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# Reproductive biology of two marine catfishes (Siluriformes, Ariidae) in the Sepetiba Bay, Brazil

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**Abstract**

Marine catfish are abundant in the Sepetiba Bay, a 305 km 2 area in Southeast Brazilian coast (Lat. 22º 54□-23º 04□S; Long. 43 o 44□-44 o 10□W), but the knowledge on their biology is still scanty. The reproductive biology of *Sciadeichthys luniscutis* (Valenciennes 1840) and *Genidens genidens* (Valenciennes 1839) was studied through monthly sampling, from October 1998 to September 1999. Fishes were caught with a standardized otter trawl, in the interior of Sepetiba Bay, and near to the confluence with a major freshwater contributor. Six gonadal stages were described, based on macroscopic observations of gonad form, size, weight, color and oocyte diameter, and microscopic observations of differences in size and staining in the nucleus and cytoplasm structures, as viewed through a light microscope. Changes in the gonadosomatic index (GSI) and in stages of gonadal development showed what *S. luniscutis* spawned in Spring, while *G. genidens* spawned in Summer. Total spawning was shown for both species as indicated by high concentration of post-ovulatory follicles in spent stages. Fecundity was low (14-38 vitellogenic oocytes for *S. luniscutis* and 6-24 for *G. genidens*), when compared with other teleosts. Low fecundity and separation in spawning period suggest that both species are k-strategist, able to avoid interspecific competition in early stages of life cycle to optimize the use of the available niche.

**Keywords**: reproduction, spawning, fecundity, reproductive strategies, Ariidae.

Marine catfish are very abundant along the East Coast of South America being common in shallow, muddy coastal areas (Araújo 1988). In southern Brazil, they play an important role as a major resource in artisanal fisheries. Most catches coincide with the seasonal reproduction migrations of adults into estuaries and lower river reaches. In the Sepetiba Bay, the members of the Ariidae family *Sciadeichthys luniscutis* (Valenciennes 1840) and *Genidens genidens* (Valenciennes 1839) are among the most abundant fish in otter trawling, ranking first (18.8% of all fish) and third (6.4% of all fish) in numbers of individuals, respectively (Araújo *et al.* 1998).

Studies of reproduction in fishes, such as duration of spawning season and fecundity, require knowledge of the stage of gonad development in individual fish. The methods used in such studies are generally based on the visual external appearance of the gonad. This is probably the most rapid but least certain technique, and a more detailed analysis requires the use of histological methods (West 1990). Little is known of the reproductive biology of Ariid fishes, in spite of their wide distribution and abundance along the Brazilian coast. Most works on reproductive biology of Ariids in Brazil aimed to determine season period and fecundity based on only macroscopic observations and have pointed for a wide spawning season from early Spring to late Summer. These are the case of Barbieri *et al.* (1992) which pointed October to February as spawning season for *G. genidens* in the Jacarepaguá lagoon system, Rio de Janeiro State. Mishima and Tanji (1983) described the reproductive biology of several species of Ariidae in Cananéia lagoon-estuarine system, São Paulo State, but the small number of fish specimens prevented detailed conclusions on seasonal period and fecundity. Gomes *et al.* (1999) analyzed the reproductive biology of *G. genidens* e *C. spixii* and found superposition in the season period for these species in Sepetiba Bay. Mazzoni *et al.* (2000) described the reproductive biology of *G. genidens* in the Maricá Lagoon system, Rio de Janeiro State and found that this species had a total spawning and breeding season occurring between December to Abril. Despite all the above cited works had shown some conclusion about the spawning period,

none of them were based on histological studies and no detailed description of oogenesis or spermatogenesis was given to support their definition of sexual maturity. As the gonadosomatic index (GSI) has been the only parameter to indicate spawning period, imprecision in the results could occur. The aim of this paper is to describe the gonadal cycle, pattern of oocytes and spermatocytes development, period of spawning and fecundity of *S. luniscutis* and *G. genidens* in the Sepetiba Bay and to present additional information on the reproductive strategy for these species.

**Materials and methods** This study, examined 162 specimens of *S. luniscutis* and 143 specimens of *G. genidens* caught monthly by an otter trawl, from October 1998 to September 1999, in the interior of the Sepetiba Bay (Lat. 22º 54□-23º 04□S; Long. 43º 34□-44º 10□W), and by gill nets, near to the mouth a major bay□s tributary (Guarda River). Sepetiba Bay is a 305 km$^2$ coastal lagoon with a wide communication with the sea (Fig. 1), at Rio de Janeiro State. The maximum depth is 30 m, near the sea, but most of the Bay presents an overall average depth of 5 m. Substrate is mainly mud flats with patches of gravel and sand; tidal amplitude is 1.5 m.

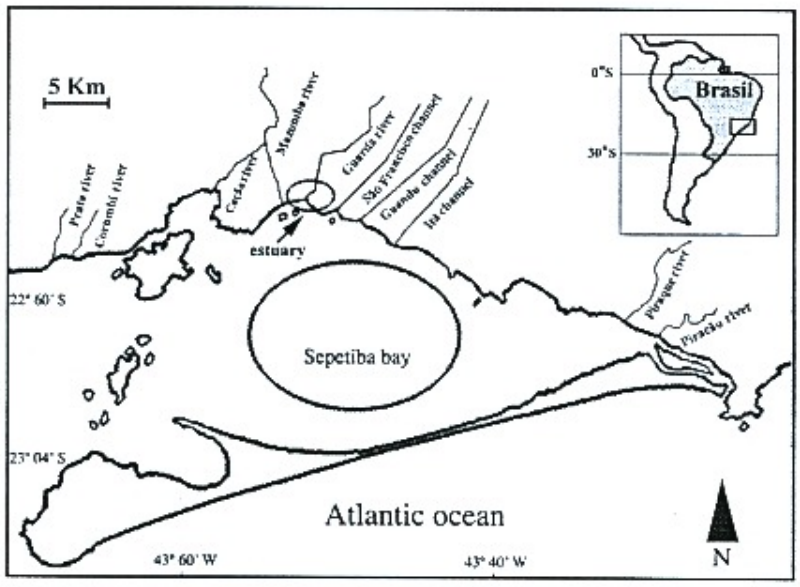


Fig. 1. Map of the Sepetiba Bay, Rio de Janeiro State, Brazil, with indications of the two sampled zones: Sepetiba Bay and Guarda River estuary.

