Cocoon production and hatching rates of *Branchiura sowerbyi* Beddard (Oligochaeta: Tubificidae)

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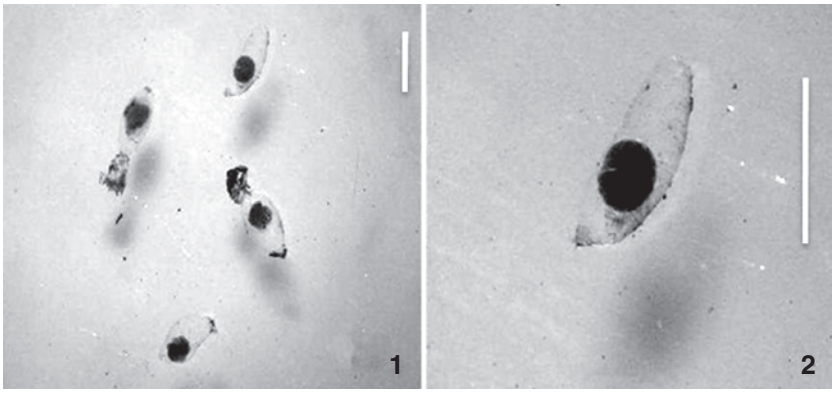
ABSTRACT. *Branchiura sowerbyi* Beddard, 1892 is a Tubificidae species abundant in tropical limnic environments and associated with sediments rich in organic matter and elevated temperatures. The present study aimed at obtaining information on laying and hatching rates of *B. sowerbyi* cocoons under laboratory conditions. In order to do this, specimens of *B. sowerbyi* were placed in beakers (250 ml) containing clay sediment and distilled water and kept at 25°C. The obtained cocoons were placed in beakers of 100 ml and kept in conditions similar to the mature individuals. Fifty seven cocoons were collected, with a mean of 0.13 cocoons·individual^{-1}·day^{-1} and 1.21 (±0.08) eggs·cocoon^{-1}. Hatching time was approximately two weeks and hatching rate was 44.93%. The results obtained were different from the ones found by other authors for *B. sowerbyi*. According to the literature, different populations of the same species can present distinct biological aspects, such as the number of cocoons, hatching rates and growth.
KEY WORDS. Hatching time; number of eggs per cocoons; number of cocoons per individual per day.

RESUMO. **Produção de Casulos e Taxa de Eclosão de *Branchiura sowerbyi* Beddard (Oligochaeta: Tubificidae).** *Branchiura sowerbyi* Beddard, 1892 é uma espécie de Tubificidae abundante em ambientes límnicos tropicais, freqüentemente associada a sedimento rico em matéria orgânica e a elevadas temperaturas. O presente estudo teve como objetivo obter informações sobre postura e taxa de eclosão de casulos de *B. sowerbyi*, em condições laboratoriais. Para isso, exemplares da espécie foram acondicionados em béqueres (250 ml), contendo sedimento argiloso e água destilada, mantidos a 25°C. Os casulos foram separados em béqueres de 100 ml e mantidos em condições similares aos indivíduos adultos. Foram coletados 57 casulos, uma média de 0,13 casulos·indivíduo^{-1}·dia^{-1}, contendo 1,21 (±0,08) ovos·casulo^{-1} em média. O tempo de eclosão foi aproximadamente duas semanas e a taxa de eclosão foi 44,93%. Os resultados obtidos mostraram-se diferentes daqueles encontrados por outros autores para *B. sowerbyi*. Os dados gerados no presente estudo podem ser considerados passos importantes para a observação de características da biologia reprodutiva da espécie, *B. sowebyi*, encontrada no sedimento de ambientes aquáticos brasileiros.
PALAVRAS-CHAVE. Número casulos por indivíduo por dia; número ovos por casulo; tempo de eclosão.

Branchiura sowerbyi Beddard, 1892 is a Tubificidae species that is abundant in tropical limnic environments and frequently associated with organically rich sediments (Aston 1973, Aston & Milner 1981), and high temperatures (Reynoldson 1987). As the use of Tubificidae has become promising in ecotoxicology studies (Nebeker *et al*. 1984, Casselato *et al*. 1992), this species has the potential for monitoring the ecological conditions of limnic environments.

The biology of *B. sowerbyi* has extensively been studied in many countries, such as Argentina (Marchese & Brinkhurst 1996), the United States (Naqvi 1973, Drews & Zoran 1989), Italy (Casselato *et al*. 1992, Bonacina *et al*. 1994) and Great Britain (Aston 1973, 1984, Aston & Milner 1981, Aston *et al*. 1982). In Brazil, however, despite the numerous accounts of the species occurrence (Takeda 1999, Alves & Strixino 2000, Pamplin *et al*. 2005, Dornfeld *et al*. 2006), there is a considerable lack of studies on its biology.

Studies on the biological aspects of *B. sowerbyi* from sediments of Brazilian aquatic environments is justified by the fact that different populations may also have different biology, as observed by Reynoldson *et al*. (1996) when studying *Tubifex tubifex* (Müller, 1774) (Tubificidae) found in North America and Spain. The aim of this study was to gather information on both cocoon production and hatching rates of *B. sowerbyi* under laboratory conditions.



Figures 1-2. Cocoons of *B. sowerbyi* right after laying (1) and (2). White bar = 3 mm.

MATERIAL AND METHODS

Specimens of *B. sowerbyi* were collected in the sediments of Lagoa do Diogo, in the margins of Mogi-Guaçu River, situated in the Jataí Ecological Station, São Paulo (Brazil). After being collected, the specimens were brought into the laboratory, where they were reared in aquariums until the beginning of the experiment, which occurred from October 2006 to January 2007.

