

Morphological abnormalities in Cladocera (Branchiopoda) in a cascade of reservoirs in the middle and lower Tietê river (São Paulo, Brazil)

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Morphological abnormalities in Cladocera were found in cascading reservoirs of the middle and lower Tietê River (São Paulo State, Brazil). These alterations occurred at the ventral margin of the carapace in *Daphnia gessneri*, *D. laevis*, *D. ambigua*, *D. lumholtzi*, *Ceriodaphnia silvestrii* and *C. cornuta* and in the helmet and rostrum of *Daphnia*. These abnormalities may have been caused by chemical contaminants or microorganisms like bacteria and viruses, linked to evidence of pollution in areas of the environment studied (Montú and Gloeden, 1982; Dias, 1999; Otha et al., 1998). In 1993, Hanazato and Dodson showed that four species of *Daphnia* (*D. pulex*, *D. galeata mendotae*, *D. lumholtzi*, and *D. retrocurva*) present morphological alterations in response to the presence of carbaryl insecticide.

In the Tietê River, the presence of toxic substances has been demonstrated by various authors. Calheiros (1993) verified contamination in Barra Bonita reservoir by persistent organochlorine compounds. Toxicity tests carried out in the Tietê River prove the presence in aquatic environmental of harmful substances, like cadmium, iron, copper, lead, and manganese; verified by Costa (2001), Fracácio (2001) and Rodgher et al. (2003).

The results presented in this study were obtained by analyzing samples from 19 stations distributed along a cascading system on the middle and lower Tietê River, taken in February, May, July, and October of 2000. They revealed organisms presenting various stages of abnormality, of which the greatest density was found in the *D. gessneri* population (Figure 1). The total density of *D. gessneri* presenting morphological alterations in the carapace varied from 160 ind.m⁻³ (July 2000) to 387 ind.m⁻³ (May 2000). Percentages of occurrence of these alterations in *D. gessneri* in relation to the total amount of healthy organisms of the same species varied from 0.03% (5 ind.m⁻³) (Tietê River, May 2000; Ibitinga dam, October 2000) to 6.85% (40 ind.m⁻³) (Três Irmãos reservoir, July 2000). *D. laevis* ranked second in density of deformed organisms, with a maximum of 54 ind.m⁻³



Figure 1. Morphological alterations in the carapace of *Daphnia* (x100); observed in samples obtained in 2000 from the reservoir cascade on the Tietê River (São Paulo, Brazil). a) *D. laevis*; b) *D. lumholtzi*; c and d) *D. gessneri*. (Photos taken by the author.)

registered in October 2000 (45 ind.m⁻³ in Barra Bonita reservoir; 9 ind.m⁻³ in Promissão reservoir). *D. lumholtzi* was also found with carapace alterations at a rate of 15 ind.m⁻³. In addition to these organisms, *Daphnia ambigua* and species of *Ceriodaphnia* also presented deformations, although at a lesser density and less frequently.

The appearance of the affected organisms suggested that the deformed tissue had resulted from invasion (Figure 1). To determine the cause, the DAPI method (Porter and Feig, 1980) was applied, which in addition to the use of an epifluorescent microscope, would reveal possible bacterial presence in the affected areas. The result was negative.

The second instance of morphological alterations was found only in individuals of the genus *Daphnia*, which presented alterations of varied appearance, confined to the helmet and rostrum (Figure 2). These organisms were found only in the Bariri reservoir (10 ind.m⁻³) and at the entrance of the dam of the Três Irmãos reservoir (5 ind.m⁻³) in February and October of 2000. This alteration may have been congenital. According to Elmoor-Loureiro (2004), who demonstrated malformations in the post-anal spines and terminal claws of *Ilyocryptus spinifer*, the causes of morphological abnormalities in microcrustaceans have not yet been adequately investigated.

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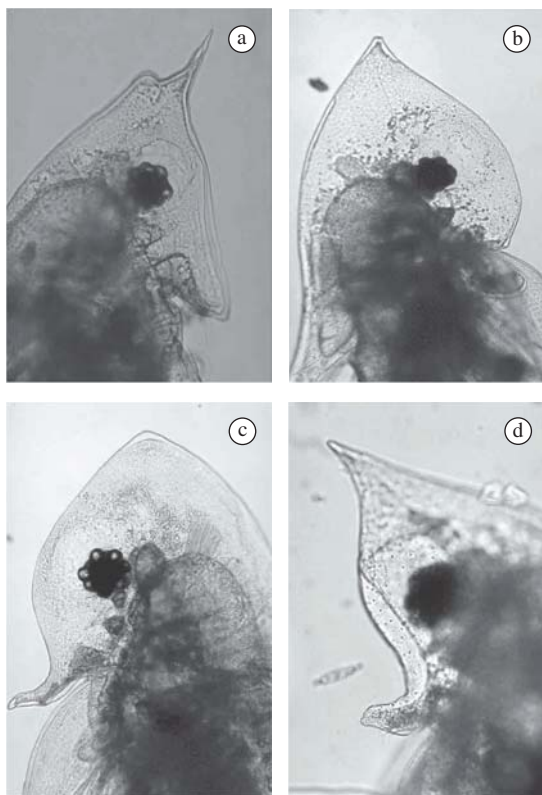


Figure 2. Morphological alterations on the head of *Daphnia* (a, b, c and d) (x 250); observed in samples obtained in 2000 from São Paulo, Brazil. (Photos taken by the author.)