Individuals were processed in the laboratory and the following measurements were made: total length (TL) with precision of 0.1 mm, total weight (TW) with precision of 0.1 g, gonad weight (GW) with precision of 0.01 g, and sex. Gonad maturity stages were assigned as immature, initial maturity, final maturity, ripe, spent and recovering-spent, according to Vazzoler (1981, 1996), and subsequently the assignment was checked by histological analysis. These six maturity stages were identified according to the vascular irrigation intensity, color and percent volume of abdominal cavity occupied by gonads. Thereafter, gonads were fixed in buffered formaldehyde (30 h). After fixation, the gonads were dehydrated and embedded in paraffin wax. Longitudinal or cross-sections, 5 µm thick, were stained with haematoxylin-eosin.

Oocytes were classified according to their morphology, their affinity for the dyes used, and the presence of specific inclusions (lipid droplets, yolk granules, yolk vesicles). Histological identification of the various maturity stages was determined according to the development of the germinate cells in the ovary and testis and also by the presence-absence of different types of oocytes (i.e. whether organized by ovarian lamellae or not) and spermatocytes with description according to Narahara (1991).

Gonad cycle was determined from changes in gonad weight, as shown by the gonadosomatic index (GSI = gonad weight / total fish weight x 100) and by temporal changes in percent distribution of the stages of maturity. Batch fecundity was estimated by counting the total number of mature eggs in both ovaries.

**Results**

**Anatomy of the gonads**

The gonads of the marine catfish, as in most of the teleosts, are structures of similar size, elongated, located dorsally into the abdominal cavity and lead to a common orifice at the level of the anus. Ovaries and testis are separated by connective tissue and are situated ventrally to kidneys and swim bladder.

The ovaries are fairly cylindrical, the oviducts are posterior continuations of the ovarian tunic, which is formed by a capsule of conjunctive tissue constituted by muscular fibers and blood vessels. The ovary consists of a series of ovarian lamellae, radially oriented towards the lumen and containing oocytes at different stages of development, in agreement with the maturation stage of the ovary (Fig. 2). Ovarian follicles developed from or in association with the germinal epithelium, which covers the surface of the ovary as an extension of the peritoneum.

