

# Reproductive Biology of a Tetragonopterinae (Osteichthyes, Characidae) of the Ubatiba Fluvial System, Maricá – Rj

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## ABSTRACT

Aspects of the reproductive biology of one Tetragonopterinae was assessed in the Ubatiba river - Maricá / RJ. Length structure and mean size suggested sexual dimorphism, females reaching larger sizes than males. The onset of sexual maturity occurred at 2.8cm for both the sexes. Fecundity, determined on ripe ovaries, showed positive correlation to females size and weight and varied from 595 to 5520 for 3.9cm and 6.2cm lengths respectively. The spawning type, defined as total, was determined by the oocyte diameter frequency from ovaries in different development stages. The frequency distribution of ovarian/testis maturation stages, associated with the temporal variation of the gonadosomatic index, suggested that the reproduction period was prolonged along the whole annual cycle.

**Key words:** Tetragonopterinae, coastal stream, reproductive biology.

## INTRODUCTION

The Ubatiba river (22°60'S and 42°48'W), together with its tributaries, Silvado, Caboclo, Fundo, Itapeteiú and Ludigério rivers, composes a small coastal fluvial system of the Brazilian East Basin in the State of Rio de Janeiro. Its main characteristic, as most of the coastal rivers, is that it is subject to sudden spates that stress local habitats and, probably, populations. More details on the thermic and hydric regimes of the Ubatiba river area can be found in Mazzoni (1998).

A total of twenty-two fish species (Costa, 1984) make up the Ubatiba river ichthyofauna, where *Deuterodon* sp. stands out as the main species, belonging to the Tetragonopterinae subfamily (Characidae), which is the most abundant and with widest distribution in the mentioned river (Mazzoni, 1998). This subfamily is the one with the largest number of species among the Brazilian Characidae (Britski, 1972), comprising a small sized species complex which does not exceed the 10cm length (Britski *et al.*, 1988). Its distribution includes both South and Central America, frequently grouping species of difficult identification (Lowe-McConnell, 1987). As there is no consensus on naming the Ubatiba

river species, we have opted for *Deuterodon* sp., a wide discussion on its taxonomical position can be found in Gomes (1994).

According to the ecological theory, the reproductive strategy of a species is an adaptative character due to the environmental situation and it can vary between populations at different condition (e.g., Stearns & Crandal, 1984; Mann *et al.*, 1984; Bye, 1984). Some studies on stream fish reproductive biology show very clear adaptations to the unstable conditions which prevail in the coastal streams (Garutti, 1989; Menezes & Caramaschi, 1994). Long reproductive season, assynchronous reproduction among individuals in the population, early onset of sexual maturity and high fecundity, can be shown as the main characteristics for this condition.

Considering these facts, the objective of this work was to describe *Deuterodon* sp. reproductive strategy. It would be based on the following parameters: length structure, length/weight relationship, onset of sexual maturity, fecundity and reproductive season. We also discuss the possible relationships between the reproductive strategy and the environmental characteristics (mainly the unstable hydric regime) of the Ubatiba river.

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## MATERIAL AND METHODS

Monthly samples were taken from the Ubatiba river - Maricá/RJ between October/94 and September/95. Three localities were sampled according to low, medium and high sections of the river. The material comprised 460 *Deuterodon* sp. caught with an electric sieve, powered by an alternate current generator with a capacity of 3-4 A, 900W. The sampling procedure and its efficiency have been previously reported (Mazzoni, 1998).

Sampled fishes were conditioned in ice for transportation, processed in laboratory, and the following data were obtained: (i) standard length (SL) to the nearest 0.1mm (ii) total weight (WT) to the nearest 0.1g (iii) sex (iv) gonadal weight (WG) to the nearest 0.1g, and (v) ovarian/testis development stages. The latter one was based on vascular irrigation as well as on occupation percentage in the abdominal cavity for both the sexes. For females, oocytes presence, its size and colour was also registered and for males sperm liberation when pressing the abdomen. According to these characteristics, the following classification was considered: females - immature, mature I, mature II, ripe, spawned and recovering, and males - immature, mature, ripe, spent and recovering.

Length structure was analyzed based on the number of individuals and their distribution according to size. Length/weight relationship was established considering the Ln transformed data of WT and SL (Ln = neperian logarithm) and the relationship among them established

through the Minimum Square method. Sexual maturity size (Lp50) was established according to Vazzoler (1981). The three previously mentioned analysis were done for males and females in separate.

