

Hermaphroditism among dioecious *Tagelus plebeius* (Lightfoot, 1786) (Mollusca, Psammobiidae) and *Iphigenia brasiliana* (Lamarck, 1818) (Mollusca, Donacidae) on the Cachoeira River Estuary, Ilhéus, Bahia, Brazil

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(With 2 figures)

Abstract

The samples of *Tagelus plebeius* and *Iphigenia brasiliana* were manually collected on the Cachoeira River estuary region (Ilhéus, BA, Brazil) between August 2005 and August 2006, with a periodicity of 15 days, with 20 animals collected/sampled, performing 500 samples from each species. The animals were measured, eviscerated and kept in solution of Davidson and after 24-30 hours, they were transferred to ethanol 70%. The material was processed for routine histology, with paraffin embedding, obtaining 7 µm thick slices, stained with Harris hematoxylin and Eosin (HE). By light microscopy analysis, 2 cases of hermaphroditism (0.4%) in *T. plebeius* samples and one case (0.2%) in *I. brasiliana* were registered with predominance of female over male follicles.

Keywords: Hermaphroditism, *Tagelus plebeius*, *Iphigenia brasiliana*, Cachoeira River estuary, Bahia.

Hermafroditismo nos moluscos dióicos *Tagelus plebeius* (Lightfoot, 1786) (Mollusca, Psammobiidae) e *Iphigenia brasiliana* (Lamarck, 1818) (Mollusca, Donacidae) na região estuarina do Rio Cachoeira, Ilhéus, Bahia, Brasil

Resumo

Os exemplares de *Tagelus plebeius* e *Iphigenia brasiliana* foram manualmente coletados na região estuarina do Rio Cachoeira (Ilhéus, Bahia), entre agosto de 2005 e agosto de 2006, com coleta quinzenal de 20 animais, totalizando 500 exemplares/espécie. Os animais foram mensurados, eviscerados e fixados em solução de Davidson por 24-30 horas e depois transferidos para etanol a 70%. O material foi processado por técnica rotineira de histologia, com inclusão em parafina, obtenção de cortes com 7 µm de espessura e coloração por hematoxilina de Harris e Eosina (HE). A análise em microscopia de luz evidenciou 2 casos de hermafroditismo (0,4%) em *T. plebeius* e um caso (0,2%) em *I. brasiliana* (0,2%), com predominância de folículos femininos sobre os masculinos.

Palavras-chave: Hermafroditismo, *Tagelus plebeius*, *Iphigenia brasiliana*, estuário do Rio Cachoeira, Bahia.

1. Introduction

Knowledge on the sexuality of a molluscan species is necessary for understanding of its life history and the problems of regulation and conservation (Quayle, 1943). The gonad of the molluscs is a tubular organ that consists of acini (follicles) and it is where the gametes and their auxiliary cells develop (Jong-Brink et al., 1983). In Bivalvia, one pair of gonads occurs, which show the tendency to fuse to one unpaired organ (Dohmen, 1983), being derived from two groups of mesodermal cells located in the dorso pericardial region (Lubet, 1996). The reproductive system of the bivalves consists of paired gonoducts, main genital canals, and numerous minor canals which terminate in a network of follicles. The go-

nads are diffuse in many species and may surround other body organs (Sastry, 1979).

Bivalvia is predominantly dioecious. Among them, few species present sexual dimorphism, and in these cases males differentiate from females by gonad colouration. However, there are rare cases where the differentiation is the shape or size of the shell (Sastry, 1979). A few number of bivalves present hermaphroditism, subdivided by Coe (1943) into four categories: functional hermaphroditism (spermatozoa and oocytes are produced simultaneously), consecutive sexuality (with a single reversal in life), rhythmic consecutive sexuality (sex reversal is repeated, either annually or at closer intervals) and alter-

nate sexuality (sex changes occur in adults that function seasonally as separate sexes, and the sex changes are erratic). Hermaphroditism has been recorded in 11 of the 45 bivalve superfamilies (Heller, 1993). Hermaphroditic individuals may occasionally be found among strictly dioecious bivalves (Sastry, 1979; Heller, 1993).