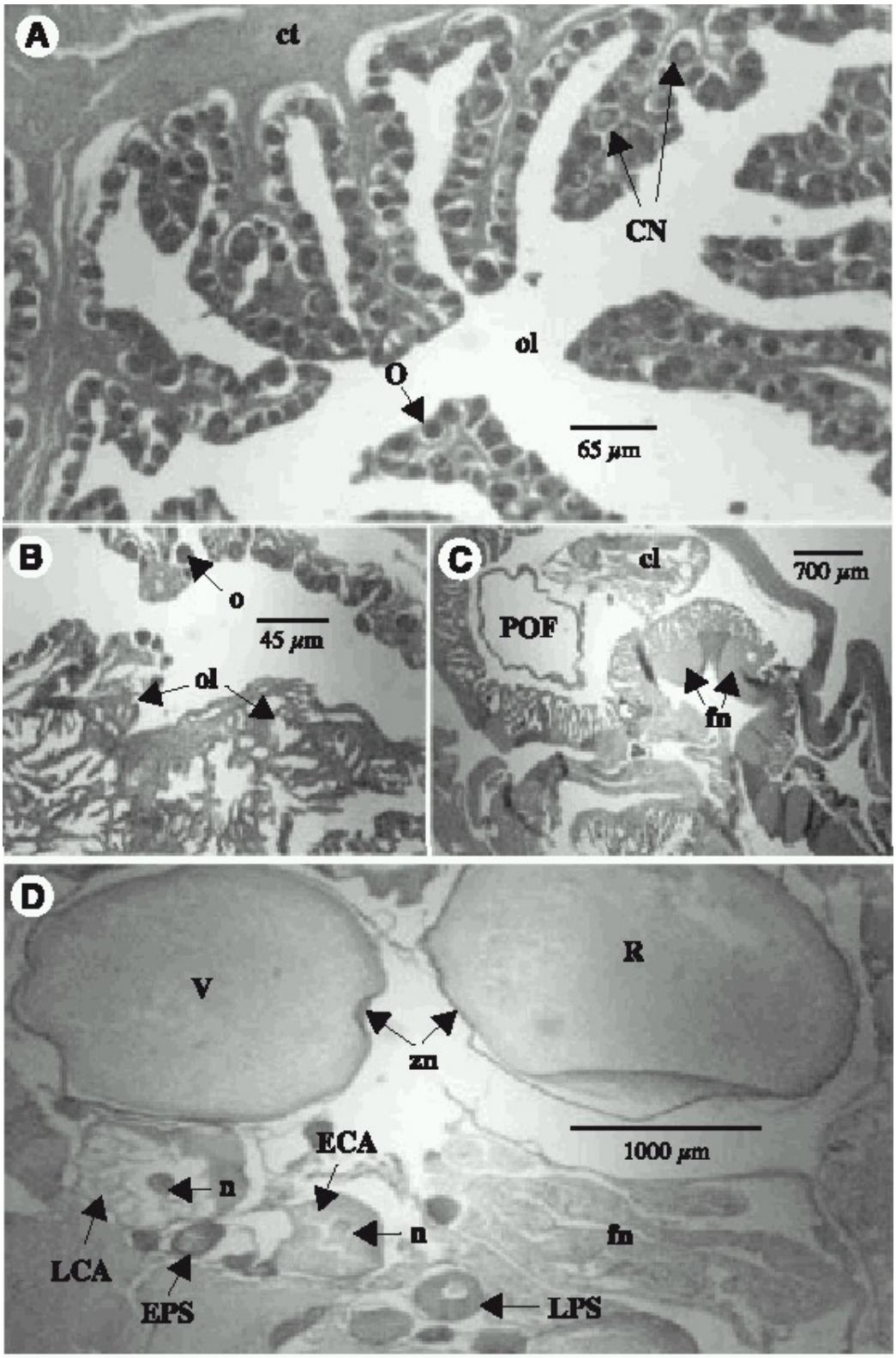


Fig. 2. Transversal section of ovaries and their structures with oocytes in various stages of development. *G. genidens* (a,b) and *S. luniscutis* (c, d). *O* oogonia; *CN* chromatin nucleolar; *EPS* early perinucleolar stage; *LPS* late perinucleolar stage; *ECA* early cortical alveoli; *LCA* late cortical alveoli; *V* vitellogenic; *R* ripe; *POF* post-ovulatory follicles; *CL* corpora lutea; *fn* fibrous nodule; *ol* ovarian lamellae; *n* nucleus; *zr* zone radiate; *ct* conjunctive tissue (haematoxylin and eosin stain).

The testis are elongated openings in the spermatic duct in its posterior extremity, and involved by a capsule of conjunctive tissue, denominated tunic albuginea (Fig. 3). Seminiferous tubules, cysts and sperms ducts are bounded by a layer of connective tissue and contain cells at different stages of development, depending on the maturation stage. In the seminiferous tubules are found different types of spermatogenetic cells, while in the cysts only cells groups in the same development stage are found. In mature testis, the seminiferous tubules are filled with spermatozoa.In the tubular testis, the resting germinate cells are particularly evident and packed together at the blind ends of the tubules near the periphery, but many of them migrate or are displaced along the walls of the tubules.

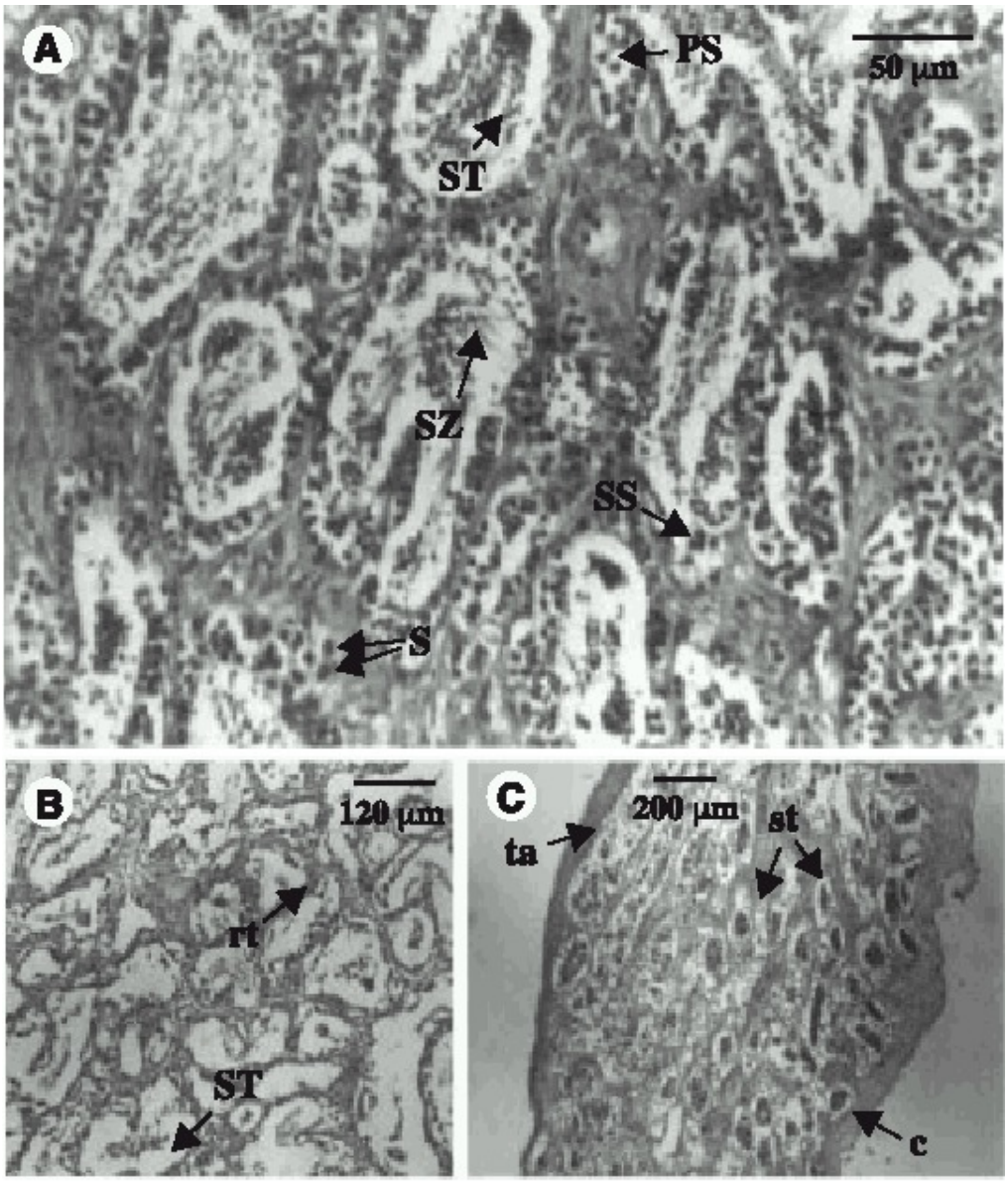


Fig. 3. Transversal section of testis and their structures with spermatocytes in various stages of development. *S. luniscutis* (a); *G. genidens* (b, c); *S* spermatogonia; *PS* primary spermatocytes; *SS* secondary spermatocytes; *ST* spermatids; *SZ* spermatozoa; *st* seminifeous tubules; *cs* cysts; *ta* tunica albuginea; *rt* reorganization tubular.