Frequency distribution percentages of ovarian/testis maturation stages was used to determine species reproductive period. Maturation stages were rearranged as follows: Immature - young fish without developed gonads and SL equal or under Lp50; Non-reproductive - adult fish in maturation, mature I and II and recovering gonads; and Reproductive - ripe and partially spawned/spent gonads. Temporal variation of the female Gonadosomatic Index ( $GSI = WG / WT * 100$ ), was used as complementary information for the reproductive period.

Fecundity (Bagenal, 1971) was determined after counting 35 ripe females. The spawning type was evaluated according to the distribution frequency of oocytes diameter from ovaries in different maturation stages (mature I, mature II and ripe). These were measured on subsamples of 10ml under a stereomicroscope (x50).

## RESULTS

### Population Structure

*Deuterodon* sp. length structure indicated that males and females reached maximum lengths of 4.4cm and 6.0cm, respectively, suggesting that females were bigger than males (Table I).

**Table I.** *Deuterodon* sp. length distribution from the Ubatiba fluvial system, Maricá - RJ. LC = length classes (cm).

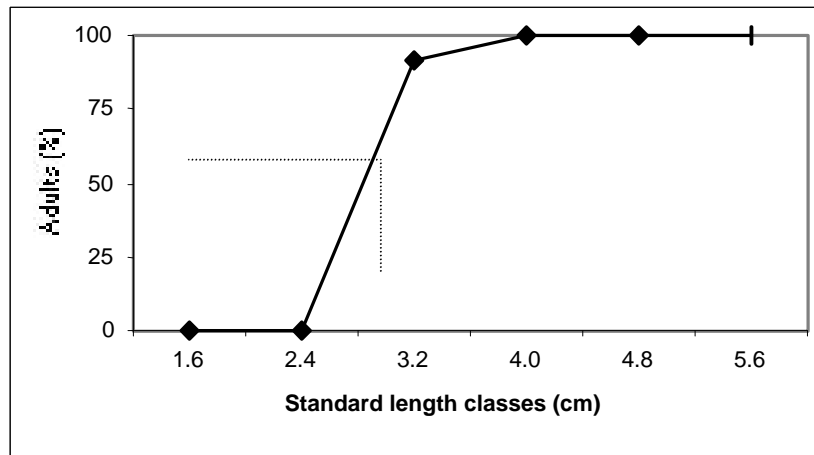
LC		2.3 -2.7	2.7 -3.0	3.0 -3.3	3.3 -3.6	3.6 -3.9	3.9 -4.2	4.2 -4.5	4.5 -4.8	4.8 -5.1	5.1 -5.4	5.4 -5.7	5.7 -6.0
Female	n	2	1	8	15	21	17	56	35	26	6	7	1
	%	1.03	0.51	4.10	7.69	10.77	8.72	28.72	17.95	13.33	3.08	3.59	0.51
Male	n	2	1	9	11	16	8	7	0	0	0	0	0
	%	3.70	1.85	16.67	20.37	29.63	14.81	12.96	0.00	0.00	0.00	0.00	0.00

Standard length / total weight relationship indicated sexual dimorphism ( $p < 0.01$ ) as well as a high correlation of the observed points for both the sexes. The equations that explain the

relationship are:  $LnWt = -3.58 + 2.95 LnSL$ ,  $r = 0.95$ ,  $n = 263$ ,  $p < 0.01$  and  $LnWt = -3.18 + 2.58 LnSL$ ,  $r = 0.89$ ,  $n = 197$ ,  $p < 0.01$ , for females and males respectively.

No differences were found for male and female onset of sexual maturity, so data of both the sexes were analysed together. Males and females reached sexual maturity at 2.8cm of SL.

These results suggest an absence of sexual dimorphism although females reached bigger size than male (Figure 1).

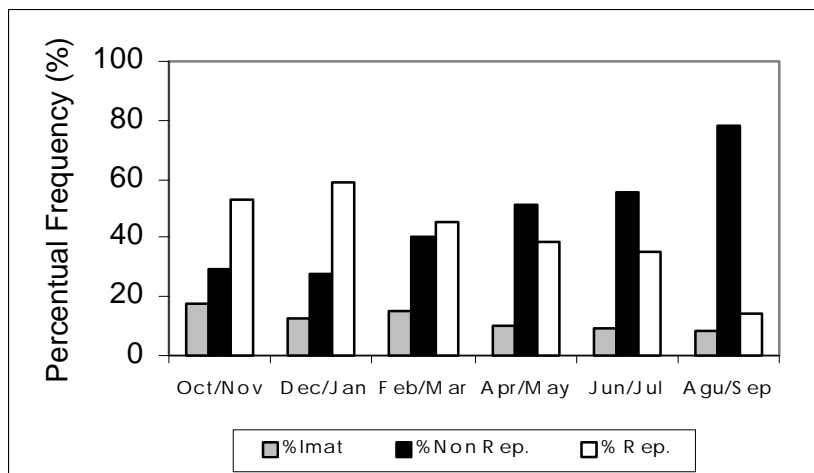


**Figure 1.** Length-frequency distribution of adult females and males of *Deuterodon* sp. The dotted line indicates the middle point of standard length class at onset of sexual maturity.

