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Age, growth, and gonad organization in red bandfish (*Cepola macrophthalma* L., 1758) from the Adriatic Sea

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The red bandfish Cepola macrophthalma *(L.) is characterized by a gonochoristic sexual organization. Age was estimated from otolith readings. Males were found to reach a greater length than females. During the reproductive period the males prevail in comparison to the females.*

Key words: *Cepola macrophthalma*, age, growth, gonad organization, Adriatic Sea

INTRODUCTION

The red bandfish *Cepola macrophthalma* (Linnaeus, 1758) is distributed throughout the Mediterranean as well as the eastern Atlantic, north to the British Isles and south to northern Senegal (TORTONESE, 1986). Literature on its biology and ecology is scarce (ATKINSON *et al*., 1977; STERGIOU *et al*., 1996). Data on its maturity were reported by ISOLA & RELINI (1984) and PASTORE *et al*., (1990). The length/weight relationship, calculated for specimens from the Ligurian Sea, statistically differed between males and females (ZAMBONI, 1990). Biological data for the Italian waters are too scarce to allow analysis of its state of exploitation (RELINI *et al*., 1999; VALLISNERI *et al*., 2002). The present paper provides information on the reproductive biology and sexual differences in growth of the red bandfish from the Adriatic Sea.

MATERIALS AND METHODS

Specimens were collected from the Adriatic Sea at depths of 15-200 m during the 1999-2000 spring-summer trawl surveys as part of the demersal resources program. Total length (TL; mm) and sex were recorded for each specimen. The sagittal otoliths were extracted and cleaned to determine age. The radius of the otolith (the distance from the center of the focus to the posterior margin of the otolith in mm) was measured with a computerized image analyzer (Leica Qween). Sex and maturity stages were determined either macroscopically or microscopically. A histological study was

conducted on a number of gonads preserved in buffered formaldehyde embedded in paraffin wax, sectioned at 7 μm, and stained with MAYER'S hemalum and eosin.

RESULTS

The total number of specimens was 527: 176 females and 351 males. Fig. 1 shows the relationship between age and TL (for females, $y = 50.520 + 89.429$, $r^2 = 0.994$; for males, $y = 6.6667 + 142.50$, $r^2 = 1.0$). Total length and age differed with sex, with males reaching a greater length than females The estimated regression of TL on the otolith radius was $y = -103.27 + 2.1495$, $r^2 = 0.998$ for females and $y = 228.60 + 3.1955$, $r^2 = 0.991$ for males (Fig. 2).

Microscopic examination of the gonads revealed that the red bandfish is characterized by a gonochoristic sexual organization (Fig. 3A). Ovary morphology generally corresponded to that reported for teleost ovaries (JONES, 1978). Numerous ovigerous folds projected into the ovarian cavity. The lamellae, consisting of connective tissue lined by germinal epithelium, contained oogonia cell

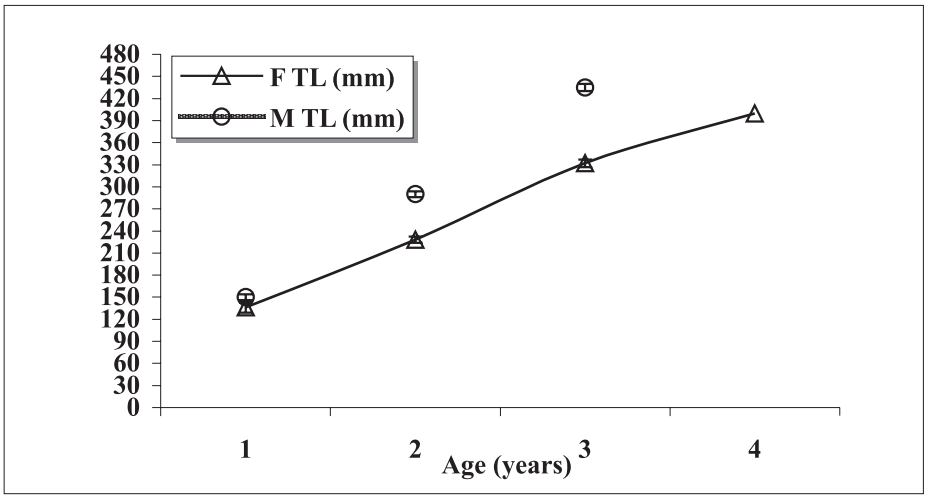

Fig. 1. Relationship between age (in years) and total length (TL; in mm)