**Stages of development of the oocytes**

A description of the different stages of development of the oocytes follows. The terminology proposed by West (1990) is used: The oogenesis (Fig. 2) consists in a growth of oocytes during the reproductive process, including the Eugenia, vitellogenesis and ripe to post-ovulatory follicles. There is no remarkable difference in the stages of development of the oocytes among the two species of marine catfishes in this study *Oogonia* (Fig. 2a,b). Spherical to slightly oval in shape. Average diameter = 22 ± 2.3 µm standard error. Sited on periphery of the ovarian lamellae, isolated or forming cyst. They are the smallest cells of the germinate lineage. At an early stage, the oogonia which arise from primordial sexual cells either in or near the germinal epithelium become surrounded by a layer of small epithelial cells to form the ovarian follicle.

*Chromatin nuclear stage* (Fig. 2*a*). Similar to oogonia, although somewhat larger (Average diameter = 46 ± 2.5 µm). Large nucleus, reduced cytoplasm, with little or no affinity with dyes used. They are originated from the oogonias and located close to them.

*Perinucleolar stage* (Fig. 2d). In the early stage size increases (Average diameter = 129 ± 9.3 µm). Cytoplasm with strong affinity for haematoxylin. In the late stage occur a faster growth (Average diameter = 273 ± 22 µm), and a progressive loss of affinity for haematoxylin. Nucleus is more evident, generally peripheral, next to nuclear membrane.

*Cortical alveoli* (Fig. 2d). Yolk vesicles (see Selman *et a*l. 1988) containing "intravesicular yolk" (Marza *et al.* 1937) present in cytoplasm, with little affinity for haematoxilin. The early cortical alveoli oocytes increase progressively in both number and size. Average diameter of oocyte is 374 ± 3 µm. Progressive loss of affinity by cytoplasm for haematoxilin. Zone radiata (Fig. 2 d) starting to be visible, although is not yet stained by eosin. Accumulation of lipid inclusions in cytoplasm has begun (Late cortical alveoli; Average diameter = 655 ± 23 µm).

*Vitellogenesis* (Fig. 2d) Yolk granules or yolk globules present. Yolk vesicles increase in size (Average diameter = 1578 ± 59 µm) and gravitate towards periphery while the yolk granules grow. Zone radiata is dyed with eosin. Yolk granules and oil drops present.

*Ripe* (Fig. 2d). Yolk granules are fused in homogeneous mass, creating "hyaline oocyte" (Howell 1983) or hydrated oocyte (Hunter and Macewicz 1985). Nucleus is not visible due to disintegration of nuclear membrane and dispersion of its contents in the cytoplasm. When oocyte reaches hydrated stage, spawning is imminent (Hunter *et al*. 1986). Average diameter of hydrated oocytes for *S. luniscutis* is 8618 ± 1183 µm, slightly larger than *G. genidens* (Average diameter = 6877 ± 1239 µm). The zone radiata is thicker.

*Post-ovulatory follicle* (Fig. 2c). Presence of empty space caused by oocytes mature that are forced into the lumen of the ovary, and are then extruded from the follicular layers. Such follicles will originate structures denominated corpora lutea (Fig. 2c). After the reabsorption inside the follicle, fibrous nodules (Fig. 2c) will be formed.

*Atresic oocytes.* Characterized by intense cellular disorganization. Such oocytes, although can occur in maturation stage, are common in ripe stage, due to break of zone radiate. They are irregular in diameter reflecting different stages of disintegration.

**Stages of development of the spermatocytes**

A description of the different stages of development of the espermatocytes is shown as follow. The terminology proposed by Hoar and Randall, 1969) for teleosts is used. The espermatogenesis (Fig. 3) consists in a process which involves a proliferation of spermatogonia through repeated mitotic divisions and growth to form primary spermatocytes; these then undergo reduction division to form secondary spermatocytes; the division of the secondary spermatocytes produces spermatids which then metamorphose into the motile and potentially functional gametes (spermatozoa). Spermatogenic cells appear in the interior of the seminiferous tubules (Fig. 3) at different stages during spermatogenesis (spermatogonia, primary and secondary spermatocytes, spermatids and spermatozoa) forming cysts.

*Spermatogonia* (Fig. 3a). They are the largest cells of the germinative lineage, which could occur isolated or in groups inside the cysts in the seminiferous tubules. They present spherical form, not very colored to the applied coloration techniques. Appearance of spermatogonia is generallly associated with tunica albuginea (Fig. 3c).

*Primary spermatocytes* (Fig. 3a*).* Smaller than spermatogonias, from where they are originated. Nucleus is strongly stained with haematoxilin and cytoplasm has little affinity for dyes.

*Secondary spermatocytes* (Fig. 3a). They present little morphologic variation, being therefore slightly different from primary spermatocytes. Somewhat smaller than primary spermatocytes, with nucleus that stains weakly.

*Spermatids* (Fig. 3a, b). Originated from secondary spermatocytes, occur in cysts and in the interior of the seminiferous tubules. Nucleus has denser and more uniform chromatin.

*Spermatozoa* (Fig. 3b,c) They are the smallest germinative cells, without to consider the length of the tail. They occur in the interior of the seminiferous tubules and sperm duct; with very basophilic nucleus and large eosinophilic tail.