### Reproductive Characteristics

Temporal variation of maturation stages indicated that immature and reproductive fishes occurred during the whole annual cycle,

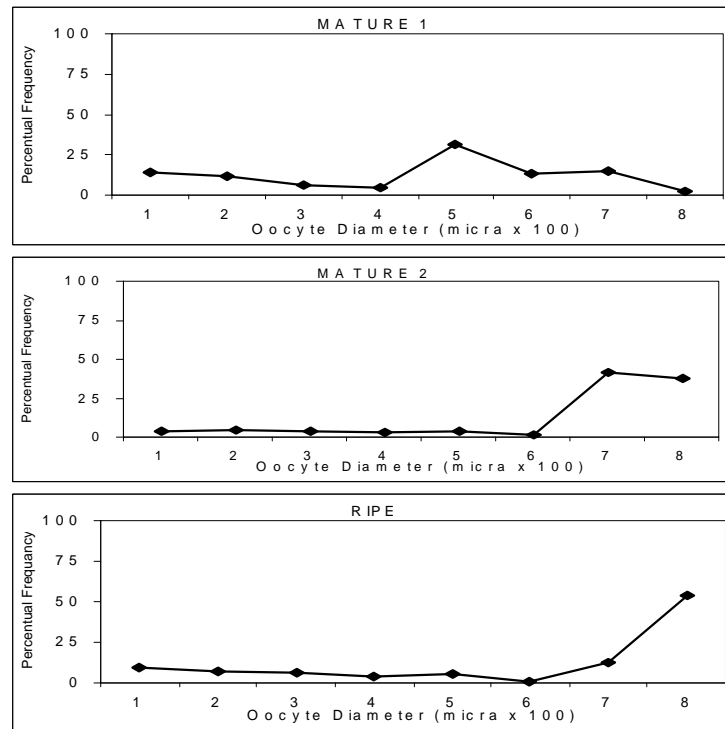
suggesting that reproduction was continuous all over the year being more intense from October to March (Figure 2).



**Figure 2.** Temporal variation in the gonadal stages frequency of males and females of *Deuterodon* sp. from the Ubatiba fluvial system Maricá-RJ.

Temporal distribution of female GSI individual values corroborated the previous result and

indicated the presence of reproductive fishes (GSI > 15) along the whole annual cycle.



**Figure 3.** Oocyte size distribution of ovaries of *Deuterodon* sp. in different maturation stages. Numbers from 1 to 8 of the axis x represent the size from 100 to 800 micra

*Deuterodon* sp. fecundity (F) showed positive correlation with length ( $F = -5150.8 + 1574.4$  SL,  $r = 0.64$ ,  $n = 35$ ;  $p < 0.01$ ) and weight ( $F = -183.7 + 783.6$  WT,  $r = 0.77$ ,  $n = 35$ ;  $p < 0.01$ ) of the females and varied from 595 to 5520 oocytes for fish of 3.9 and 6.2 cm respectively.

Oocyte size distribution from ovaries in different maturation stages suggested a total spawning type (Figure 3). Only one mode of 500 micra was found in mature I ovaries. The evolution of this mode was observed in mature II and ripe ovaries, 700 and 800 micra, respectively. This indicated that only one oocyte batch was recruited to maturation and only one batch was released at each reproductive event.

## DISCUSSION

Fish dimorphism has been frequently discussed in the literature, body size differences between males and females were referred by Nikolsky (1963) as the most frequent form of expression of this character. *Deuterodon* sp. length

structure from the Ubatiba river, showed female predominance in the larger SL classes, suggesting sexual dimorphism for length, with females reaching bigger sizes than males. Rodrigues *et al.* (1989) and Barbieri (1992), studying different *Astyanax* species (species correlated to *Deuterodon*) found similar results. Larger size among females could be interpreted as an evolutionary advantage as larger body sizes produce, potentially, more and larger offsprings. The high correlation between SL and fecundity found in our study confirmed this.

The length / weight relationship also suggested sexual dimorphism ( $p < 0,05$ ), females weigh more than males, when fishes of the same length were compared. Similar results were supported by Rodrigues *et al.* (1989) for the *Astyanax bimaculatus* population from Tietê Basin and by Barbieri *et al.* (1982) for *Astyanax fasciatus* and *Astyanax bimaculatus*.

