

Cytogenetics analysis and heterochromatin distribution in ZZ/ZW sex chromosomes of the mailed catfish *Loricariichthys platymetopon* (Loricariidae: Siluriformes)

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ABSTRACT

A cytogenetic study was conducted on 26 *Loricariichthys platymetopon* specimens from the region of Porto Rico, State of Paraná, Brazil. Both males and females had a diploid number equal to 54, with a probable sex mechanism of the ZZ/ZW type. Constitutive heterochromatin was located in the centromeric region of all chromosomes in the karyotype and coincided with the nucleolus organizer region.

INTRODUCTION

Although the family Loricariidae is one of the largest freshwater fish families in the Neotropical region, few data are available on its cytogenetics, probably due to the difficulty in species identification.

The subfamily Loricariinae comprises approximately 30 genera and 185 species and forms the most specialized subfamily of Loricariidae, at least in terms of outer appearance (Burguess, 1989). The following species have been studied in this subfamily: *Loricaria parva*: 2n=48 (Post, 1965), *L. macrodon*: 2n=58; NF=78 (Michele *et al.*, 1977), *Loricaria* sp from the Amazonian region: 2n=62 (Della-Rosa *et al.*, 1980), *L. proluxa*: 2n=62; NF=86 and *Loricaria* sp: 2n=64; NF=84, from the Paraná river basin (Scavone, 1993), *Rhineloricaria latirostris*: 2n=44 (Giuliano and Bertollo, 1982) and *Loricariichthys* sp: 2n=54 (Fenocchio *et al.*, 1990) from the middle Paraná river.

In the present investigation we analyzed the karyotype and some chromosomal characteristics of *Loricariichthys platymetopon*.

MATERIAL AND METHODS

Specimens of *L. platymetopon* (18 females and eight males) were collected from the Paraná River basin in the region of Porto Rico, State of Paraná, Brazil (Figure 1).

Mitotic preparations were obtained from the anterior portion of the kidney, and metaphase stimulation was obtained by the technique of Cucchi and Baruffaldi (1990). Mitotic chromosomes preparations were obtained by the method of Egoscue (1971), modified by Bertollo (1978). Nucleolus organizer regions (NORs) were detected by the method of Howell and Black (1980) and the constitutive heterochromatin according to Sumner (1972), modified by the Cytogenetics Laboratory of the University of São Carlos, São Paulo, Brazil.

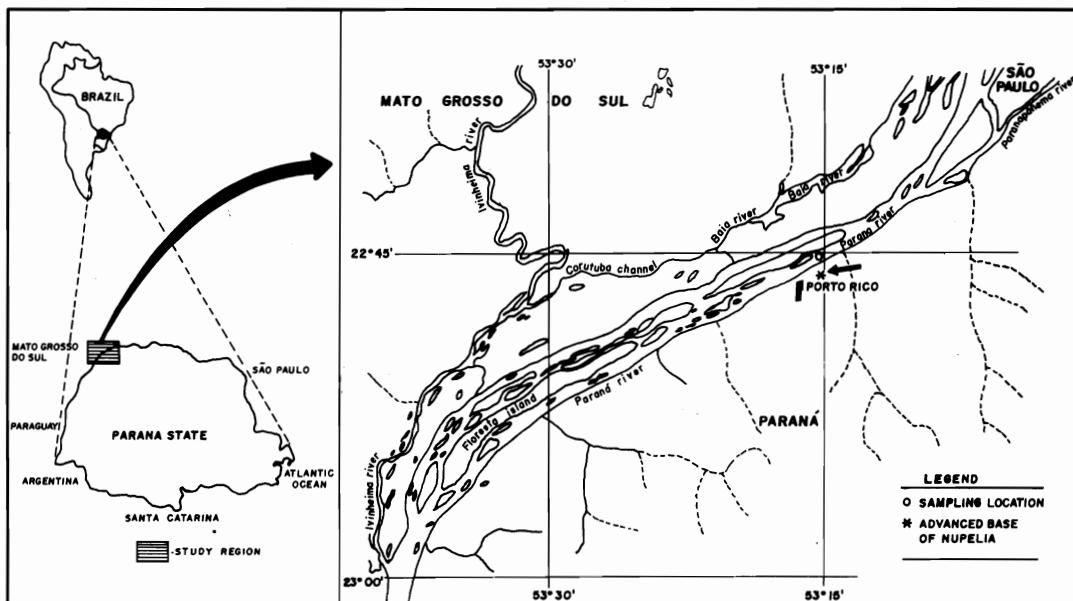


Figure 1 - Map of the Paraná river showing the sampling location.