**Stages of sexual maturation**

Gonadal maturation were classified in agreement with macroscopic and microscopic observations of the 6 phases: immature, mature I, mature II, Ripe, Spent and Recovering. Such phases are based on the scale of maturity defined by Vazzoler (1981) and are adapted for the marine catfishes (Tables 1 and 2) in agreement with the histological and macroscopic aspects of the ovaries and testicles.

TABLE 1
*Macroscopic and microscopic characteristics of the ovaries in* S. luniscutis *and* G. genidens

| Maturity stages | Macroscopic | Microscopic |
|---|---|---|
| Inmature | Ovaries slender, whitish and translucent. Small, filiform, occupying less than one-third of abdominal cavity. Oocytes very small, not visible to bare eye. | Oogonia in a serial of ovarian lamellae. Oocytes in nucleolar chromatin and Perinucleolar stages with higher Frequency. |
| Mature I | White to pale cream color, subtle granulation visible to bare eye. Signs of enlargement take up half of abdominal cavity. Oocytes visible by bare eye . | Ovarian lamellae, oocytes from nucleolar Chromatin to cortical alveoli oocytes. This later in bigger number and size. |
| Mature II | Whitish-yellow, higher enlargement in the anterior | Higher concentration of cortical alveoli oocytes. |

| | | |
|---|---|---|
| | portion than Mature I stage. Lobular, fills two-thirds of abdominal cavity. Oocytes mature. | Presence of oocytes of all anterior stages. |
| Ripe | Yellowish, volumous, with blood vessels, taking up two-thirds of abdominal cavity. Oocytes vitellogenics, golden-yellow, higher diameter than Mature II stage. | Presence of vitellogenic oocytes and higher concentration of ripe. |
| Spent | Flaccid, wrinkled, showing smaller size than Ripe stage, occupying nearly half of abdominal cavity. Hemorrhagic appearance. Oocytes heterogeneous, some residual or in degeneration. | Post-ovulatory follicle in higher concentration. |
| Recovering | Pale cream color, with higher enlargement than to anterior stage, takes up less than one-third of abdominal cavity. Oocytes, showing a cream to brown color, some residual forming patches. | Presence of fibrous nodules. Presence of oocytes from oogonias to perinucleolar stages. |

TABLE 2
*Macroscopic and microscopic characteristics of the testis in* S. luniscutis *and* G. genidens

| Maturity stages | Macroscopic | Microscopic |
|---|---|---|
| Immature | Testis unrecognizable. Translucent. Filiform, enlarged, occupying less than one-third of abdominal cavity. | Testis formed by spermatogonia, not organized in tubules. |
| Mature I | Testis showing white to pink color, with a visible enlargement than Imature stage, occupying about one-third of abdominal cavity. | Testis arranged in tubules with spermatogonias, spermatocytes and spermatids. |
| Mature II | Testis white and developed, occupies less than half of abdominal cavity. Testis' weight heavier than Mature I stage. | Seminiferous tubules contain all spermatogenic cells, with highest concentration of spermatids. |
| Ripe | Highly developed, cream colored testis, occupying more than two-third of abdominal cavity. | Seminiferous tubules filled with spermatozoa, easily expelled out of testis under slightly pressure. |
| Spent | Flaccid gonad occupies nearly half of the abdominal cavity. | Testis in regression. Cells appear fused. Higher frequency of primary and secondary spermatocytes. |
| Recovering | Testis pale cream color, more consistent, occupying less than one-third of abdominal cavity. | Tubular reorganization, with frequent spermatogonias in formation. |

**Spawning season**

Highest GSI monthly average was recorded in October for *S. luniscuti*s, and in January for *G. genidens* (Fig. 4). The changes shown in the GSI for both species were in general agreement with the trend observed in the percentage or mature individuals (Tables 3 and 4). The greatest mean GSI for *S. luniscutis* in September/October; ovaries and testis in ripe stage occurred chiefly in October, while

females in spent stage occurred mainly in February (Table 3). GSI values for *G. genidens* began to increase in December and reached a maximum in January; the higher proportion of ovaries and testis in ripe stage occurred in January, while females in spent stage occurred mainly in March/April (Table 4).

TABLE 3
*Monthly distribution of individuals of* Sciadeichthys luniscutis *as a function of maturity stage*
(I *immature;* MI *mature I;* MII *mature II;* R *ripe;* S *spent;* RE *recovering)*

| Year/Month | Maturity stage | Females | | Males | |
|---|---|---|---|---|---|
| | | n | (%) | n | (%) |
| 1998 | | | | | |
| O | I | 0 | (0) | 1 | (1.8) |
| | MI | 0 | (0) | 4 | (6.9) |
| | MII | 3 | (10.0) | 6 | (10.3) |
| | R | 25 | (83.4) | 47 | (81.0) |
| | RE | 2 | (6.6) | 0 | (0) |
| N | MI | 1 | (12.5) | 1 | (50.0) |
| | MII | 3 | (37.5) | 0 | (0) |
| | R | 0 | (0) | 1 | (50.0) |
| | S | 4 | (50.0) | 0 | (0) |
| D | MI | 2 | (66.6) | 1 | (9.0) |
| | MII | 1 | (33.4) | 1 | (9.0) |
| | R | 0 | (0) | 9 | (82.0) |
| 1999 | | | | | |
| J | I | 0 | (0) | 1 | (100) |
| | MI | 1 | (100) | 1 | (100) |
| F | MI | 0 | (0) | 1 | (25.0) |
| | R | 0 | (0) | 2 | (50.0) |
| | S | 6 | (100) | 1 | (25.0) |
| M | S | 4 | (100) | 0 | (0) |
| | RE | 0 | (0) | 1 | (100) |
| A | S | 3 | (100) | 1 | (100) |
| M | I | 1 | (33.3) | 0 | (0) |
| | MI | 1 | (33.3) | 0 | (0) |
| | MII | 1 | (33.4) | 1 | (50.0) |
| | S | 0 | (0) | 1 | (50.0) |

| | | | | | |
|---|---|---|---|---|---|
| J | - | 0 | (0) | 0 | (0) |
| J | MI | 1 | (33.4) | 0 | (0) |
| | MII | 2 | (66.6) | 0 | (0) |
| | R | 0 | (0) | 3 | (100) |
| A | MII | 2 | (100) | 1 | (50.0) |
| | R | 0 | (0) | 1 | (50.0) |
| S | R | 11 | (100) | 2 | (100) |