The bivalves *Tagelus plebeius* (Lightfoot, 1786) (Psammobiidae) and *Iphigenia brasiliana* (Lamarck, 1818) (Donacidae) are dioecious species. The stout razor clam *T. plebeius*, popularly known in Brazil as “unha de velha”, is distributed from North Carolina to Florida, Texas, West Indies, Venezuela, Surinam, Brazil to Southern Argentina and inhabits sand and muddy-sand substrates of estuarine regions not deeper than 10 m. The giant coquina or giant false coquina *I. brasiliana* known in Brazil as “tarioba”, is reported to occur in Florida, West Indies, Surinam, Brazil to Uruguay and inhabits sand and sandy mud of shallow waters (Rios, 1994). On the Cachoeira River estuary area (Ilhéus, Bahia), both species are intensely exploited by the human population which lives on the border of the river, either for self-consumption or commercialization. This study is a register of the occurrence of hermaphroditism among *T. plebeius* and *I. brasiliana* in this region.

2. Material and Methods

The samples were collected on the Cachoeira River estuary region (14° 46' 30" S and 39° 03' 20" W) between August 2005 and August 2006, with the primary objective of studying the reproductive cycle and the parasites associated with these species. The samples were collected manually, being the ones from *T. plebeius* in a tidal flat known as “Coroa do Meio” (Middle Crown) and the ones from *I. brasiliana* in the stream bed of the river. The periodicity of the sampling was 15 days, being 20 animals collected, performing 500 samples from each species. The animals had their shells measured (antero-posterior axis), they were eviscerated and kept in solution of Davidson (Shaw and Battle, 1957) and after 24-30 hours, they were transferred to ethanol 70%. The material was processed for routine histology, with paraffin embedding, obtaining 7 µm thick slices and stained with Harris hematoxylin and eosin (HE). Then light microscopy analysis was used. The slices are held by the authors.

3. Results

The samples of *T. plebeius* measured between 36.5 and 68.3 mm of length, being the average 53.2 mm ± 6.6 (n = 500) and the samples of *I. brasiliana* measured between 45.7 and 74.8 mm, being the average 60.2 ± 4.4 mm (n = 500). Among *T. plebeius*, the number of males (M) was 238 (47.6%) and the number of females (F), 229 (45.8%), resulting in a proportion of M:F of 1:0.96. Among *I. brasiliana*, the number of males (M) was 221 (44.2%) and the number of females (F), 245 (49%), resulting in the proportion of M:F of 1:1.1. In 31 samples of *T. plebeius* (6.2%) and in 33 *I. brasiliana* (6.6%), it

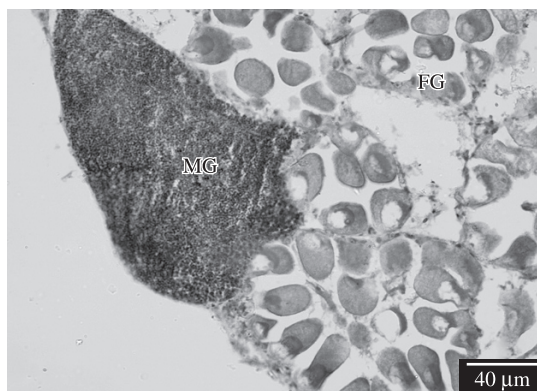


Figure 1. *Tagelus plebeius* hermaphrodite from the Cachoeira River Estuary region, Ilhéus, Bahia, Brazil. MG = Male gonad; FG = Female gonad.

