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GONADAL HISTOLOGY IN *DIPLODUS VULGARIS* FROM THE WEST ALGERIAN COAST

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ABSTRACT

The reproduction of *Diplodus vulgaris* in the Algerian west coast was studied between September 2015 and August 2016. Gonadal differentiation and development of males and females were established through histological analysis. Of a total of 472 sampled specimens 246 were females, 206 were males and 20 of undetermined sex. The obtained results show that this species has a clearly defined reproductive period lasting from October to February with a spawning phase in January.

Key words: *Diplodus vulgaris*, reproduction, ovaries, testicles, west Algeria

ISTOLOGIA GONADICA IN *DIPLODUS VULGARIS* LUNGO LA COSTA ALGERINA OCCIDENTALE

SINTESI

La riproduzione di *Diplodus vulgaris* lungo la costa occidentale algerina è stata studiata tra settembre 2015 e agosto 2016. La differenziazione e lo sviluppo gonadico di maschi e femmine sono stati stabiliti attraverso l'analisi istologica. Su un totale di 472 esemplari campionati 246 erano femmine, 206 maschi e 20 di sesso indeterminato. I risultati ottenuti mostrano che questa specie ha un periodo riproduttivo ben definito che va da ottobre a febbraio con una fase di deposizione delle uova a gennaio.

Parole chiave: *Diplodus vulgaris*, riproduzione, ovaie, testicoli, Algeria occidentale

INTRODUCTION

The two-banded sea bream *Diplodus vulgaris* (Geoffroy Saint-Hilaire, 1817) is easily recognized by a broad triangular black band on the nape of the neck, before the pectoral fins, and another on the caudal peduncle, which extends to the dorsal and anal fins. It is classified among the endemic species of the Mediterranean (Quignard & Tomasini, 2000). Since *D. vulgaris* can be found at variable depths, the capture fishing targeting this species involves a multitude of fishing gear such as trawls, trammel nets, the so-called *charfia* traps, pots, and beach seines (Hadj Taieb, 2018). This work is the first presentation of histological data on the reproduction of the seabream *D. vulgaris* from the west coast of Algeria (North Africa).

MATERIAL AND METHODS

The study of the reproduction of *D. vulgaris* was carried out on a sample of (472) individuals between September 2015 and August 2016, collected at the port of Beni Saf on the west Algerian coast (Fig. 1).

The histology of the gonads of two-banded sea bream was studied on samples collected monthly from the captures by the local fishermen. The research involved a group of 472 individuals, com-

posed of 206 males, 246 females and 20 specimens of undetermined sex.

The study of the microscopic stages consisted in carrying out histological cuts of the gonads after fish dissection. Each collected gonad was preserved in a 10% formaldehyde solution.

The various histological techniques (fixing, dehydration with paraffin embedding, tissue sectioning, staining) were carried out at the Pathological Anatomy and Cytology Laboratory of the Dr. Benzedjeb Hospital in Ain Temouchent (Algeria) following the recommendations by Martoja & Martoja (1967). Slices of tissue 6–7 µm thick were prepared using a microtome, the staining was done with hematoxylin-eosin. All the sections so obtained were then observed under an optical microscope provided with a camera.

RESULTS

The microscopic observation of specimens of both sexes of *D. vulgaris* has made it possible to highlight the evolution of the cells according to the different stages of maturity.

The first stage in females is pre-vitellogenesis, i.e., the differentiation of an oogonium into an oocyte, which is characterized by a homogeneous cytoplasm and a central and bulky nucleus limited by a membrane, which will later be bordered by a zona radiata (Fig. 2A).



Fig. 1: Geographical location of the Bay of Beni Saf on the western coast of Algeria (Rahmani et al., 2021).
Sl. 1: Geografska lega zaliva Beni Saf na zahodni obali Alžirije (po Rahmani in sod., 2021).

