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Biological variables of *Hypostomus francisci* (Siluriformes: Loricariidae) from Itapecerica River, Minas Gerais State, Brazil

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ABSTRACT

Herein we determine for the first time the reproduction parameters and population structure of *Hypostomus francisci* in the Itapecerica River, São Francisco Basin. A total of 250 specimens was captured quarterly between March 2010 and February 2012. Body weight, total length and weight of the gonads were obtained in the laboratory. Gonad samples were submitted to histological and histochemical techniques. Females with spawning capable ovaries were used to determine the fecundity and relative fecundity. Sex ratio with 1:1.01 (female:male) was observed. Males were more numerous than females for individuals smaller than 170 mm, however the number of females was significantly greater for specimens larger than 330 mm. The length-weight relationship estimated for *H. francisci* indicates negative-allometric growth. Females spawning capable were observed mostly in November-December-January. Two cohorts of oocytes at a determined time evidencing the development type group-synchronic. The eggs reaching 3.4 mm and the fecundity ranged from 312-1,460 oocytes with an average of 585.81 ± 337.43 oocytes per female. The reproductive parameters and population structure of *H. francisci* from Itapecerica River suggested that this species showed singular reproductive tactics among congeners.

Key words: fecundity, gametogenesis, neotropical freshwater fish, population structure, reproduction.

INTRODUCTION

Quantitative aspects of the population structure and reproductive biology, such as sex ratio, length-weight relationship, reproductive strategies and fecundity, are important tools to investigate the life history of freshwater fishes. These aspects can be identified as strategies of freshwater fishes that represent the essential trade-offs among the basic demographic survival parameters (Winemiller and Rose 1992).

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The loricariids exhibit a great variety of reproductive strategies and tactics related to the environment (Suzuki et al. 2000). The genus *Hypostomus* Lacépède is the largest genus within the family Loricariidae, with approximately 130 species recognized (Zawadzki et al. 2010). This genus habits clear running water on the rocky-bottom of South American Rivers (Garavello and Garavello 2004), as well as, muddy water with soft bottoms and can withstand the barrage events by adapting to reservoirs (Duarte et al. 2011). Due to their iliophagous feeding habits, they play an important role in accelerating the recycling of nutrients. The armored catfish *Hypostomus francisci* is one of the most frequently caught species in the Itapecerica River (Domingos et al. 2013). The Itapecerica River receives a variety of effluents along its course and, due to that, has become a very disturbed ecosystem. There is generalized pollution from organic and industrial effluents from poorly planned municipal sewage systems, which is probably the cause of the primary water quality problems, as indicated by chemical oxygen demand range 2.95 and 7.78 mgL^{-1} and total coliforms between 10,500 and 56,600 CFU^{-100mL} (Menezes and Faria 2003).

Although *H. francisci* has a wide distribution along the São Francisco Basin, studies about the reproductive biology of this species are non-existent. Thus, the aim of this study was to evaluate aspects of the population structure, length-weight relationship and reproductive biology of this species in an urban stretch of the Itapecerica River, contributing to the knowledge of the biology of this armored catfish and providing information about fish reproduction in environments under urban influence.

MATERIALS AND METHODS

Population Structure

The specimens were collected quarterly from May 2010 to February 2012 in two sites of the Itapecerica River in the urban perimeter of Divinópolis, São Francisco Basin, Minas Gerais State, Brazil (Fig. 1). Fishes were caught using casting nets (3 and 5 cm mesh size), trawl net (50 mm mesh size) and gillnets. The gillnets had mesh sizes ranging from 1.5 to 6.0 cm (stretched mesh), were 10 m long and 2.0 m high. In each site, the gillnets were maintained for approximately 14 h. Fish were euthanized by transversal section of the spinal cord following the ethical principles established by the Brazilian College of Animal Experimentation (COBEA). Representative specimens of *H. francisci* were fixed in 10% formalin and preserved in 70% alcohol for ichthyological collection. The voucher specimens were deposited at the Department of Zoology MHN-UFMG, access number MHN-UFMG 1456. Then, body weight (BW), total length (TL) and gonad weight (GW) of each individual were obtained in the laboratory. This data were used to calculate the gonadosomatic index (GSI = 100*GW/BW). In addition, the length-weight relationship (LWR) of *H. francisci* was calculated using the equation $W = aL^b$, where *"a"* is a coefficient related to body shape, and *"b"* is an exponent that indicates isometric growth when equal to 3 (Rickter 1973). This work was approved by ethics committee, protocol Nº 49/2010 CEPEA/UFSJ.

Histology and Histochemistry

Gonad samples were fixed in Bouin's fluid for 12 hours, embedded in paraffin and stained with hematoxylin-eosin or Gomori´s thricrome. Content histochemical analysis of the oocyte structures were performed for identification of carbohydrate, sialomucins and neutral glycoproteins evaluated by periodic acid Schiff (PAS) and Alcian Blue (AB), pH 2.5 (Bazzoli and Rizzo 1990).