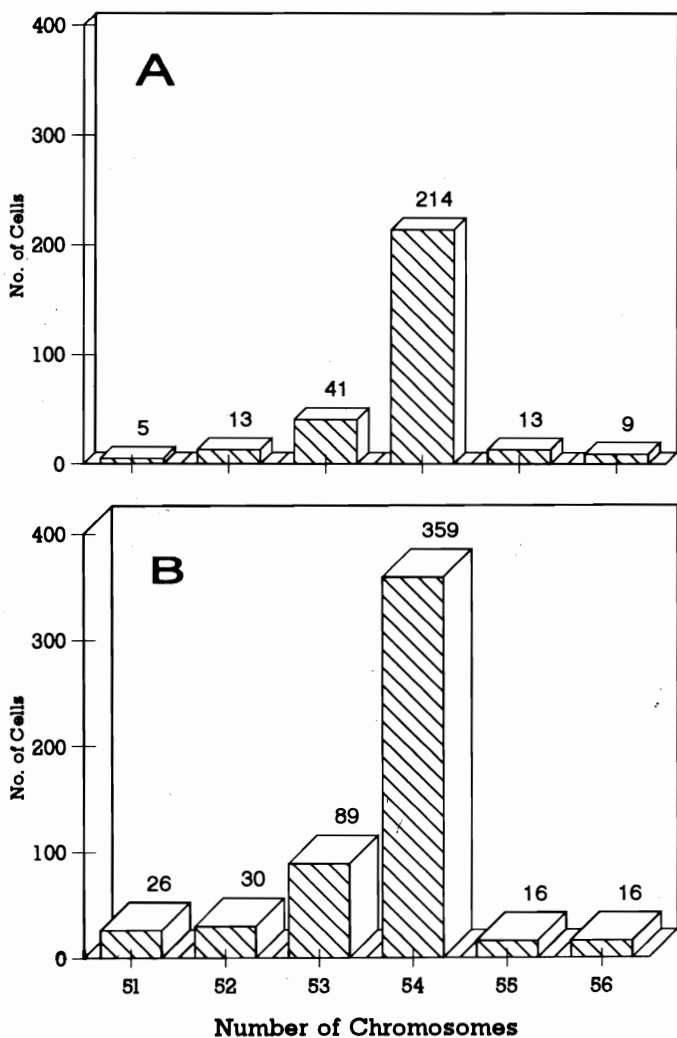


Figure 2 - Diploid number frequencies of males (A) and females (B) of *Loricariichthys platymetopon*.

The chromosomes were arranged in decreasing order of size following the classification of Levan *et al.* (1964). Idiograms were constructed according to chromosome measurements, using computational methods.

RESULTS

L. platymetopon has a modal diploid number of 54 chromosomes (Figure 2). The female karyotype comprises seven metacentrics, 20 submetacentrics, four subtelocentrics and 23 acrocentrics, for a total number of chromosome arms (NF) equal to 85. The male karyotype comprises six metacentrics, 20 submetacentrics, four subtelocentrics and 24 acrocentrics, for a total number of chromosome arms (NF) equal to 84 (Figure 3).

The NOR was located on the short arm of chromosome pair 14 (Figure 4). Constitutive heterochromatin was detected in the centromeric regions of all chromosome pairs and in the short arm of pair 14, in the same region as the NOR (Figure 5).

DISCUSSION

The species *L. platymetopon* has the same modal diploid number detected in *Loricariichthys* sp. by Fenocchio *et al.* (1990). However, the chromosome formulae of these two species are different. *Lorica-*