In order to observe the production of cocoons, six 250 ml beakers containing 100 ml each of clay substrate and 100mL of aired distilled water, were filled with five adult individuals each. The beakers were then kept in a B.O.D incubator at 25ºC for 15 days. The clay substrate, which has previously been analyzed for the presence of the organisms, was obtained from Milho Branco stream at Santa Cândida Biological Reserve, in Minas Gerais (Brazil).

All beakers were observed every two days for the presence of cocoons during the 15-day period. In order to count the number of cocoons, the substrate was rinsed with the aid of a 210µm mesh sieve (Marchese & Brinkhurst 1996) and then analyzed under a stereoscopic microscope. Cocoons could then individually be pinched and placed into 10 individual 100 ml beakers containing 25 ml each of substrate and aired distilled water (Aston 1984). The number of cocoons per individual per day and eggs per cocoon were determined.

The recipients containing the cocoons were kept in incubators at 25ºC for seven days and later analyzed every two days so to observe both the hatching time and rate.

RESULTS

Fifty-seven cocoons were collected in fifteen days, a mean number of 0.13 cocoons·individual^{-1}·day^{-1}. The number of eggs per cocoon varied between 1 and 4, and the mean number was 1.21 (±0.08) eggs·cocoon^{-1} (Tab. I). In figures 1 and 2, one can observe *B. sowerbyi* cocoons right after laying. Due to transparency, it is possible to see the eggs inside the cocoon.

The hatching time varied between 10 and 20 days. The majority of the cocoons, however, hatched in a 14 to 16-day interval. The hatching rate was 44.93% (Tab. I). In figure 3, one can observe a cocoon containing an individual just before it hatched.

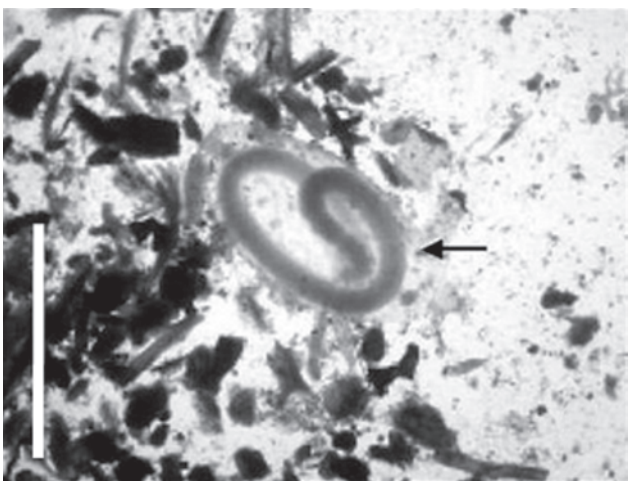


Figure 3. Cocoon of *B. sowerbyi* (arrow) containing an individual just before hatching. White bar = 3 mm.

DISCUSSION

The number of cocoons per individual per day was below the one previously found by Marchese & Brinkhurst (1996), which was 0.17 (±0.02) at 25°C.

The number of eggs per cocoon was also below the one previously found by Aston *et al*. (1982) and Marchese & Brinkhurst (1996), which were 2.82 (±0.47) and 1.94 (±0.13), respectively. In cocoons containing two or more eggs, generally only one was found to be viable, just as it has previously been reported by Marchese & Brinkhurst (1996).

The first hatchings occurred in 14 to 16 days, what agrees with the period of time observed by Bonacina *et al*. (1994) for

Table I. Number of cocoons, number of eggs, number of eggs per cocoon, number of hatchings and hatching rate of cocoons (per beaker and total) obtained in a 15 day observation period of 30 *B. sowerbyi* specimens maintained at 25ºC.

Beaker	Number of cocoons	Number of eggs	Eggs per cocoon *	Hatchings	Hatching rate
1	9	10	1.11 (±0.35)	8	0.8000
2	4	5	1.25 (±0.50)	1	0.2000
3	4	8	2.00 (±1.41)	4	0.5000
4	4	4	1.00 (±0.00)	1	0.2500
5	9	12	1.33 (±0.54)	7	0.5833
6	6	7	1.17 (±0.34)	2	0.2857
7	12	13	1.08 (±0.29)	5	0.3846
8	5	5	1.00 (±0.00)	0	0.0000
9	2	2	1.00 (±0.00)	1	0.5000
10	2	3	1.50 (±0.71)	2	0.6667
Total	57	69	1.21 (±0.08)	31	0.4493

Egg/cocoon relationship ± standard deviation.

this species but differs from the one found by Kosiorek (1974) for *T. tubifex*, which was found to occur in 10 to 12 days. Our results show that *B. sowerbyi* embryos took a maximum of three weeks to develop into the adult form at 25ºC. After a 3-week period no hatching was observed.

The hatching rate found in this study overcame the 34.4% observed by Marchese & Brinkhurst (1996) at the same temperature. According to Wisniewski (1979), the development rate of some Tubificidae cocoons can be improved by placing them 2 to 5 cm depth into the sediment, because at this depth cocoons are less vulnerable to microorganisms present in the water that can jeopardize the embryo's development.

The results of this study differ from those found by other authors (Aston *et al*. 1982, Marchese & Brinkhurst 1996) for *B. sowerbyi*. According to the findings of Reynoldson *et al*. (1996) for *T. tubifex*, different populations of one given species may present difference in some biological features, such as number of cocoons per individual, as well as hatching and growth rates.

In this study, it was possible to determine important reproductive characteristics of *B. sowerbyi*, such as the relationship between the number of cocoons·individual^{-1}·day^{-1} and number of eggs·cocoon^{-1}, as well as hatching rate, which are undoubtedly relevant features for the observation of the reproductive aspects of *B. sowerbyi* found in sediments of Brazilian aquatic environments.

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