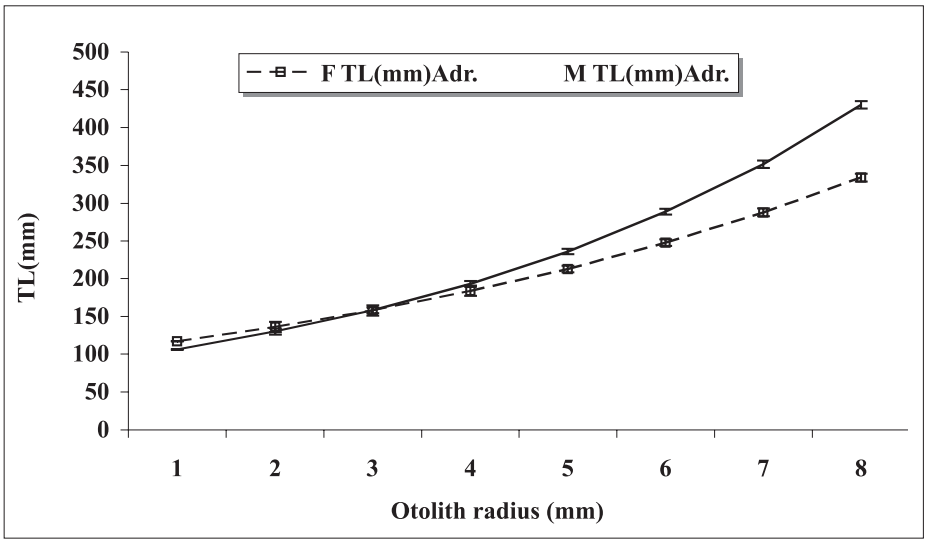

Fig. 2. Relationship between otolith radius (r; in mm) and total length (TL; in mm)

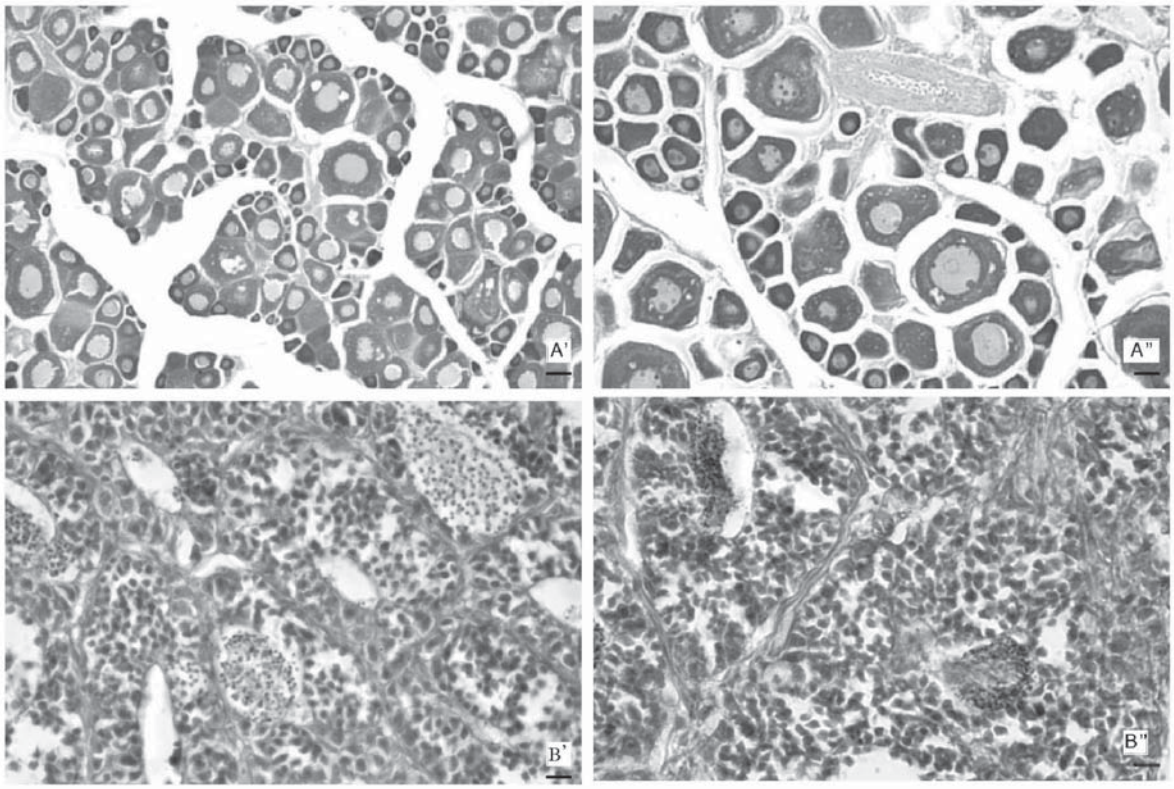

Fig. 3. (A) Post-spawning ovary (A' bar: 100 µm, A" 30 µm) and (B'- B") mature testes (bar:40 µm)