First maturation length is defined by Vazzoler (1981) as the size in which 50% of the individuals of the population reach sexual

maturity. According to this, we found that *Deuterodon* sp. males and females attained sexual maturity within the same size. Barbieri (1992) estimated 4.9cm and 4.2cm (females/males) as *Astyanax scabripinnis paranae* first reproduction size. Agostinho *et al.* (1984), concluded that *Astyanax bimaculatus* (Paraná basin) reached first maturation at 7.8cm and that at 9.5cm all females were able to participate in the reproduction activity. All these results showed an early onset of sexual maturity for *Deuterodon* sp. from the Ubatiba river.

The onset of sexual maturity has an important role to understand the life-history adopted by a species during its evolution (Stearns, 1976; Lessels, 1991). It is accepted that the optimum size for the first reproduction depends on many factors, including the relative allocation food (energy), between somatic and gonad growth (Mann *et al.*, 1984). Interpretation of the selective forces acting on *Deuterodon* sp. suggests that this precocity can be related to an adaptive behaviour to compensate high juvenile losses, this is a consequence of the stressed climate that prevails in the Ubatiba river system. Such an adaptation can explain the success of a small sized species as *Deuterodon* sp. (it is the most abundant species in the mentioned river), when considering an unexpected environment like the Ubatiba river.

The fecundity of *Deuterodon* sp. Could be positively correlated to size and weight and varied from 595 to 5,520 oocytes in females between 3.9 and 6.2cm respectively. Our minor values were similar to those registered by Barbieri & Barbieri (1988) for *A. bimaculatus* that presented fecundity between 625 and 9,845 oocytes in females of 4.0 and 10.4cm of total length. In the same way, the mean fecundity of *Astyanax fasciatus* was 2,144 oocytes, ranging from 680 to 4,451 in females of 5.1 and 11.4cm of total length, respectively (Barbieri & Barbieri, 1988). Barbieri (1992) concluded that the average fecundity of *Astyanax scabripinnis paranae* was reduced (2,239 oocytes). According to these results, we suggested that

*Deuterodon* sp. has fecundity values similar to the most fecund Tetragonopterinae quoted in the literature.

Temporal distribution of GSI values, as well as the presence of young fishes all over the year, suggested an uninterrupted reproduction along the annual cycle; this mean constant recruitment of young fishes in the population. The interpretation of this characteristic suggest an adaptive advantage to an unexpected environment. Continuous recruitment of young fishes is a way of guaranteeing the maintenance of species that could be subject of important losses during the sudden spates. Menezes & Caramaschi (1994) made similar observation for *Hypostomus cf. punctatus* of the Ubatiba river. Corroborating our proposition, we pointed out conclusions presented by Garutti (1989) that showed an amplification of *A. bimaculatus* spawning period as the river order decreased.

Apparently contradictory to the above mentioned results, has been the total spawning type. Nevertheless, an asynchronous reproductive behaviour, among individuals in the population, has been a way of guaranteeing reproductive process all over the year. Associated to this, we observed, by histological analysis that females of *Deuterodon* sp. has a continuous process of maturation without recovering ovaries and very fast oocyte recruitment and maturation (unpublished data).

The *Deuterodon* sp. reproductive strategy could be considered as an opportunistic strategy (*sensu* Winemiller, 1992). Although this was not tested in the present study, we suggest that the unexpected climatic conditions, especially the hydric regime, could probably be the main determinant for this behaviour. Following Menezes & Caramaschi (1994) proposition, we suggest that this strategy makes the maintenance of *Deuterodon* sp. possible, and that, probably most of the species of this fluvial system adopt similar strategies.

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## RESUMO

São avaliados alguns aspectos da biologia reprodutiva de um Tetragonopterinae do rio Ubatiba – Maricá / RJ. A estrutura em comprimento e o tamanho médio sugerem dimorfismo sexual com as fêmeas alcançando tamanhos superiores aos dos machos. A fecundidade, estabelecida a partir da análise de ovários maduros, apresenta correlação positiva com o tamanho e peso das fêmeas e variou de 595 a 5520 para os comprimentos de 3,9cm e 6,2cm, respectivamente. O tipo de desova, definido como total, é determinado pela distribuição de frequência do diâmetro dos ovócitos de gônadas em diferentes etapas de desenvolvimento. A distribuição da frequência percentual de diferentes estádios de maturação, associada a variação temporal do Índice Gônado-Somático sugerem que o período de reprodução é prolongado ao longo de todo o ciclo anual com um período mais intenso nos meses de outubro a março.

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