Determination of the Stages of Gonadal Maturation

The gonadal classification method was adapted from Lowerre-Barbieri et al. (2011) following the stages: 1=regenerating, 2a=initial developing,

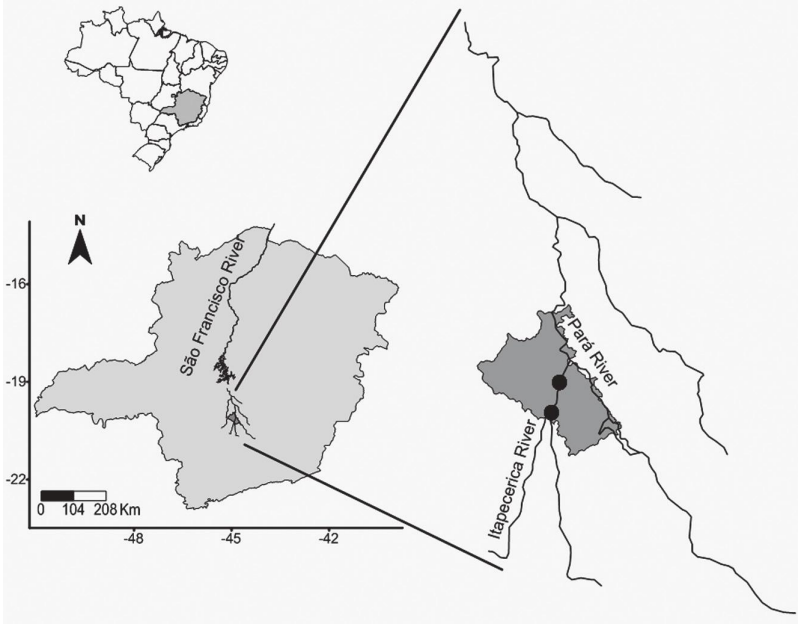

Figure 1 - Location of sampling sites in the Itapecerica River, São Francisco River Basin in the urban perimeter of Divinópolis, Minas Gerais, Brazil (20º13'09''S; 44º54'51''W and 20°07'80''S; 44º52'83''W).

2b=advanced developing, 3=spawning capable and 4=regressing.

Morphometric Analysis of Gonads and Fecundity

Micrographs of ovaries and testes were obtained using a trinocular light microscope (Primo Star Zeiss) coupled with a photographic camera. The diameters of the germ cells were then determined using Axiovision 4.8 software from Zeiss. A total of 26 oocytes were measured at each stage of oogenesis, and 50 cells in each phase of spermatogenesis were measured. The thickness of zona radiata from 25 vitellogenic follicles was also measured using the same software.

To analyze fecundity a total of 17 spawning capable females was used. A sub-sample (~ 1 g) of the medial portion of the ovary (PO) was collected and immersed in a solution of modified Gilson (Simpson 1951) until complete dissociation of vitellogenic oocytes. The vitellogenic oocytes (VO) were counted using a stereomicroscope. Fecundity (F) was calculated using the formula F = GW*VO/PO. Relative fecundity (RF) was determined through the following formula: RF = AF/TL, RF = F/BW and RF = F/GW.

Statistical Analysis

Values were expressed as the mean ± standard error for GSI and mean ± standard deviation for other parameters. The means were compared by ANOVA followed by a Tukey post-test, which was performed using GraphPad Instat with a confidence interval of 95%. The degree of association between the variables W and L and fecundity analysis were evaluated by the determination of coefficient (R^2) using the software R. The chi-square ($\chi 2$) test was used to evaluate if the sex ratio differ from parity, i.e., 1:1 (F:M) by size classes.

RESULTS

Population Structure

During the study period, 250 specimens of *H. francisci* were collected, including 124 females and

126 males, which indicates a sex ratio of 1:1.01, with no significant difference from parity ($\chi 2 = 0.01$, df = 1, $p > 0.05$). The total length and body weight ranged, respectively, from 140 to 470 mm (258 ± 75) and from 33 to 950 g (230 ± 206) for females and from 99 to 445 mm (260 ± 70) and from 7.8 to 1,000 g (228 ± 205) for males. For individuals smaller than 170 mm, the sex ratio was two males to each female. Among the specimens larger than 330 mm, the number of females was significantly higher (Table I). The LWR was estimated for *H. francisci*: parameter "*b*" was 2.883, and parameter "*a*" was 0.015 with a determination coefficient (R^2) equal to 0.94 ($p < 0.001$) (Fig. 2). When the LWR was analyzed separately for sex, males showed a parameter "*b*"= 2.767 ($R^2 = 0.87$; $p < 0.01$) and females "*b*" = 2.898 ($R^2 = 0.97$; $p < 0.001$).

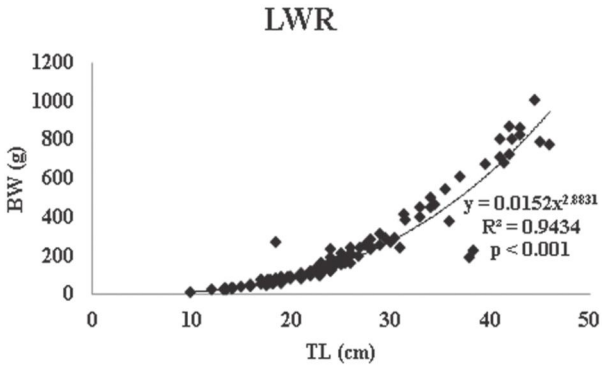

Figure 2 - Length-weight relationship of *H. francisci* from Itapecerica River with $p < 0.001$.

