

Health variables and gill morphology in the tropical fish *Astyanax fasciatus* from a sewage-contaminated river

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Abstract

The relative condition factor (Kn), gonadosomatic index (GSI), selected hematological variables and gill morphology of the fish *Astyanax fasciatus* were analyzed in two sites (site 1 was unpolluted and site 2 was polluted with untreated domestic sewage) of a tropical river (Camanducaia river, São Paulo State, Brazil). The relationship between the body mass (M_B) and the standard length (L_S) of *A. fasciatus* from both sites was $M_B = 0.00799 L_S^{3.51843}$. The Kn values from both males and females and the GSI of females were significantly higher in site 2. The mean corpuscular hemoglobin and mean corpuscular hemoglobin concentration were higher in females from site 2. Gill tissue anomalies and gill parasites were rare in fish from both sites; however, the number of chloride cells was significantly higher in fish from site 1. *A. fasciatus* presents high capacity to live in ion-poor and soft water and is able to compensate for environmental changes caused by untreated domestic sewage discharges.

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1. Introduction

Untreated sewage effluents may consist of complex mixtures of toxicants that may impair the health of fish and have been considered as an important factor contributing to the reduction of species diversity in the world (Schmidt et al., 1999; Amisah and Cowx, 2000). The tolerance limits to toxicants found in domestic effluents vary among species and their integrative effects may lead to reproductive failure and reduction of survival and growth of the more sensitive fish species (Waring et al., 1996; Wendelaar Bonga, 1997). Some species, however, are abundant in degraded waters, displaying a high tolerance to changes in environmental

conditions and a high capability to compensate for homeostatic disturbances (Wootton, 1990).

Laboratory tests exposing fish to a given chemical or physical factor do not reproduce real environmental conditions and may under- or overestimate effects. Field studies comparing impacted and nonimpacted areas permit an evaluation of the health condition of fish in their own environment, although it is not always possible to determine with precision the causal agent of any given organosomatic change. Representative indices of the whole fish, hematological variables, and some morphological tracts of individual fish, such as the gills which are the main organs for gas exchange in most species and important organs for osmo- and ionoregulation, can be used to provide an indication of how well fish are coping with their environment (Banerjee and Homechaudhuri, 1990; Goede and Barton, 1990; Martinez and Souza, 2002).

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In this context, the present study quantified variations in the condition factor (K_n), the gonadosomatic index (GSI), hematological variables, and the gill morphology of the characid fish *Astyanax fasciatus* Cuvier of two sites: one unpolluted area of the Camanducaia River and a downstream site polluted with domestic sewage. The later site is representative of other rivers in Brazil that run throughout small cities (around 50,000 inhabitants) and receive daily untreated domestic sewage. *A. fasciatus* is an abundant (Nomura, 1975; Araujo, 1996) and widely distributed species across Central and South America (Sterba, 1973). This species is territorial and is able to live and reproduce in waters exhibiting a high degree of variation in physico-chemical characters (Menni et al., 1996; Garutti and Figueiredo Garutti, 1992).

2. Materials and methods

2.1. Study area

The Camanducaia River is located in the state of São Paulo, Brazil and is approximately 150 km long; 14 km of the river lie inside the urban area of Amparo (22°42'43" S and 46°45'52" W), a city of 60,000

inhabitants (Fig. 1). The river receives over 12,000,000 L of untreated domestic sewage daily. The mean water flow is $10.8 \text{ m}^3 \text{ s}^{-1}$ during the rainy season (from December to March) and $4.0 \text{ m}^3 \text{ s}^{-1}$ during the dry season (from August to October). High levels of sewage effluent concentration characterize the end of the dry season due to the low level of water (Alberto, 2002).

A. fasciatus specimens and water were collected from two sites at the end of the dry season (September and October 2000–2001): site 1, the reference or unpolluted area, was located 5 km upstream from the first sewage effluent discharge, above the city of Amparo, while site 2, the untreated-sewage-polluted area, was located downstream from the city, below the sewage discharge (Fig. 1). No industrial effluents are discharged into the river upstream of sites 1 and 2. The distance between sites 1 and 2 was 17 km, interspersed by several waterfalls, which constitute physical barriers to hinder the movement of fish from site 2 to site 1. Samples (four) of fish (50 specimens) and water were collected from the two sites on September and October 2000 and 2001 (one sample in each period), always during the afternoon. Each sampling period, three-gill nets (15, 20, and 25 mm mesh size) were set stretched at three stations located 50 m apart from one another.

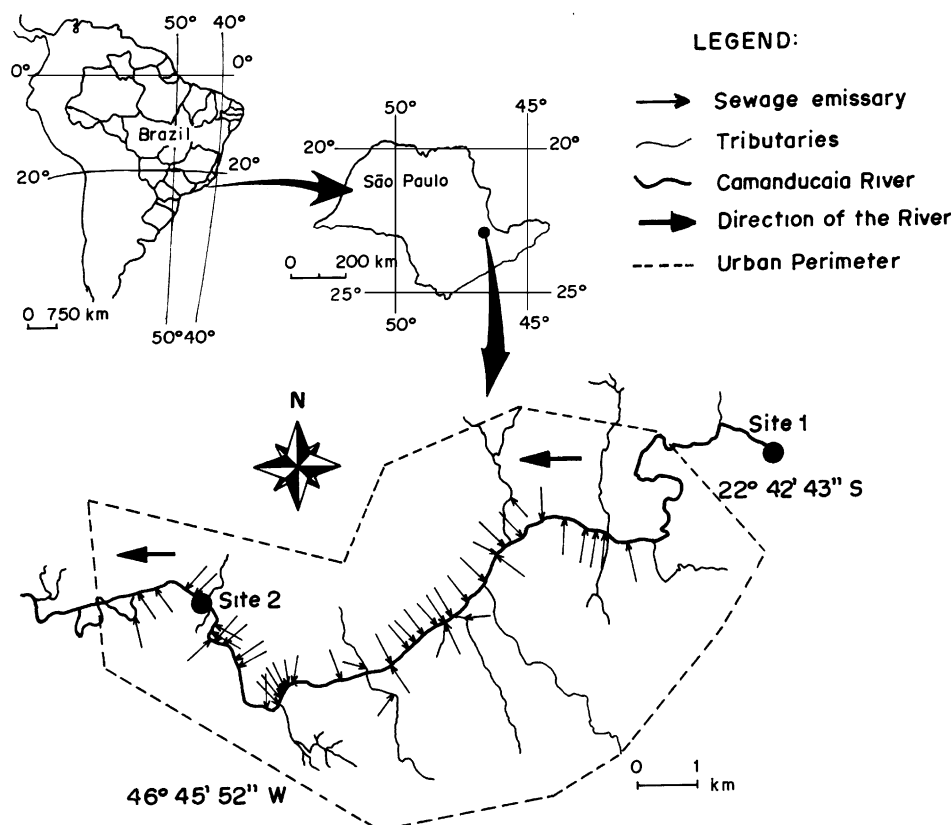


Fig. 1. Map of the Camanducaia River, showing the urban area of the Amparo city (inside of dashed line), untreated domestic sewage discharges (small arrows) into the river and tributaries, sites 1 (unpolluted) and 2 (untreated-domestic-sewage-polluted) of water and fish collection (●), and the approximate location in the state of São Paulo and Brazil.

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