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Reproduction Cycle of Striped Venus *Chamelea gallina* from the Black Sea Coast of Turkey

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Abstract: The gametogenetic cycle of striped venus *Chamelea gallina* of southern Black Sea population was studied using standard histological technique and a condition index. There was a synchronism between sexes in terms of gametogenetic development. The beginning phase occurs during spring (March-May) and maturation occurs during Summer (June). Most of the spacemen spawn in July. The gonadal stages were consisted of five phases including primordial, development, mature, spawn and resting. Results obtained in this study fit with seasonal restrictions of *C. gallina* fishery in the Black Sea.

Key words: *Chamelea gallina*, striped venus, Bivalvia, condition index, reproductive cycle, histology

INTRODUCTION

Striped venus (*Chamelea gallina* L., 1758) is an Atlantic-Mediterranean species that inhabits all over the coasts of Turkey. Landings of this clam increased year by year as a result of export demands and reached 47215 tons in 2007 (Anonymous, 2008).

Reproductive cycle is essential to establish the timing of spawning. Several methods are available for determining the gonad development and spawning time of clams such as examination of smears of gonads, annual change at condition index and the histological examination of gonadal tissues. The most detailed information could be obtained from the histological preparation of gonadal samples (Moura *et al*., 2008).

The reproductive cycle of *C. gallina* was described by Salvatorelli (1967), Poggiani *et al.* (1973), Marano *et al.* (1982) and Corni *et al.* (1985) for Adriatic populations and for Atlantic populations (Gaspar and Monteiro, 1998). Deval and Oray (1992) studied the reproduction cycle of *C. gallina* from Marmara and the Black Sea by microscopic examination of smears of the gonads and concluded that spawning occurred from June-September with small differences between the local areas.

The aim of the present study was to investigate, the gametogenetic cycle of *C. gallina* through histological observations. The exact time period for gametogenetic cycle could be used for arrangement of seasonal restriction for landings of this species in Turkey.

MATERIALS AND METHODS

Clams (>20 mm) were collected monthly by divers from depth of 13 m from December 2002 to November 2003. The sampling station was located at Sinop, Southern Black Sea (Turkey) (Fig. 1). Water temperature and chlorophyll-a (Cl-a) values were obtained from a simultaneously ongoing study and shown in Fig. 2 (Sahin, 2005). Live clams were transferred to the laboratory in a cooling box and divided into two subgroups for condition index and gonadal development studies. Monthly Condition Index (CI) of 30 individuals was estimated by using the following Equation (Lutz *et al*., 1980; Karayucel and Karayucel, 1997).

$$CI = \left(\frac{\text{Volume of soft tissue}}{\text{Volume of shell cavity}}\right) \times 100$$

Each month, subsamples of 20 clams were separated for histological aspects. Histological examinations were

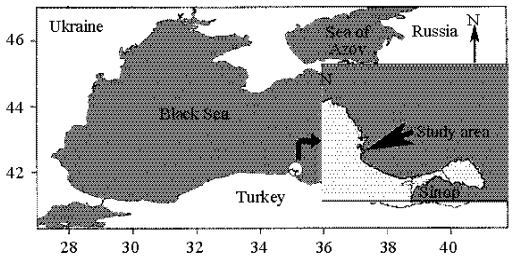

Fig. 1: Map of the study area

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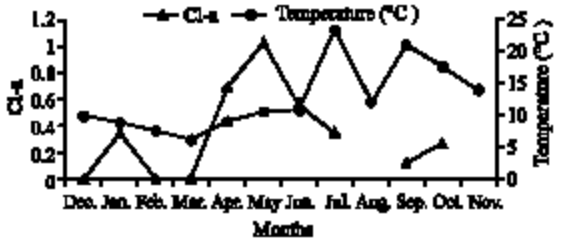

Fig. 2: Annual variation of water temperature and Cl-a (10 m depth) values in the sampling area (Sahin, 2005)

carried out according to the procedure of Laruelle *et al*. (1994) and Corni *et al*. (1985). Soft tissues were removed and fixed in 4% of formalin. Subsequently, samples were dehydrated in ethanol series, embedded in paraffin and sectioned to 4 μm thicknesses with a microtome. Then studied were stained with Harris haematoxylin and contrasted with eosin. After mounting on glass slides, studies were observed under microscope.

A gametogenetic scale was drawn up after examining the histological studies.

RESULTS

Out of 240 specimens, 99 males (41.25%) and 141 females (58.75%) were determined, thus, presenting sex ratio of 1:1.4 (χ^2, $p>0.05$) was not significantly different from 1:1. No hermaphroditism was detected.