Gonadal Histology and Histochemostry

The oogonia were the smallest oogenic lineage cell and were grouped in nests with varying numbers of cells. They had a euchromatic nucleus with large single nucleoli. The initial perinucleolar oocyte (O1) (Ø 80.4 ± 20.4 µm) displayed a central nucleus with dispersed chromatin, the presence of nucleoli with varying sizes in the nuclear periphery and basophilic cytoplasm (Fig. 3a). The advanced perinucleolar oocytes (O2) (Ø 160 ± 31 µm) were larger and had less basophilic cytoplasm than the initial perinucleolar oocytes. Close to the nucleus, Balbiani bodies were observed. Cortical vesicles were observed migrating toward the cortical region. The follicular cells were squamous, and the theca was very thin (Fig. 3a, b).

The pre-vitellogenic oocytes (O3) (Ø 431.7 ± 111.8 µm) displayed euchromatic nuclei and small nucleoli attached to the nuclear envelope. The ooplasm displayed few basophilic granules occupying the cortical region (Fig. 3b). In addition, newly formed zona radiata was observed around the oocyte. The follicular cells were cubic with a cytoplasm weakly stained. The vitellogenic oocytes (O4) (Ø 2,412.8 ± 366.2 µm) presented a central euchromatic nucleus observed. The ooplasm was completely filled by strongly acidophilic yolk granules (Fig. 3c). Cortical vesicles in the cortical region of the ooplasm were observed. The follicular cells displayed a prismatic shape and theca remained thin. The zona radiata was observed totally formed (thickness 3.6 ± 0.8 µm).

The ovaries after spawning presented a thick tunica albuginea compared with ovaries before spawning and contained numerous postovulatory follicles, some non-spawned vitellogenic oocytes and another group of oocytes in which the vitellogenesis had not still started (Fig. 3d). The postovulatory follicle was characterized by a prismatic layer of follicular cells with an irregular lumen (Fig. 3e). Follicular atresia was observed mainly in vitellogenic follicles that were characterized by an early disappearance of zona radiata, yolk globules lost the integrity becoming liquefied and hypertrophied follicular cells which were in intense phagocytic activity engulfing the yolk (Fig. 3f).

Histochemical analysis indicated vitellogenic oocytes with zona radiata and follicular cells PAS positive (Fig. 4a-c). In addition, pre-vitellogenic and vitellogenic oocytes had Alcian Blue (AB, pH = 2.5) positive in the cortical alveoli (Fig. 4d-f).

SPERMATOGENESIS

Testis of *H. francisci* showed anostomosed seminiferous tubules, with different types of germ cell (spermatogonia to spermatozoa) associated Sertoli cells and distributed along the entire length of the testes. Leydig cells were observed in the interstitial compartment. Five spermatogenic cell lineages had been identified: primary spermatogonia, secondary spermatogonia, spermatocytes, spermatids, spermatozoa (Fig. 5).

The primary spermatogonia were the first and largest germ lineage cells differentiated (Ø 8.2 ± 1.1 µm) with large, central and spherical nucleus with prominent nucleoli. The cytoplasm was visible and presented hyaline staining (Fig. 5a). This type of cell was found in cysts with small groups (2 to 8) in all stages of gonadal development. The secondary spermatogonia (Ø 5.5 ± 0.5 µm) derived from the mitotic divisions of the primary spermatogonia. They displayed spherical nucleus and central