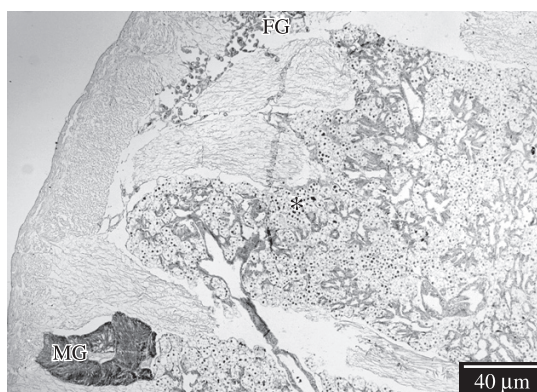


Figure 2. *Iphigenia brasiliana* hermaphrodite from the Cachoeira River Estuary region, Ilhéus, Bahia, Brazil. MG = Male gonad; FG = Female gonad; *gonadal area, not differentiated.

was not possible to check the gender, since these animals have shown themselves sexually undetermined. Two cases of hermaphroditism (0.4%) were registered among the *T. plebeius*, in March and May 2006. In *I. brasiliana* only one case was registered (0.2%), in March 2006. The hermaphrodite specimens of *T. plebeius* measured 59.8 and 48.7 mm and the *I. brasiliana* 48.1 mm of length.

Among the hermaphrodites *T. plebeius*, the predominance of female over male follicles was noticed and the latter occurred chiefly in the peripheral region of the gonad (Figure 1). In *I. brasiliana* the female follicles had a small numeric predominance over the male follicles and both occurred chiefly in the peripheral area of the gonad, constituted by a large internal gonadal area, not differentiated (Figure 2).

4. Discussion

According to Dohmen (1983), the male and female gametes of the molluscs differentiate from sexually non-determined germ cells. In dioecious, the differentiation of

primordial germ cells into male or female gametes seems to be controlled by a neurohormone, the androgenic factor. Experiments with isolated gonads have shown that with the lack of this factor, the cells differentiate into female gametes, while in its presence they differentiate into male gametes. In simultaneous hermaphrodites, like the *Helix aspersa* Muller, 1774, the presence of an androgenic factor has also been demonstrated. However, the issue of how female gametes develop is not known yet. It's believed that the spatial organization of the gonadal acini may contribute to the differentiation of germ cells, since these compartments may provide microenvironmental conditions that control their differentiation.

According to Jong-Brink et al. (1983), histological and embryological evidence among different hermaphrodite mollusc species, have shown that the male and female gametes may be produced in common or different acini, and in the case of different acini, they may be distributed randomly or in special parts over the gonad. Among Pulmonata (Gastropoda), the male and female gametes are produced in common acini, with the female gametes in the periphery and the male gametes in the centre of the acini. On the other hand, among *Hypomenia nierstraszi* van Lumel, 1930 (Aplacophora), the gametes are produced in different acini, the female acini being located in the anterior and the male acini in the posterior of the gonad. In the present study, male and female gametes were located in different acini (follicles). And, mainly among the *T. plebeius*, the male and female follicles have shown to be contiguous being only separated by a small portion of connective tissue.

The sexuality of bivalves may vary among species belonging to the same genus and also within populations of the same species (Heller, 1993). According to Quayle (1943), sex changes in bivalves often occur as a result of age, rapidity of growth, or differences in environment. According to Sastry's revision (1979), it appears that the hermaphroditic state in bivalves might be determined by an interaction of genetic and environmental factors. However, the factors that determine the occasional hermaphroditism in dioecious bivalves are not well known yet. According to Heller's revision (1993),

occasional hermaphrodites have been found in families such as Arcidae (genus *Anadara*), Unionidae (e.g., *Anodonta*), Mytilidae (*Perna*, *Modiolus* and *Mytilus*), Myidae (*Mya*), Pectinidae (*Placopecten*), and Mactridae (*Spisula*), and at least in unionids occasional hermaphroditism has been associated with trematode parasitism. In the present study, the hermaphrodites did not show parasites. The occasional hermaphroditism among the dioecious bivalves *T. plebeius* and *I. brasiliana* on the Cachoeira River estuary might be related to effects of salinity variation and pollution.

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