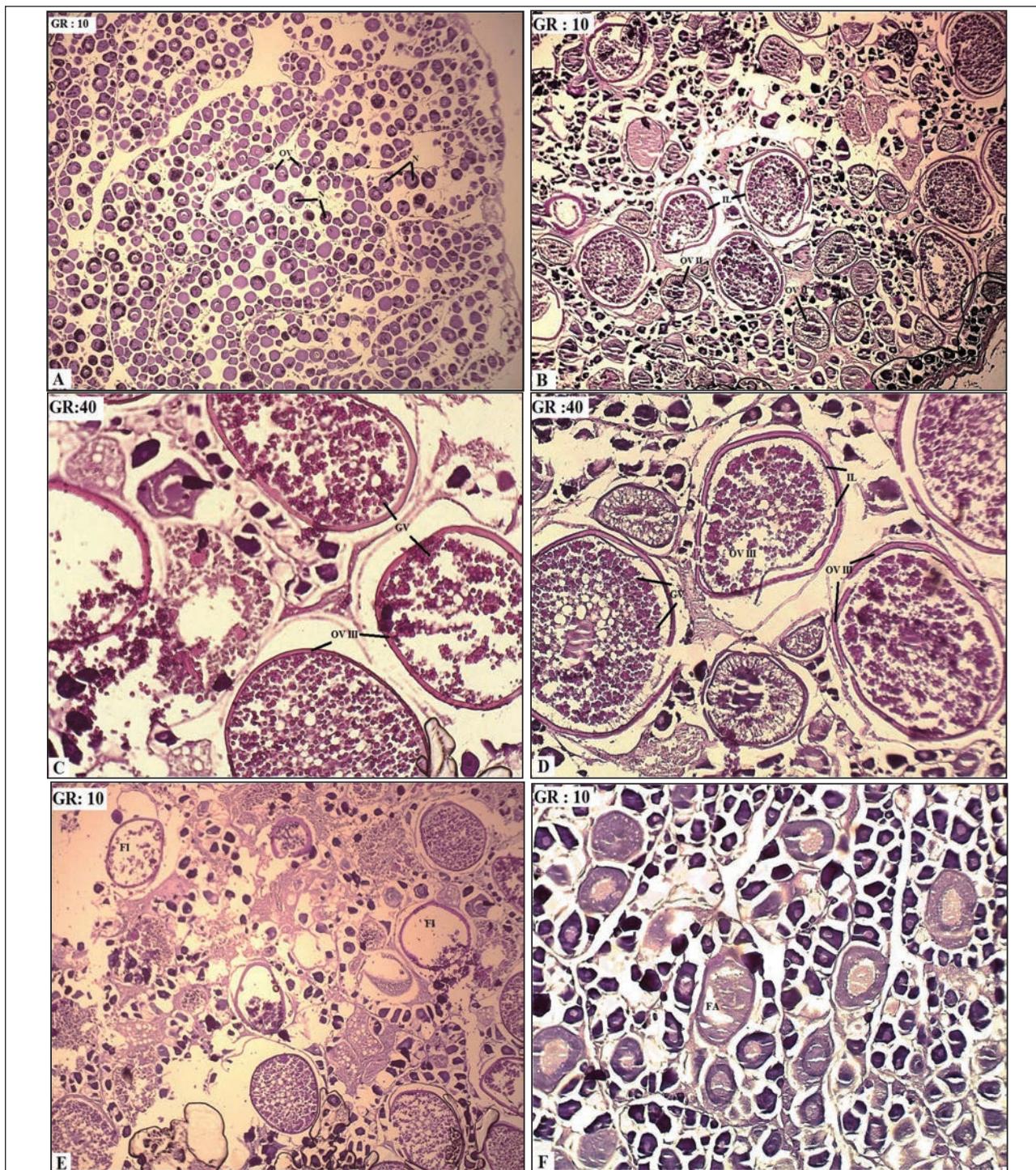


Fig. 2: Histological representation of the four stages of sexual maturity in the females of *Diplodus vulgaris*. A: stage I, immature; B: stage II, beginning of maturation; C, D: stage III, maturation and laying; E, F: stage IV, post laying and sexual rest. Ov: oogonium; Lo: lumen of ovary; Il: lipids inclusions; N: nucleus; Gv: vitelline globule; Ov II: oocyte stage II (beginning of maturation); Ov III: oocyte stage III (mature); FL: empty follicle (post-ovulatory gaps); Fa: atretic follicle.

Sl. 2. Histološki pregled štirih stopenj spolne zrelosti pri samicah fratrov. A: faza I, nezrelo; B: faza II, pričetek zorenja; C in D: faza III, zorenje in izleganje; E, F: faza IV, po izleganju. Ov: oogenij, Lo: lumen ovarija, Il: lipidni vključki, N: jedro, Gv: vitelinska kroglica: Ov II: oocitna faza II (začetek zorenja); Ov III: oocitna faza (zrela); FL: prazen folikel (postovulacijska vrzel); atretični folikel.

