First report of a B chromosome in a natural population of
Astyanax altiparanae (Characiformes, Characidae)

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Abstract
Several species of the genus Astyanax have already been genetically studied, and B-chromosomes have been considered to be an interesting feature in some species of this group. In the present paper we report, for the first time, the occurrence of a B microchromosome in a natural population of A. altiparanae. This additional genomic element was identified as an acrocentric chromosome, similar in size to the smallest chromosomal pairs of the standard karyotype. Analysis of the constitutive heterochromatin pattern by C-banding evidenced heterochromatic blocks located on centromeric, pericentromeric, and interstitial regions of some chromosomes, and also positive marks in a subtelocentric chromosomal pair that presented the short arms entirely heterochromatic. The application of this methodology also revealed a heterochromatic pattern in the extra chromosome, a typical feature of supernumerary chromosomes.

Key words: B chromosomes, fish cytogenetics, Astyanax altiparanae.

Received: September 27, 2006; Accepted: May 22, 2007.
Our results showed a diploid number equal to $2n = 50$ chromosomes and a karyotypic formula composed of $12M + 18SM + 12ST + 8A$ (fundamental number = 92) for both sexes (Figure 1) of *Astyanax altiparanae* from Campo Novo River. However, two specimens presented a diploid number of $2n = 51$ chromosomes, bearing an extra chromosome, characterized as a small acrocentric chromosome, similar in size to the smallest chromosome pairs of the standard karyotype (Figure 1 - insert).

The diploid number of $2n = 50$ chromosomes corroborates previous data reported for different *A. altiparanae* populations (Daniel-Silva and Almeida-Toledo, 2001; Fernandes and Martins-Santos, 2004; Daniel-Silva and Almeida-Toledo, 2005). This species has been regarded as presenting a high karyotypic stability within the genus *Astyanax*, especially when compared with *A. scabripinnis* and *A. fasciatus* that present variation in the diploid number and more pronounced differences in the macro and micro-structure of their chromosomes (Oliveira et al., 1988; Moreira-Filho and Bertollo, 1991; Pazza et al., 2006).

Despite the maintenance of the diploid number, the karyotypic formula of the present population is composed of 12 metacentric, 18 submetacentric, 12 subtelocentric, and 8 acrocentric chromosomes, with a fundamental number of 92, thus demonstrating some variation when compared to other populations (Daniel-Silva and Almeida-Toledo, 2001; Pacheco et al., 2001; Fernandes and Martins-Santos, 2004; Daniel-Silva and Almeida-Toledo, 2005). Such differences can be explained by the occurrence of small non-Robertsonian chromosomal rearrangements, mainly pericentric inversions, although different levels of chromosomal condensation and/or morphological misclassification of the chromosomes cannot be excluded.

![Figure 1](image1.png) - Giemsa-stained karyotype of *Astyanax altiparanae* from the Campo Novo River. In evidence, one supernumerary chromosome.

Analysis of the constitutive heterochromatin patterns by C-banding showed heterochromatic blocks on centromeric, pericentromeric, and interstitial regions of some chromosomes, besides consistent marks on a pair of subtelocentric chromosomes that presented the short arms entirely heterochromatic. Such general heterochromatin pattern has frequently been observed in distinct populations of *A. altiparanae* (Daniel-Silva and Almeida-Toledo, 2001; Fernandes and Martins-Santos, 2004), demonstrating that these chromosomal regions present a highly conservative distribution in this species. The supernumerary chromosome was totally heterochromatic (Figure 2), in accordance with a common feature reported for B chromosomes in the genus *Astyanax* (Salvador and Moreira-Filho, 1992; Mizoguchi and Martins-Santos, 1997; Néo et al., 2000a, b; Moreira-Filho et al., 2001).

B chromosomes have already been described in other three *Astyanax* species, such as *A. scabripinnis* (Salvador and Moreira-Filho, 1992; Vicente et al., 1996; Ferro et al.,

![Figure 2](image2.png) - Metaphases of *Astyanax altiparanae* from the Campo Novo River. Arrows indicate the supernumerary chromosome (conventional Giemsa staining) (a) and the heterochromatic supernumerary chromosome after C-banding (b).
2003), A. fasciatus, and A. schubarti (Moreira-Filho et al., 2001). In A. scabripinnis, supernumerary elements are very frequent in distinct populations (for review, see Moreira-Filho et al., 2004), with several studies related to the distribution of B chromosomes according to altitude (Néo et al., 2000b), sex (Vicente et al., 1996; Mizoguchi and Martins-Santos, 1997), morphology and size (Néo et al., 2000a, b; Ferro et al., 2003), and origin in natural populations (Salvador and Moreira-Filho, 1992; Vicente et al., 1996; Mestriner et al., 2000; Néo et al., 2000a). Nevertheless, there are no reports about B chromosomes in Astyanax altiparanae, and this represents the first occurrence reported for this species.

Although A. scabripinnis reveals B chromosomes of different morphology and size, a metacentric B macrochromosome (Bm) has been found to be a common feature in most of the analyzed populations with supernumerary chromosomes (Moreira-Filho et al., 2004). Additionally, a similar Bm chromosome has been found in other three species of the same genus (A. eigenmanniorum, A. fasciatus, and A. schubarti), suggesting that this Bm variant might have preceded the differentiation of these species (Moreira-Filho et al., 2001). Thus, considering this hypothesis, the B microchromosome of A. altiparanae appears to have an independent origin of the Bm variant found in other Astyanax species and can represent a sporadic case in this species.

Even though the diploid number remains unchanged and the heterochromatin pattern appears similar amongst different populations of A. altiparanae, the presence of B chromosomes, as well as variation in both karyotypic formula and fundamental numbers, show that a plenty of work is still required in order to provide a better understanding of the chromosomal diversification of this fish group.

Acknowledgments

F.P.F. was supported by a fellowship from Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP). This work was supported by grants from Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP).

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**Associate Editor: Luiz Antonio Carlos Bertollo**

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