Monthly distribution of condition index was shown in Fig. 3. The highest values were in June (55.19±2.74%). The sharp decrease in CI was occurred in July and reached the minimum value in August (33.33±0.00%) and resumed in September.

We established, a five-stage gametogenic scale, as described and illustrated in photomicrographs (Fig. 4 and 5).

Stage 1 (begining gametogenesis): Follicles were observed both in female and male specimens between connective tissue. Follicle size increased and the first previtellogenic oocytes appeared on the follicular wall in females.

Stage 2 (advanced gametogenesis): Amount of connective tissue among the follicles both in males and females was reduced. Pedunculated oocytes were observed in females. Follicles were grown in males.

Stage 3 (ripened): In females, peduncule of oocytes were become thinner and follicles reached their maximum sizes. In males follicles were reached their maximum sizes and bands of spermatocytes could easily be seen.

Fig. 3: Monthly changes in condition index in *C. gallina*

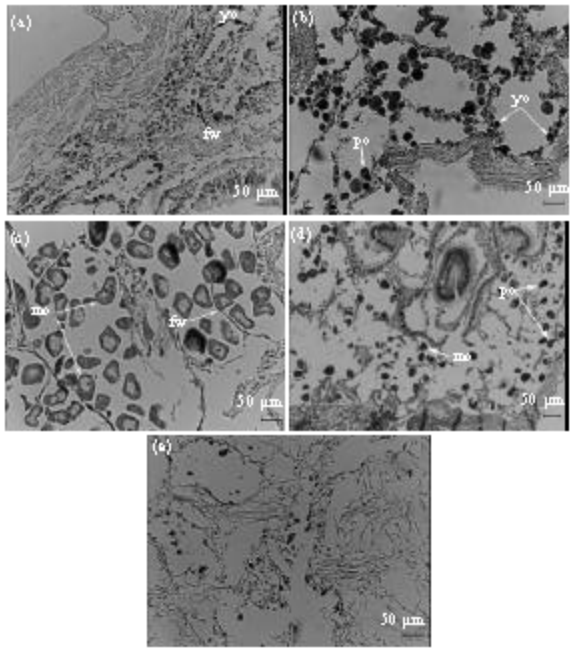

Fig. 4: Photomicrographs showing stages in the development of female gonad: Stage 1 (a) (fw: follicule walls); stage 2 (b) (yo: young oocyte; po: pedunculated oocyte); stage 3 (c) (mo: mature oocytes); stage 4 (d) and stage 5 (e)

Stage 4 (spawning): Regular structure of the follicles was disappeared in females. In males a few number of mature oocytes were present in the follicle. Follicles were clearly visible and the containing spermatocytes band became thinner.

Stage 5 (resting): In both female and male connective tissue were started to surround the gonad area. Gametogenesis finished and a resting stage was started. We observed residual gametes isolated in the tissue, confirming the individual's sex.

In females, orogenic activity was took place between March and August. During March 15% and in April 80% of females were in beginning (stage 1) of gametogenesis

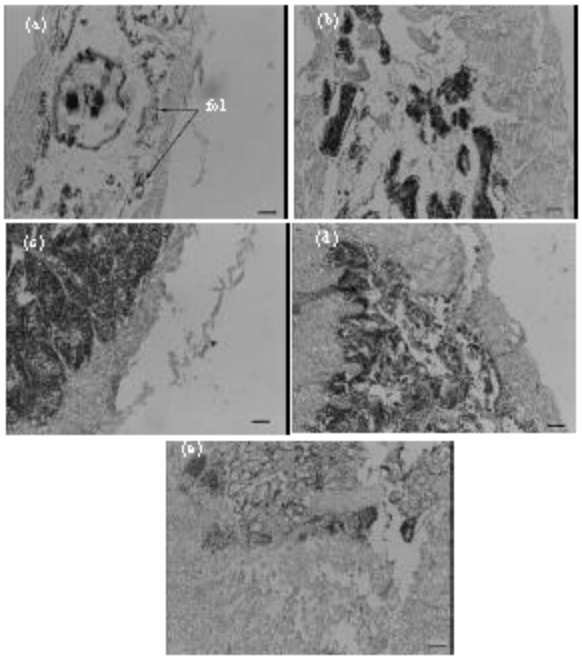

Fig. 5: Photomicrographs showing stages in the development of male gonad: Stage 1 (a) (fol: follicule); stage 2 (b); stage 3 (c); stage 4 (d) and stage 5 (e). Scale bar: 100 μm