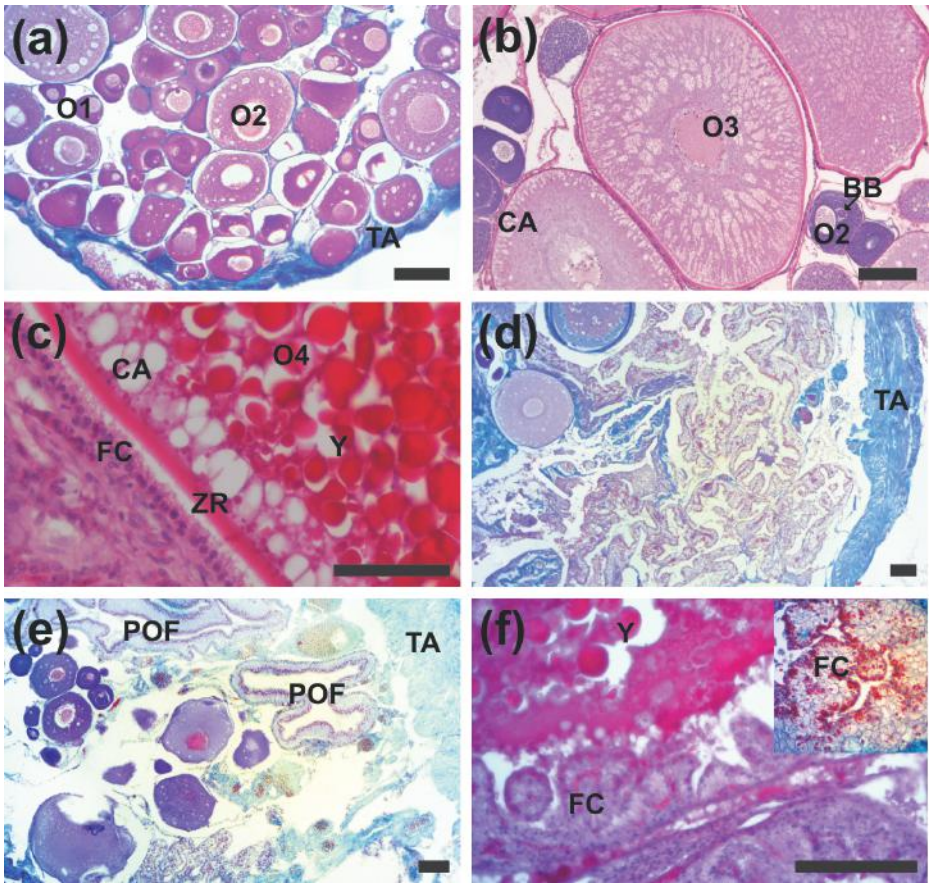

Figure 3 - Histological sections of *H. francisci* ovaries stained with hematoxylin-eosin and Gomori´s thricrome. **(a)** ovarie in regenerating stage, with perinucleolar oocytes (O1 and O2), Note the thin ovarian tunica albuginea (TA). **(b)** initial previtelogenic oocyte (O3) and perinucleolar advanced (O2) with Balbiani´s Body (BB). **(c)** vitellogenic oocyte (O4) with the cytoplasm rich in yolk globules (Y), zona radiata (ZR), cortical alveoli (CA). **(d)** ovary in regressing stage with a thick tunica albuginea (TA). **(e)** postovulatory follicle (POF) with prismatic cells and large lumen. Note the thick tunica albuginea. **(f)** atretic follicles (AF), with liquefied yolk (Y), prismatic follicular cells (FC). Insert evidenced the yolk reabsorption in follicular cells (FC). Bars: 100 µm.

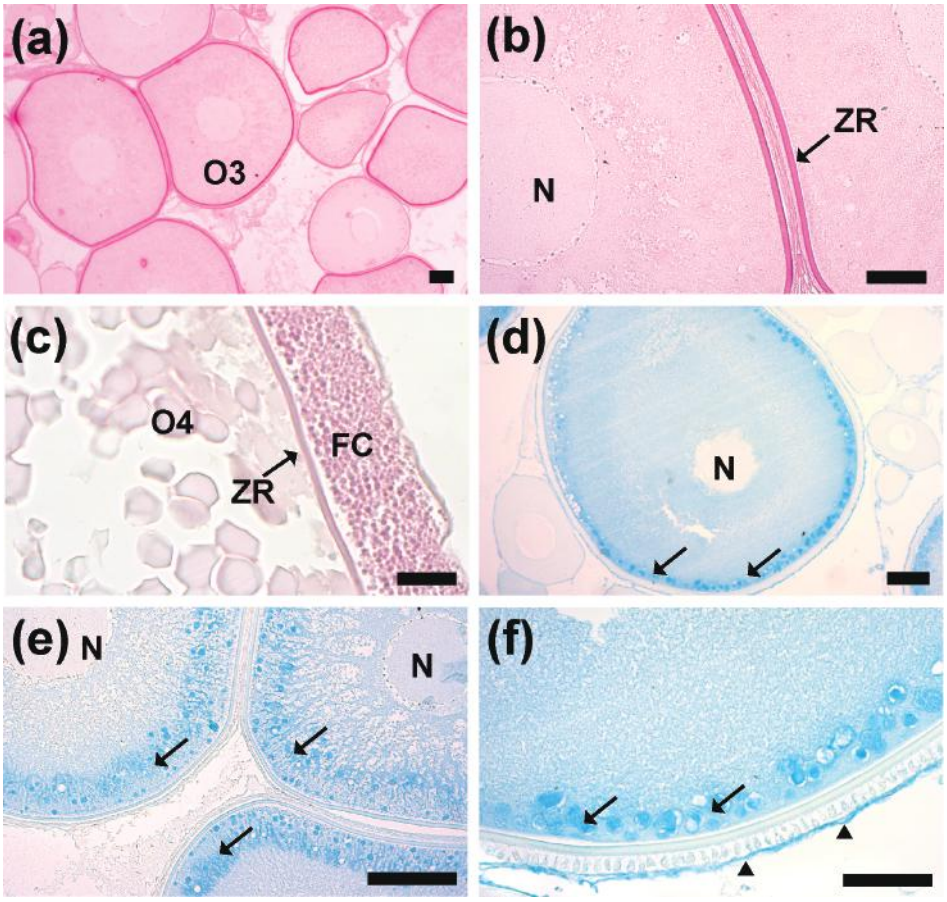

Figure 4 - Histochemical reaction in the *H. francisci* ovaries by periodic acid Schiff (PAS) a-c and Alcian Blue (AB), pH 2.5 d-f. **(a)** pre-vitellogenic oocyte (O3). **(b)** zona radiata (ZR) PAS-positive and nucleus of pre-vitellogenic oocyte (N). **(c)** zona radiata and follicular cells (FC) PAS-positive in the vitellogenic oocyte (O4). **(d)** and **(e)** previtellogenic oocyte (O3) with cortical alveoli AB-positive (arrow). **(f)** cortical alveoli (arrow) and theca (arrowhead) AB-positive. Bars: **a)** 50 µm, **b)** 35 µm, **c**) 50 µm, **d-e)** 100 µm and **f)** 70 µm.

nucleolus. These cells were organized into cysts of many cells (Fig. 5a).