TABLE 4
*Monthly distribution of individuals of* Genidens genidens *as a function of maturity stage*
(I *immature;* MI *mature I;* MII *mature II;* R *ripe;* S *spent;* RE *recovering)*

| Year/Month | Maturity stage | Females | | Males | |
|---|---|---|---|---|---|
| | | N | (%) | N | (%) |
| 1998 | | | | | |
| O | I | 1 | (8) | 8 | (72.7) |
| | MI | 5 | (42) | 3 | (27.3) |
| | MII | 3 | (25) | 0 | (0) |
| | R | 3 | (25) | 0 | (0) |
| N | I | 2 | (66.6) | 6 | (75) |
| | MI | 1 | (33.4) | 0 | (0) |
| | R | 0 | (0) | 2 | (25) |
| D | MI | 1 | (11.1) | 2 | (25) |
| | MII | 4 | (44.5) | 1 | (33.4) |
| | R | 4 | (44.4) | 1 | (33.3) |
| 1999 | | | | | |
| J | I | 1 | (7) | 1 | (7.7) |
| | MI | 2 | (15) | 2 | (15.4) |
| | R | 8 | (63) | 8 | (61.5) |
| | S | 2 | (15) | 2 | (15.4) |
| F | MI | 1 | (33.4) | 0 | (0) |
| | MII | 1 | (33.3) | 0 | (0) |
| | R | 1 | (33.3) | 1 | (100) |

| | | | | | |
|---|---|---|---|---|---|
| M | I | 0 | (0) | 1 | (5) |
| | MI | 0 | (0) | 11 | (67) |
| | R | 0 | (0) | 1 | (6) |
| | S | 8 | (100) | 3 | (17) |
| | RE | 0 | (0) | 1 | (5) |
| A | I | 1 | (14.3) | 0 | (0) |
| | MI | 0 | (0) | 5 | (100) |
| | S | 6 | (85.7) | 0 | (0) |
| M | MI | 2 | (34) | 1 | (50) |
| | S | 1 | (16) | 1 | (50) |
| | RE | 3 | (50) | 0 | (0) |
| J | I | 0 | (0) | 1 | (16.6) |
| | MI | 0 | (0) | 2 | (33.4) |
| | MII | 2 | (100) | 3 | (50) |
| J | MI | 2 | (40) | 1 | (50) |
| | MII | 2 | (40) | 3 | (20) |
| | RE | 1 | (20) | 1 | (60) |
| A | MI | 1 | (100) | 1 | (25) |
| | MII | 1 | (100) | 1 | (25) |
| | R | 0 | (0) | 1 | (50) |
| S | - | 0 | (0) | 0 | (0) |

