary vitellogenesis***): the oocytes presented drops of protein vitellin (Y=yolk) scattered in the cytoplasm and lipid vesicles increased in number; the follicular cells started to thin out and the ZR to thicken. NPR=0.056; diameter=210-270 µm (Fig. 1c).

Y2 (***Secondary vitellogenesis***): the cytoplasm was acidophilous; the drops of protein vitellin increased in number and size and started to unite into progressively larger drops; the ZR appeared very thick and the follicular cells continued to spread. NPR=0.021 diameter=270-500 µm (Fig. 1d).

Y3 (***Tertiary vitellogenesis***): the drops of protein vitellin were completely joined together as well as the lipid vesicles. The nucleus migrated to the periphery of the oocyte until it disappeared completely. Diameter >500 µm (Fig. 1e).

T (***Translucent***): the oocyte was large and characterised by clarification of the protein vitellin. The oocyte was ready to be shed (Fig. 1f).

Four stages of development have been assigned to the male portion of the gonad: primary spermatocyte, secondary spermatocyte, spermatid, and sperm.

Two periods of oocyte development were identified in a year: 1) spent ovary, (an ovary with immature oocytes: B, LV); 2) ovary with oocytes belonging to all the stages of maturation and sperms which were also mature. The reproductive season started in May and ended in September with a reproductive peak in July. In the mature ovaries the contemporary presence of oocytes at progressive stages of development was pointed out (asynchronous ovary), the eggs were shed several times during a reproductive season.

It has been possible to hypothesise a simultaneous type of hermaphroditism. During the reproductive season, in fact, the presence of mature male and female elements was observed (TL>9 cm). The species seems to be sequentially protandric hermaphroditic: very small individuals (TL 5-8 cm) presented immature ovaries during all the months of the year, they always showed mature sperm.

Nevertheless the adopted reproductive strategy is still not clear. Self-fertilisation could be possible for anatomical reasons (the male and female genital tracts meet at one and the same opening), moreover, the gonads contemporaneously present mature female and male sexual elements. However, *C. agassizi* lives in large shoals, which suggests that meeting a sexual partner would not be difficult. This hypothesis is further confirmed by the presence of a luminous organ of symbiotic bacteria in the perianal area (5), which could be used for sexual attraction, being an intraspecific system of communication.

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