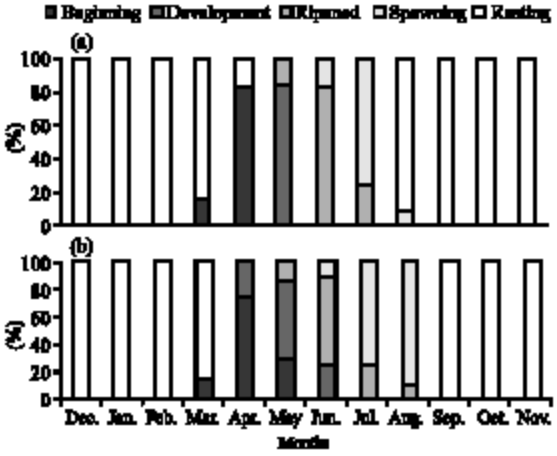

Fig. 6: Monthly gonadal development stages of female (a) and male (b) in *C. gallina*

(Fig. 4a and 6a). About 14, 13 and 29% of males were in the beginning (stage 1) in March, April and May, respectively (Fig. 4b and 6a). Alveoli were displayed rounded shapes and pedunculated oocytes were attached to the inner alveolar walls in advanced gametogenesis (stage 2) of female gonads (during May 85%) (Fig. 4b and 6a). For males in the advanced gametogenesis (stage 2) spermatic series were completed and spermatozoa were grouped in dense packs oriented in a radial form within the alveoli (Fig. 5b). In April and June 25%, in May 57% of males were observed in the advanced gametogenesis (stage 2) (Fig. 6b). Ripened (stage 3) females and males of *C. gallina* were shown in Fig. 4c and 5c. Follicles were completely filled by the mature oocytes and the oocytes stalks became thinner in ripened (stage 3) females and in May 15, June 8% and July 25% of females were in this stage (Fig. 6a). While, follicles were reached their maximum size and spermatocytes bands became thinner in ripened (stage 3) males in May 14, June 63, July 25 and August 11% of the examined males were in this stage (Fig. 6b). First spawning (egg release) was observed during June. About 75% of the females and males were in spawning (stage 4) during July. During August rates of females and males in this stage were 89 and 10%, respectively (Fig. 4d and 5d; 6a, b). During August most of the females (91%) were in resting (stage 5). From September to March all females and males were in resting (stage 5) (Fig. 4e and 5e; 6a, b). Not only gonadal renewal but also gamete emission was occurred in autumn months.

DISCUSSION

It was not possible to establish sex from the color of gonads during the study. There was no sexual dimorphism at the examined specimens. Although, *C. gallina* is reported as a gonochoric species by Froglia (1989) and Corni *et al.* (1985) reported two hermaphroditic specimens at Atlantic populations of *C. gallina*, while hermofrodita was not observed in the present study.

Condition index values were indicated two main peaks (Fig. 3); one in June and second in September. Gradually, decreasing condition index from June-August indicated significant loses in tissue weight or reserves due to release of gametes. A quick recovery was occurred after August and condition index reached second peak in September when, algal blooms occurred in the area. Same results for *Anadara inaequivalvis* (Arcidae) were reported from the southern Black Sea (Sahin *et al*., 2006).

There wasn't any study about the gametogenetic cycle of *C. gallina* distributed along the coasts of Turkey up to this study. According to Marano *et al.* (1982), gametogenesis seems to be almost constant after the spawning (June), with a slow beginning in September to October. Also, Corni *et al.* (1985) reported similar results for Adriatic population of *C. gallina*. Gaspar and Monteiro (1998) declared that gametogenesis for *C. gallina* in Atlantic coasts starts in November and spawning occurs between June and September. According to histological findings of this study, gametogenesis starts in late spring with the increasing of

sea water temperature and chlorophyll a value in the Black Sea. Spawning starts in June when sea water temperature reached to 20°C and carries on during July.

During the study *C. gallina* male and female gonads developed and underwent spawning almost in parallel through time. The synchrony in the timing of gamete release is important for reproductive success and this case was noted for various bivalve populations include *C. gallina* (Gaspar *et al*., 1999; Gaspar and Monteiro, 1998, 1999; Moura *et al*., 2008).

CONCLUSION

In Turkey, there is both seasonal and area restrictions for *C. gallina* fishery. Landing is free in some parts of the Black Sea. Fishing season starts in September and ends in the beginning of May. In this research gametogenetic activity was occurred in seasonal fallowing of *C. gallina* fishing grounds. So, the results of this study were confirmed the present management strategy of this type fishery.

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