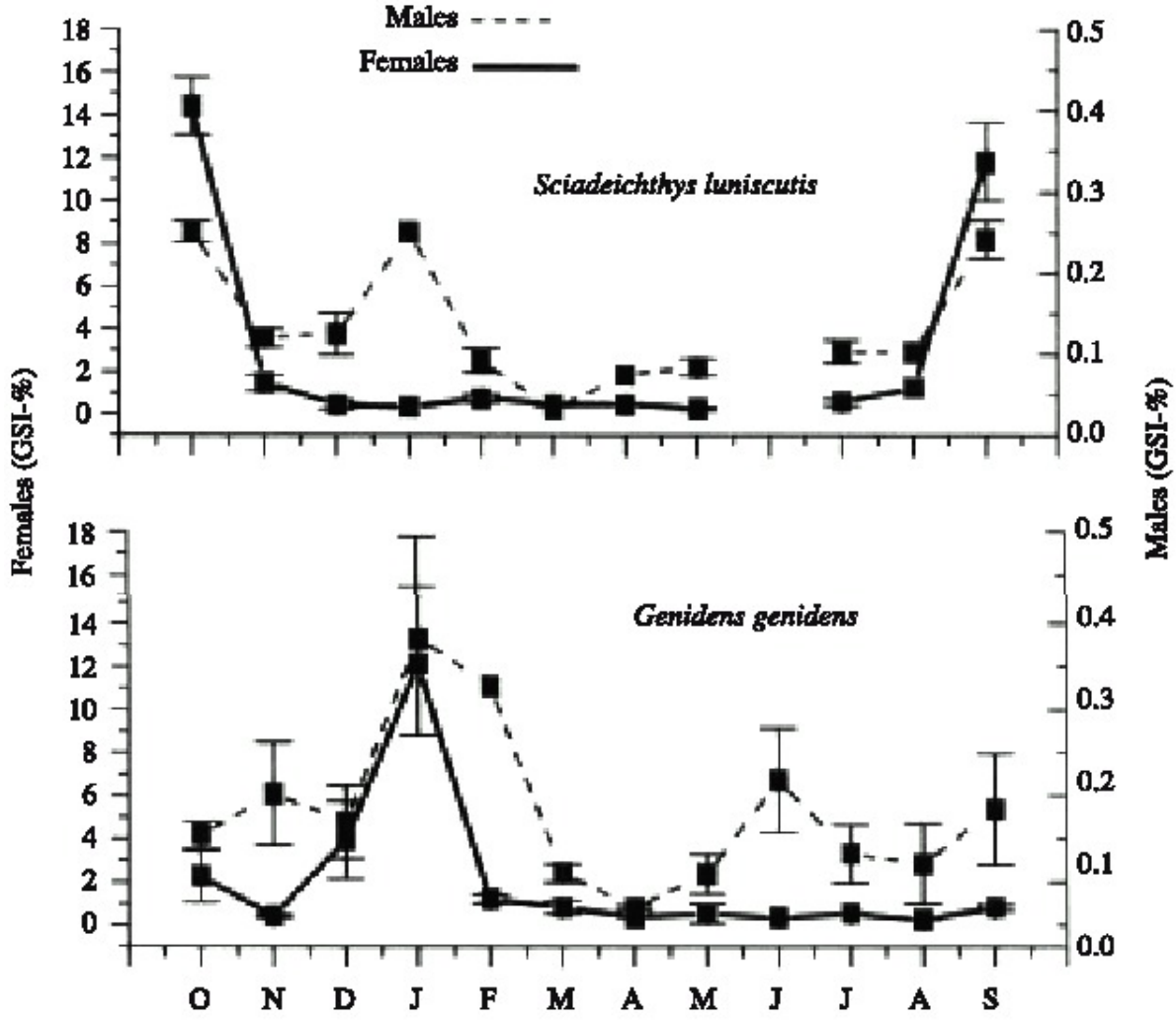


Fig. 4. Monthly mean variation (± standard error as vertical lines) of the gonadosomatic index - GSI for *S. luniscutis* and *G. genidens* in Sepetiba Bay, Brazil.

### Fecundity

Maximum, minimum and mean values of fecundity for *S. luniscutis* was 38, 14 and 26 respectively in 30 females examined, while for *G. genidens* was 24, 6 and 15 respectively in 22 females.

Females in ripe stage ranged from 255 to 397 mm TL for *S. luniscuti*s, and from 180 to 277 mm for *G. genidens*, while brooding males, ranged from 284 to 410 mm for *S. luniscutis* and from 191 to 252 mm for *G. genidens*.

### Discussion

The description of the phases of gonadal development is of great importance for understanding the dynamics of the gonad and to assess reproductive mechanisms of a species. Macroscopic examination and histological analysis of the gonads of *S. luniscutis* and *G. genidens* revealed that in the maturation process the ovaries and testis underwent gradual macroscopic modifications but it is the microscopic characteristics that define the stage. As ovaries develop, they present accentuated differences in size and form. The mature stage is well evidenced by its largest volume, corresponding to increasing size of cells of the germinative lineage. Variations in the form occur, starting from the filiform appearance of the immature stage, becoming lobular along the maturation process, and resulting wrinkled after spawning. Afterward they became turgid and lobuled, characterizing the starting of the recovering stage. The origin of yolk-vesicle formation is still object of some discussion, and the mechanisms of its formation are not clear. As this type of cell developed, it is shown a migration toward the cytoplasm to the zone radiata and break up during the fertilization for liberation of its content between the zone radiata and the cytoplasm surface, avoiding the polysperm (Hoar and Randall 1969). Various stages of oocytes development have been classified, varying in number of phases, from too brief to too complicated. In general, the ovarian development process in teleost can be divided into two phases (Wallace and Selman 1981); the previtellogenic phase, when growth is comparatively slow, with few cytoplasmic changes, and the vitellogenic phase, characterized by faster growth and the deposition of large amounts of yolk in the ooplasma.

The testis did not show accentuated differences in size and form, being prolonged and filiform. The spermatogenesis, on the other hand, did not present the remarkable variations over the development process as the oogenesis, with gradual decreasing from spermatogonia to spermatozoa. The increase of the volume of the testis in the mature phase corresponds to the contribution of the seminiferous tubules, where cells of different spermatogenic lineage, mainly spermatozoa, are contained in the seminal fluid (Hoar and Randall 1969).

The marine catfish studied did not present the stage semi-spent, found by Narahara *et al.* (1988), characterized by the decrease of the gonad size, associated with the presence of blood vessels together with ripe and other oocytes in different stages of development. This situation is typical for multiple spawning fish with asynchronic ovarian development. In this study, in the spent stage, the females presented high concentrations of post-ovulatory follicles, as result of the total liberation of the ripe oocytes, characterizing a single annual spawning, and synchronic ovarian development.

GSI has been used thoroughly as indicator of the spawning period in teleosts (De Vlaming 1972) and its use in reproductive biology has been considered more appropriate when associated with other indicators of the reproduction, as histological techniques and macroscopic observations (DeMartini and Lau 1999). The high occurrence of the post-ovulatory follicles in *S. luniscutis* ovaries in November, and *G. genidens* in March, indicates that eggs were released recently in each of these month by periods, suggesting a single annual spawning period in September/October, and January, respectively. GSI variations also confirmed these seasons spawning indicated by frequency of maturation stages. Peak of GSI for *S. luniscutis* females in September/October were confirmed by the largest frequency of the mature phases (Mature II and Ripe), while for *G. genidens* females in December/January.

Males of *S. luniscutis* presented a wider period of high GSI values, coupled with high frequency of mature phase. According to Chaves (1991) females are better indicators of spawning period than males, since males stay in mature stage for a wider period of time. In this study, high GSI were recorded for males of *S. luniscutis* from September to January, and for males of *G. genidens,* from June to February, therefor a much wider period than the spawning season. Mature females of *G.genidens* were found in high numbers in a narrower period (December and January), coinciding with the reproductive period found by Mishima and Tanji (1983) at Cananéia estuarine-lagunar system (25º S, 48º W). Barbieri *et al.* (1992) found that *G. genidens* at Jacarepaguá Lagoon system (23º S, 43º W) showed spawning period extended from October to February, but was more intense in December/January, while Mazzoni *et al.* (2000) found December to April as the spawning and breeding season for this species at Maricá lagoon (23º S, 41º W). It has been accepted that the extension of the breeding season is inversely related to latitude, i.e., longer breeding period in low latitude. Furthermore, short breeding season is expected for species with total spawning and the extending breeding period is expected for fractional spawners (Wallace and Selman 1981). In Sepetiba Bay (23ºS, 43ºW), we found a narrow spawning period for both species, which go against the founds for Barbieri *et al.* (1992) and Mazzoni *et al.*(2000) both located at the same latitude. Lack of intrapopulational synchronization, with mature/ripe males available for a wider period, while mature/ripe females occurred only in a shorter period determined the season spawning. Furthermore, the spawning period of *S. luniscutis* and *G. genidens* is different, with the former spawning in Spring and the later, in Summer. The temporal separation in spawning period may be a strategy for coexistence in high abundance in the Sepetiba Bay (Azevedo *et al.* 1999), avoiding interspecific competition of these very close related species.