The spermatocytes (Ø 4.5 ± 0.6 µm) exhibited condensed chromatin that occupied a large portion of the nucleus, with scarce cytoplasm and inconspicuous cytoplasm (Fig. 5b). Spermatids were observed as small cells (Ø 2.9 ± 0.4 µm) with a spherical shape and very condensed chromatin. The cytoplasm was clear and displayed an undefined shape (Fig. 5c). The spermatozoa were the smallest germinative cells (1.7 ± 0.3 µm), which displayed a dense nucleus with highly condensed chromatin (Fig. 5c-d).

Reproductive Parameters

The stages of the reproductive cycle were determined for *H. francisci* collected in the Itapecerica River using macroscopic and microscopic analyses of the gonads. The GSI (mean ± SEM) was to female and males, respectively: Regenerating (0.19 ± 0.02 and 0.01 ± 0.002); Initial and advanced developing (1.3 ± 0.3 and 0.1 ± 0.03); Spawning-capable (7.1 ± 6.5 and 0.15 ± 0.03); Regressing (0.50 ± 0.12 and 0.11 ± 0.03). Maximum GSI values were recorded in November-December-January for females and males (Fig. 6). Spawning capable females were

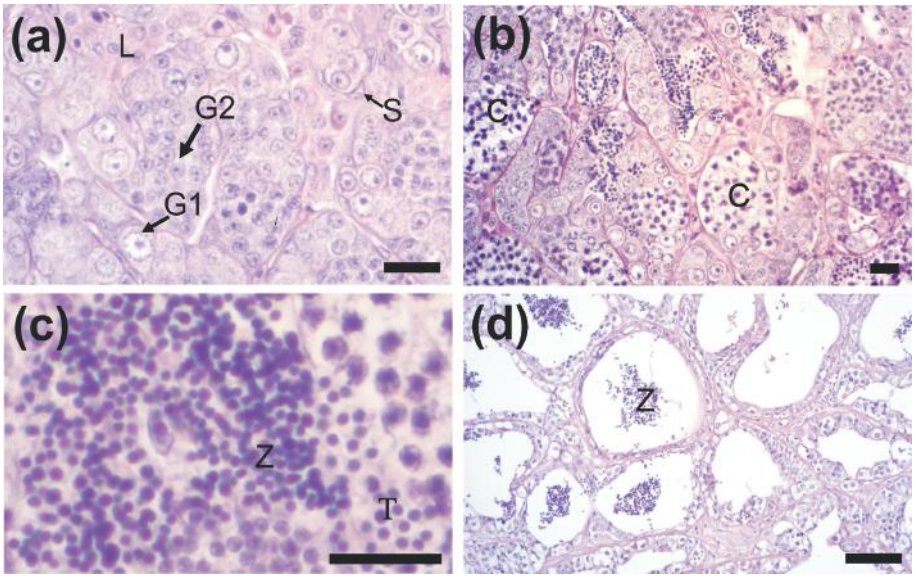

Figure 5 - Histological sections of *H. francisci* testes stained with hematoxylin-eosin. **(a)** primary spermatogonia (G1), secondary spermatogonia (G2), Leydig cells (L) and Sertoli cell (S). **(b)** spermatocytes (C). **(c)** spermatids (T) and spermatozoa (Z). **(d)** spermatozoa (Z). Bars: **a-c)** 20 μm and **d)** 90 μm.

caught mostly in November-December-January period and regressing females in the subsequent quarter, February-March-April (Fig. 6). Males in stage 3 were rarely caught throughout the sampled period, being zero in August-September-October and just one in November-December-January.

The distribution of oocytes size classes indicated the presence of two populations of oocytes with different diameters in spawning capable ovaries, with the bigger ones reaching 3.4 mm (Fig. 7). A well-defined reproductive period, with GSI peak in November-January for both sexes in addition to oocyte development suggest total spawning for this species.

The fecundity ranged from 312-1,460 oocytes and averaged 585.81 ± 337.43 oocytes per female.