nests with developing ovarian follicles. Ovaries were in the post-spawning stage (having post-ovulatory follicles and oocytes in the late perinucleolar stage). Active spermiogenesis was observed in the testes, with a marked prevalence of spermatozoa over spermatocytes and spermatids (Fig. 3B). The distribution of oocytes is given in Fig. 4, the cells being at various stages of development from 10 to 150 µm.

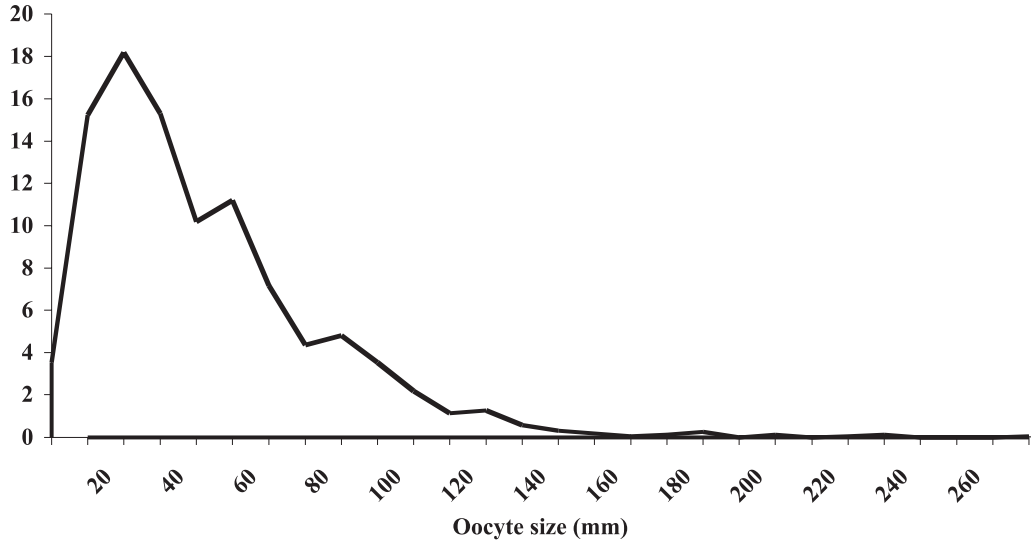

Fig. 4. Oocyte size (µm) distribution frequency in post-spawning ovaries

DISCUSSION

The gonochoristic sexual organization of red bandfish reported in this study agrees with the findings of ISOLA & RELINI (1984), PASTORE *et al*. (1993), and STERGIOU *et al*. (1996). However, it disagrees with the findings of VIVES *et al*. (1959), according to whom the red bandfish is hermaphroditic, having gonads that contain a maturing testicular portion and an atrophic ovarian portion. Such anomalies have frequently been observed in teleosts (ATKINSON *et al*., 1977). VIVES *et al.* (1959) based their proposition on the sex ratio imbalance that favors males on the assumption that a percentage of the females changes into males after the second year of life, but they used no histological evidence to support this proposition.

Oocyte development appeared to be an asynchronous process as the oocytes of the post-spawning stage were in various stages of development (diameter 10-150 μm), similar to the findings reported by ISOLA & RELINI (1984). RELINI *et al*. (1999), KAYA & OZAYDIN (2001) and STERGIOU *et al.* (1996) also reported that the males of the red bandfish prevail in comparison to the females.

The best indicator of age in the red bandfish is the otolith (STERGIOU *et al*., 1992). Marked sex-related differences in growth rate were reported for fish of over two years by other Authors (ZAMBONI *et al*., 1990; STERGIOU *et al*., 1992; KAYA & OZAYDIN, 2001).

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Rast, starost i struktura gonada kurdele, (*Cepola macrophthalma* L.) u Jadranskom moru

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SAŽETAK

Kurdela, *Cepola macrophthalma* (L.) je gonohorist. Starost je određena temeljem čitanja otolita. Utvrđeno je da mužjaci dosižu veće dužine od ženki. Tijekom razdoblja razmnožavanja mužjaci su znatnije zastupljeni u populaciji nego ženke.

Ključne riječi: *Cepola macrophthalma*, starost, rast, struktura gonada, Jadransko more