Previous studies have shown that ariids generally spawn in warm season or associate with increasing temperatures (Dmitrenko 1970; Rimmer and Merrick 1983), in lower reaches of estuary, and these match what was found in this study, as spawns were recorded between Spring and early Summer. Marine catfishes generally present a single annual spawning period corresponding to the warm season or associated with high water temperature (Dmitrenko 1970, Yañez-Arancibia *et al.* 1976, Rimmer and Merrick 1983).

Several species have also been reported incubating eggs or young or having maximum gonadal development in areas or periods of low salinity (Gunter 1947, Reis 1986, Chaves 1994, Araújo *et al.* 1998, Gomes *et al.* 1999); males, and rarely females, mouthbrood, with all eggs, embryos or young within a batch carried by an individual male were at the same stage of development. The incubation of eggs and embryos presenting large yolksacs is typical of marine catfish, as part of its k-strategy; only males of both species broodcare, although some works have mentioned that females also could carry eggs (Yañez-Arancibia and Sanchez-Gil 1988, Chaves 1994), and the observation of males from both species practicing oral incubation of eggs and larvae during sampling is an important contribution of theses results. Ariids produce the largest eggs among the teleosts (Wallace and Selman 1981). During these incubation period, males showed an expansion of the hyoid region probably to increase the space available to carry

eggs or young. Low fecundity is a remarkable characteristic of k-strategist species like the marine catfish, which have large vitellogenic oocytes and high reproductive effort. In the Sepetiba Bay, *S. luniscutis* (26 oocytes) showed higher fecundity than *G. genidens* (15 oocytes). Fecundity might be limited by space available in the males oral cavity and by the amount of females resource resources allotted to yolk production in each spawning event. If we consider the large investment Ariids direct to individual eggs, and that larger females have larger batch fecundity during a given spawning season, it is not surprising that reproductive success is limited depends not only on fecundity but also on the numbers of eggs incubated by males. *S. luniscutis* are comparatively larger sized than *G. genidens* and this could be related to higher fecundity of the former species, because larger space available in their oral cavity.

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**Resumen**

El pez-gato de mar es abundante el la Bahía Sepetiba, un área de 305 $km^2$ en la costa del sureste brasileño, pero el conocimiento de su biología es aun escaso. La biología reproductiva de *Sciadeichthys luniscutis* y *Genidens genidens* fue estudiada a través de muestreos mensuales, desde octubre de 1998 a setiembre de 1999. Los peces fueron capturados con una red barredera estandarizada, en el interior de la Bahía Sepetiba, y cerca de la confluencia con un río tributario principal. Seis estadíos gonadales fueron descritos, basados en observaciones macroscópicas de diferencias en el tamaño y tinción del núcleo y estructuras citoplasmáticas, observadas a través del microscopio de luz. Los cambio en el índice gonadosomático () y en los estadíos del

desarrollo gonadal, mostraron que *S. Luniscutis* desova en primavera, mientras que *G. genidens* desova en verano. El desove fue evidenciado en ambas especies por una alta concentración de folículos post-ovulatorios en los estadios maduros. La fecundidad fue baja (14-38 oocitos vitelogénicos en *S. luniscutis* y 6-24 en *G. genidens*) cuando se la compara con otros teleósteos. La baja fecundidad y la separación en el período de desove sugiere que ambas especies tienen estrategia-k, capaces de evitar competencia interespecífica en los primeros estadíos del ciclo de vida, para optimizar el uso del nicho disponible.

**Resumo**

Os bagres marinhos constituem um dos mais abundantes recursos pesqueiros da Baía de Sepetiba (Lat.22º54□-23º04□S, Long.43º34□-44º10□O), porém o conhecimento da biologia é escasso. Abiologia reprodutiva de *Sciadeichthys luniscutis* (Valenciennes, 1840) e *Genidens genidens* (Valenciennes, 1839) foi estudada através de amostragens mensais entre outubro-1998 e setembro- 1999. Os peixes foram capturados em coletas de arrasto de fundo na Baía de Sepetiba e com redes de espera, na confluência com o rio da Guarda. Foram descritas 6 fases de desenvolvimento gonadal, com base em observações macroscópicas de forma, tamanho, peso, cor e diámetro dos ovócitos, e observações microscópicas de diferenças de tamanho das estruturas celulares. Variações no índice gonadossomático (IGS) e nos estádios de desenvolvimento gonadal indicaram que *S. luniscutis* desova na primavera, enquanto *G. genidens* desova no verão. A desova total apresentada por ambas espécies, foi indicada pela elevada concentração de folículos pós-ovulatórios em ovários desovados. A fecundidade foi baixa (14-38 ovócitos vitelogênicos para *S. luniscutis* e 6-24 para *G. genidens*), quando comparada a outros teleósteos. A tendência de desenvolvimento da estratégia K foi desenvolvida por ambas espécies caracterizada pelo grande tamanho dos ovócitos, baixa fecundidade, elevada proteção à prole e separação temporal no período reprodutivo, podendo ser um mecanismo para evitar competição interespecífica na Baía de Sepetiba, por estas abundantes espécies tão proximamente relacionadas.

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