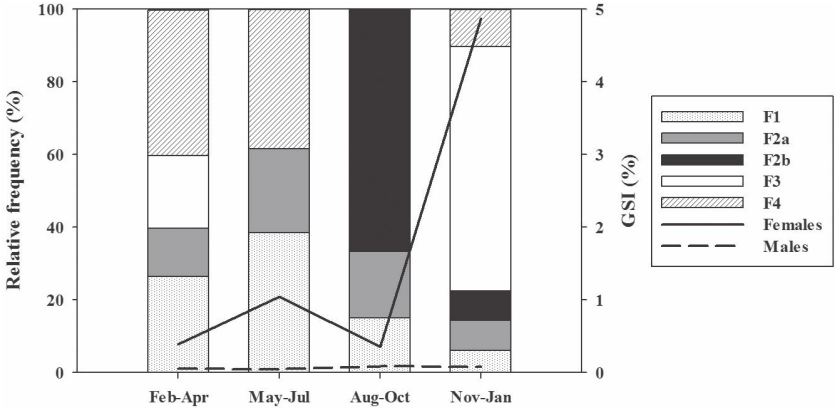

Figure 6 - Seasonal variation in GSI of females (continuous line) and males (discontinuous line) and relative frequency of gonadal stages in females of *H. francisci* captured in Itapecerica River. F1 = females in stage 1 (regenerating), F2a = females in stage 2a (initial developing); F2b = females in stage 2b (advanced developing); F3 = females in stage 3 (spawning capable); F4 = females in stage 4 (regressing).

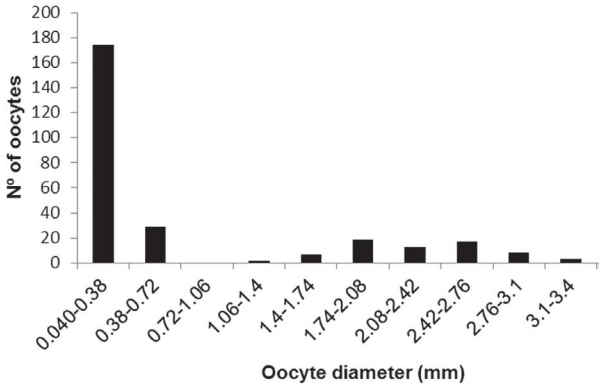

Figure 7 - Frequency of oocytes diameter classes (mm) in spawning capable ovaries of *H. francisci*.

The relative fecundity to gonadal weight, body weight and total length of *H. francisci* females was respectively: 67.73 ± 38.37, 3.93 ± 1.67 and 33.08 ± 26.9. Fecundity tended to increase linearly with significant relationship with gonadal weight (R^2 = 0.72, $p < 0.05$), body weight ($R^2 = 0.97$, $p < 0.001$) and total length ($R^2 = 0.88$, $p < 0.001$) (Fig. 8a-c).

DISCUSSION

The data of the present study determine for the first time the reproduction parameters and population structure of *Hypostomus francisci* in the São Francisco Basin.

The population of *H. francisci* presented the expected balanced sex ratio of wild populations of tropical fish: one male to one female. However, the number of females was significantly greater for larger specimens above 331 mm. Sexual dimorphism in relation to size also occurs in *Loricariichthys castaneus* (Gomes et al. 2011) and *Hypostomus affinis* (Duarte et al. 2011), with females reaching larger sizes than males. This observation can be re-