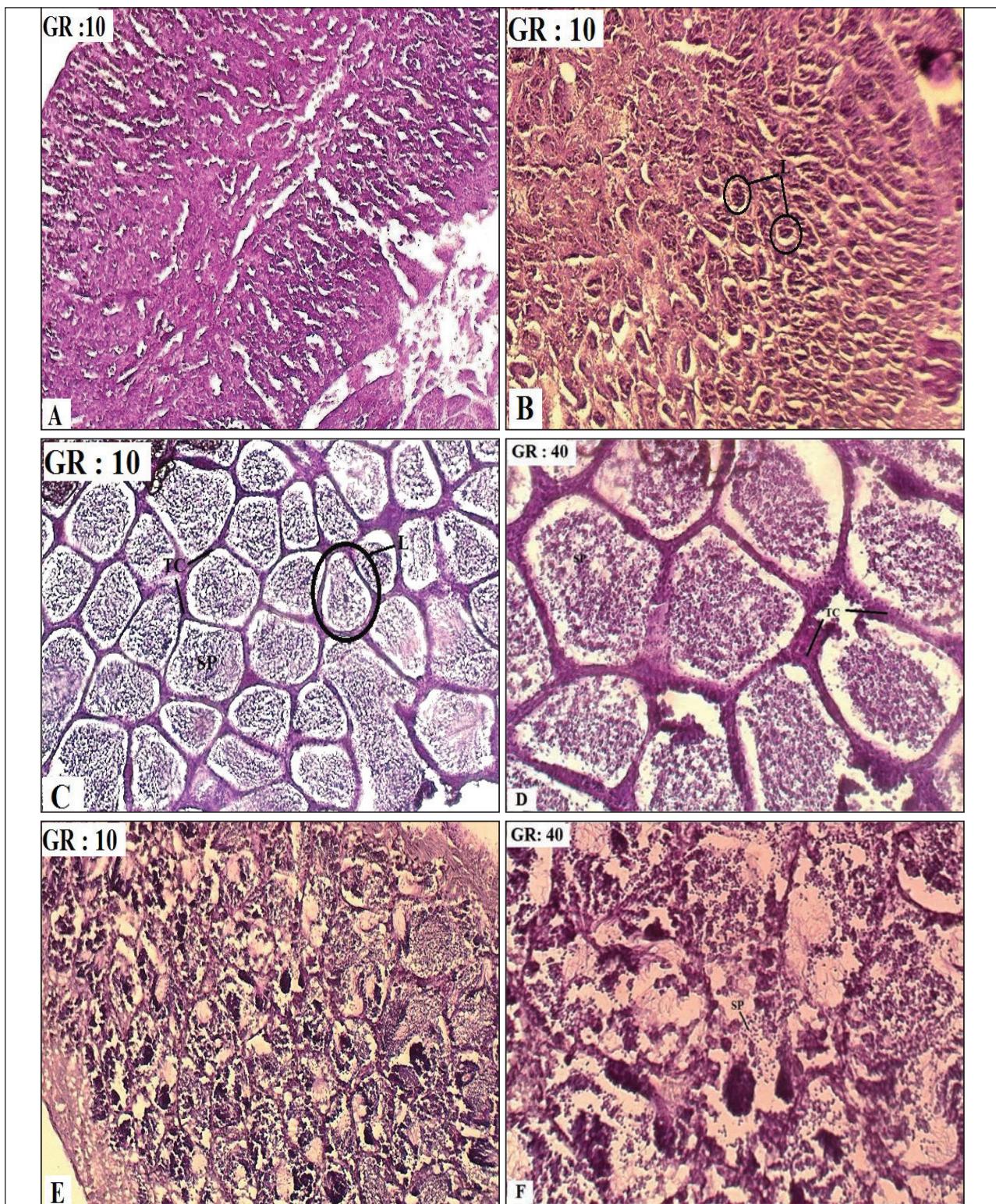


Fig. 3: Histological representation of the four stages of sexual maturity in the males of *Diplodus vulgaris*. A: stage I, immature; B: stage II, beginning of maturation and laying; E, F: Stage IV, post laying and sexual rest. Tc: connective tissue, L: lobule, Sp: sperm.