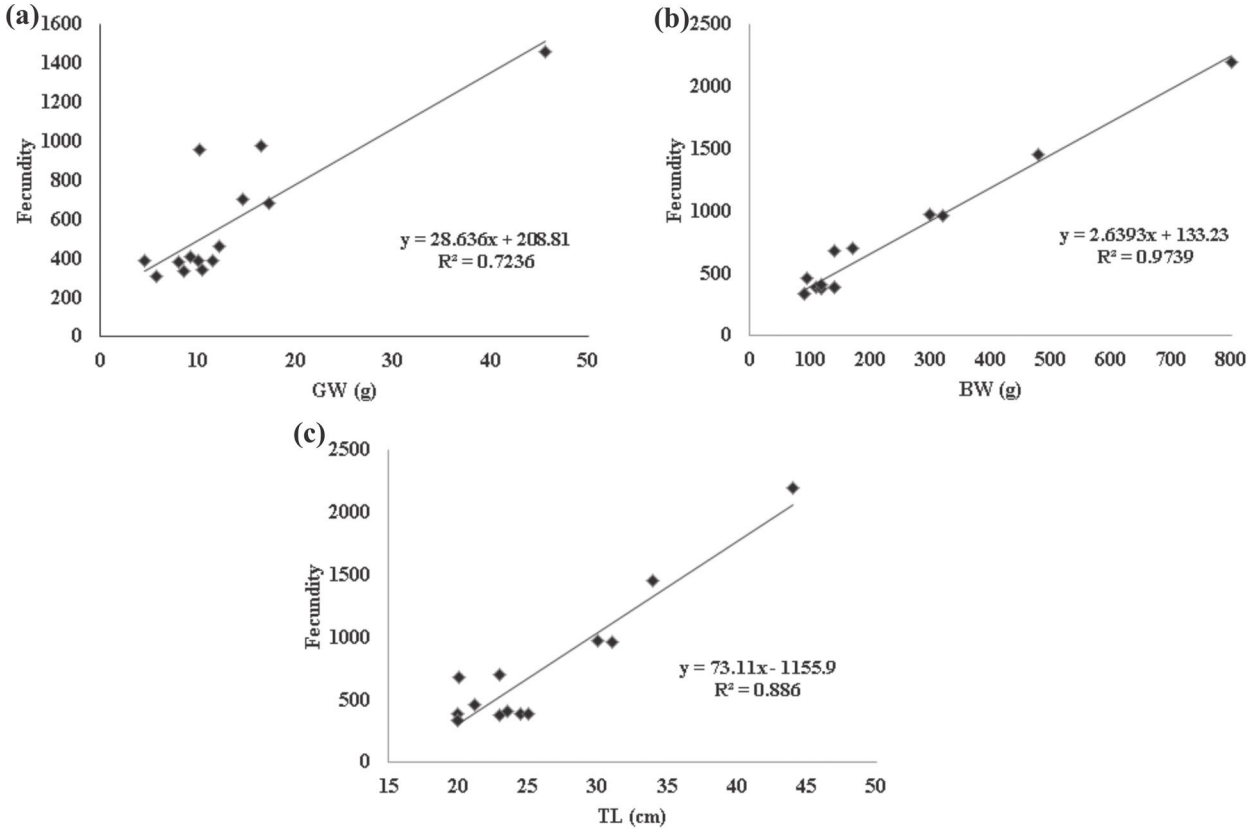

Figure 8 - Fecundity in relation to gonadal weight (GW) **(a)**, body weight (BW) **(b)** and total length (TL) **(c)** of *H. francisci* females in spawning-capable stage. All analysis showed a statistical difference ($p < 0.05$).

lated to the fecundity, since larger fish produce more eggs increasing the population number (Murua and Saborydo-Rey 2003). Indeed, it was observed a high correlation between fecundity and total length in *H. francisci* as well as, with gonadal weight and body weight. The smaller size of the males may be in part a consequence of selection for precocious maturation and reproductive effort, which reduces the growth of males compared with females (Andersson 1994). Males that exhibit parental care are often observed in *Hypostomus*. Suzuki et al. (2000) reported males of *Hypostomus ternetzi* guarding nests after spawning. This behavior may become males less susceptible to be captured during the spawning season. In fact, in *H. francisci*, males in stage 3 were rare through the collect period and just one was recorded in November-January, as well as described to *Hypostomus auroguttatus* (Gomes et al. 2015). The LWR estimated for *H. francisci* indicates negative-allometric growth in the species during its development. In *Hypostomus* cf. *ancistorides* (Viana et al. 2008) and *Rhinelepis aspera* (Agostinho et al. 1990), isometric growth with "*b*" = 3 have been observed. According to Bayesian approach for estimating LWR (Froese et al. 2014) to *H. francisci* the "*b*" should be equal to 3.03 (range = 2.78 - 3.28), based on LWR estimates for this Subfamily-body shape. The parameter"*b*" can vary between species of the same family, reflecting environmental conditions and the fish health (Le Cren 1951, Bagenal and Tesch 1978). Insufficient nutrition, adverse environmental conditions and pathological states lead to change of this fish growth pattern (Abdullahi et al. 2014). In fact, the values obtained to *H. francisci* ($b < 3$) can indicate a simple observation that fish grow at a higher rate than body mass. On the other hand, it is possible that results lead to believe an impact on the growth and on the utilization of natural resources due to environmental impact in consequence of the sewage release in the Itapecerica River.

The analysis of the relative frequency of gonadal stages in female indicates that *H. francisci* has a long reproductive period in Itapecerica River. Moreover, the highest GSI for females was recorded between November and January, the rainy and warm season in Southeastern in Brazil, coinciding with the higher frequency of females in stage 3. Instead, the lowest values of GSI for females were observed in August-October. Similar results have been reported for *Hypostomus* cf. *ancistroides* (Viana et al. 2008) and *Hypostomus* aff. *plecostomus* (Barbieri and Verani 1987).

The presence of two populations of oocytes recognized at a determined period indicates that the oocyte development was type group-synchronic with total spawning. The spawning behavior is variable between species of Loricariidae and can include total spawning in *H. ternetzi* (Suzuki et al. 2000) and *H. auroguttatus*, or partial spawning in *H. affinis* (Mazzoni and Caramaschi 1997), *Loricariichthys castaneus* (Gomes et al. 2011) and *L. platymetopon* (Suzuki et al. 2000) which confirm the large diversity of reproductive strategies within this family.

The bigger class of eggs size in *H. francisci* from Itapecerica River reached values around 3.4 mm, similar to *H. affinis* from Lajes reservoir (Duarte et al. 2011) and smaller than *H. auroguttatus* from Paraíba do Sul River (Gomes et al. 2015). Large eggs had been reported in other species of the *Hypostomus* (Menezes and Caramaschi 1994), suggesting energy investment in egg quality. Larger eggs generally result in larger larvae, which may provide size advantage relative to individuals from smaller eggs (Sogard 1997). Moreover, smaller eggs are usually associated with other reproductive parameters like higher values to fecundity and indicate an opportunistic strategy.

Duarte and Araújo (2002) and Duarte et al. (2011) examined armored catfishes captured in an oligotrophic reservoir with sediment accumulation. In this work, the animals had a reproductive tactic

unexpected for the species, including decreased oocyte size and increase of fecundity. Herein, the fecundity values of *H. francisci* were lower than those observed in *H. affinis* (Duarte and Araújo 2002) and *H. ternetzi* (Suzuki et al. 2000). Marked differences in fecundity among species often reflect different reproductive tactics (Murua and Saborido-Rey 2003). Data on quality of oocytes (size) and fecundity are important for establishing better conservation strategies, since the knowledge on fecundity increases the ability to estimate the recruitment and maintenance of a species and its relationship with the environment.

The oogenesis was similar to that observed in other Siluriformes with external fertilization (Melo et al. 2011, Sales et al. 2012), as well as, the histochemistry analysis of oocyte structures (Bazzoli and Godinho 1994). In *H. francisci*, during the development of oocytes, the zona radiata became visible in pre-vitellogenic oocytes and PAS-positive, indicating neutral glycoproteins. The zona radiata thickness was similar to that found in *H. ternetzi* and lower than that observed in other Loricariidae (Suzuki et al. 2000). The thickness of the zona radiata may be related to the reproductive strategy type, where a thinner zona radiata is associated with large diameter oocytes that are characteristic of species that exhibit parental care such as loricariids. Therefore, the results obtained in regards to the zona radiata thickness associated with information about male nest guard suggest that *H. francisci* provides parental care. The morphology of the follicular cells of *H. francisci* was similar to that observed in Siluriformes: squamous in perinucleolar follicles and prismatic in vitellogenic follicles (Santos et al. 2006). The prismatic cells have a higher capacity to synthesize substances that are transferred to the zona radiata supporting the adhesion of eggs, which facilitates parental care (Melo et al. 2011) as reported for *Lophiosilurus alexandri* (Barros et al. 2007).

The *H. francisci* ovaries displayed several postovulatory follicles and few atretic follicles. This find indicated reproductive success of the species in Itapecerica River. The postovulatory follicles are remnants of ovulated vitellogenic oocytes and consist of a wall containing follicular cells, theca and lumen (Drummond et al. 2000), and often are used to assess the reproductive success (Thomé et al. 2012). Non-ovulated oocytes are reabsorbed by a degenerative process called follicular atresia (Santos et al. 2009). The morphological characteristic of atretic follicles observed in *H. francisci* was similar to that described in other neotropical fish (Morais et al. 2012). However, in the present study the zona radiata disappears in early stages of atresia when compared with *H. auroguttatus* (Gomes et al. 2015) that happened at the end of the process.

Regarding the morphology of the testes, the species studied displayed characteristics similar to other loricariids with cells in different stages of development in the seminiferous tubules. The spermatogenic cell lines were organized into cysts delimited by cytoplasmic extension from Sertoli cells, and in each cyst, there were cells at the same stage (Grier 1981, Guimarães-Cruz et al. 2005, Nóbrega et al. 2009).

Winemiller et al. (2005) proposed a triangular model (equilibrium, opportunistic and periodic) from concepts developed by Winemiller and Rose (1992) based on changes in patterns of life history of fish to explain the adaptive responses of species to environmental changes regarding predictability and scale relative to the generation time. Reproductive parameters observed for *H. francisci* in the river Itapecerica, i.e., long reproductive period, total spawning and parental care, suggest adaption toward equilibrium strategy that seems to be efficient in running waters (predictable environments). However, compared with other species of the genus *Hypostomus* with equilibrium strategy (Gomes et al. 2015), *H. francisci* showed small eggs and high fecundity. Whereas, if compared with armored fish

opportunistic strategy (Duarte and Araujo 2002, Duarte et al. 2011), it showed low fecundity and oocytes with similar size.

In summary, we observed that *H. francisci* presented a variation of reproductive strategy between equilibrium and opportunistic. Since there are no studies with *H. francisci* it is not possible to know if these characteristics are typical of this armored catfish or result from environmental influences, leading to reproductive plasticity.

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RESUMO

Nós determinamos pela primeira vez os parâmetros reprodutivos e a estrutura populacional de *Hypostomus francisci* no rio Itapecerica, bacia do São Francisco. Um total de 250 espécimes foi capturado trimestralmente entre março de 2010 e fevereiro de 2012. O peso corporal, comprimento total e peso das gônadas foram obtidos em laboratório. Amostras de gônadas foram submetidas à técnicas histológicas e histoquímicas. Fêmeas com ovários capazes de desovar foram utilizadas para determinar a fecundidade e a fecundidade relativa. Observou-se uma proporção sexual de 1:1,01 (Machos:Fêmeas). Os machos foram mais numerosos do que fêmeas na classe de indivíduos menores que 170 mm, no entanto, o número de fêmeas foi significativamente maior para os espécimes acima de 330 mm. A relação peso comprimento estimada para *H. francisci* indica crescimento alométrico negativo. Fêmeas capazes de desovar foram registradas principalmente em Novembro-Dezembro-Janeiro. Duas populações de ovócitos em um momento determinado do ciclo comprovam desenvolvimento ovocitário do tipo grupo-sincrônico. Os ovos atingiram 3,4 mm e a fecundidade variou de 312-1,460 ovócitos com uma média de 585,81 ± 337,43 ovócitos por fêmea. Os parâmetros reprodutivos e a estrutura populacional de *H. francisci* do rio Itapecerica sugerem que esta espécie possui táticas reprodutivas singulares entre congêneres.

Palavras-chave: fecundidade, gametogênese, peixe neotropical, estrutura populacional, reprodução.

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