Sl. 3: Histološki pregled štirih stopenj spolne zrelosti pri samcih fratrov. A: faza I, nezrel; B: faza II, pričetek zorenja in izleganja; E in F: faza IV, po izleganju. Tc: vezivno tkivo, L: lobul, Sp: sperma.

The vitellogenesis stage is characterized by an increase in the size of the oocytes and the deposit of yolk, which will make their cytoplasm increasingly heterogeneous; we also noted the multiplication of follicular cells and thecal cells. In addition, lipid inclusions were observed around the nucleus and at the periphery of the cytoplasm (Fig. 2B).

The end of the vitellogenic stage is marked by hyaline oocytes and followed by the laying, which corresponds to the expulsion of the oocyte wall of its follicular envelope as a result of the destruction of the ovarian follicle wall (Fig. 2C and 2D).

After the laying (Fig. 2E and 2F), any oocytes that are not ovulated will undergo atresia, i.e., degeneration. Only oogonia will remain in the gonads (cellular stock for possible sexual cycles).

The male gonads of *D. vulgaris* are composed of lobules containing cysts filled with spermatogonia. The lobules are separated by connective tissue, during maturation it was observed that the lobules were occupied by cells in advanced spermatogenesis (Fig. 3B, 3C and 3D).

When the wall of the cyst breaks, the sperm floods the spermatic routes. In post-laying the lobules are drained and the lumina narrow (Fig. 3E and 3F).

DISCUSSION AND CONCLUSIONS

According to Konan et al. (2020), the gametogenesis in fish transforms the paramount cells into gametes.

Microscopic analysis was essential to determine the maturation of gametes, as the latter cannot be ascertained by the morphological study of the gonads alone.

We studied the histology of the gonads on a random and monthly sample of *D. vulgaris* fished in the Bay of Beni Saf of the west Algerian coast, during the period from September 2015 to August 2016.

Based on the gonado-somatic index (GSI) and macroscopic observations of the gonads we were able to confirm the period of reproduction, as had been previously demonstrated also in a study by Bouziani et al. (2018). Our results correspond to those provided by Lechkhab (2007) for the Gulf of Annaba, establishing the period of reproduction for *D. vulgaris* to be between November and February, with the egg-laying phase, i.e., the GSI peaking, in January.

According to Lechkhab and Djebbar (2001), before entering the spawning period, the fish undergo a phase of pre-maturation or slow growth, which is characterized by a gradual increase in the value of the gonado-somatic index (GSI). As observed during the phase of maturation, i.e., the pre-laying phase in November and December, the testes start to accumulate increasingly more sperm in the lumina of the seminiferous tubes, whereas the ovaries, containing oocytes at various stages of development, increase in volume owing to the accumulation of vitelline granules.

According to Konan et al. (2020), the testicles delimit a conjunctive network containing the sperm. In each conjunctive network a subdivision of germinal cells that have reached the same development stage takes place in the spermatocytes or cysts.

Bruslé & Quignard (2004) noticed that after spawning, all the oocytes which are not ovulated will undergo atresia, that is, degenerate and become atretic.

Any sexual cells not reaching maturation, whether male or female, gather and transition to a phase of sexual rest, as previously reported by Cassifour (1975).

Information about reproduction and its peculiarities is one of the most important aspects of studying the biology of a given species. It enables the monitoring of the condition of the exploited stock, its renewal and evolution over time and space.

HISTOLOGIJA GONAD PRI NAVADNEM ŠPARU (*DIPLODUS VULGARIS*) IZ ZAHODNE ALŽIRSKE OBALE

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POVZETEK

Avtorji poročajo o raziskavah razmnoževanja pri fratu (*Diplodus vulgaris*) med septembrom 2015 in avgustom 2016 na zahodni obali Alžirije. S histološko analizo so preverjali diferenciacijo in razvoj gonad pri samcih in samicah. Od skupno 472 vzorčenih osebkov je bilo 246 samic, 206 samcev in 20 primerkov nedoločenega spola. Dobljeni rezultati kažejo, da ima ta vrsta jasno opredeljeno obdobje razmnoževanja, ki traja od oktobra do februarja s fazo drstenja v januarju.

Ključne besede: *Diplodus vulgaris*, razmnoževanje, ovariji, moške spolne žleze, zahodna Alžirija

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