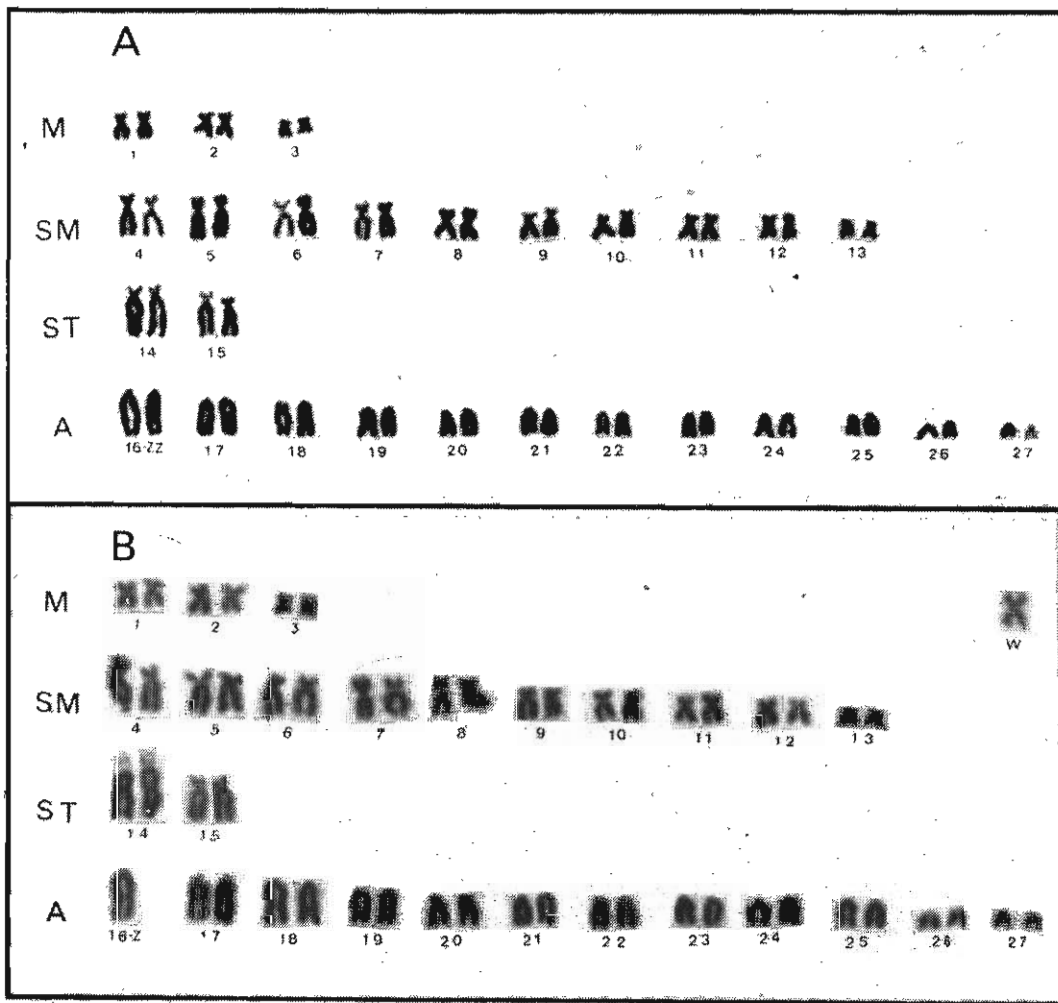


Figure 3 - Karyotype of the male (A) and female (B) of *Loricariichthys platymetopon*.

nichthys sp. has three more submetacentric and three less acrocentric pairs than *L. platymetopon*. Although few species of Loricariinae have been studied cytogenetically, the available data permit us to suggest divergent karyotypic evolution. The data obtained for *L. platymetopon* support this suggestion.

The NORs of *L. platymetopon* occur on only one chromosome pair in the karyotype, in agreement with the general trend observed in Siluriformes. The coincidence with the region of constitutive heterochromatin is a common occurrence. Several investigators have detected heterochromatin regions coinciding with the NOR or intercalated with this region. According to Kligerman and Bloom (1977), the presence of constitutive heterochromatin in the NORs is not correlated with gene inactivity since these regions need to be functional for nucleoli organization. Galetti Jr. (1988) suggests that ribosomal cistrons may be intercalated with heterochromatin sites, forming a mosaic.

In addition to coinciding with the NOR, heterochromatin occurred in the centromeric regions of all chromosomes in the karyotype. The common occur-

rence of centromeric blocks suggests that these regions have characteristics favorable to the accumulation of repetitive sequences, or that the mechanism for sequence accumulation occurs preferentially in these regions (John, 1988).

L. platymetopon females show a metacentric chromosome having no homology with any other chromosome in the karyotype, and an unpaired acrocentric chromosome, possibly the number 16 in the karyotype (Figure 3). This is not the case for males, which have 27 homomorphic pairs. This occurrence in all males and females analyzed indicates a sex heteromorphism of the ZZ/ZW type. Few cases of heteromorphic sex chromosomes have been related for Loricariidae fishes. These are the XY and ZW systems recently described in *Pseudotocinclus tietensis* and *Microlepidogaster leucofenatus*, respectively (Andreatta *et al.*, 1992, 1993), with the Y and W chromosomes clearly identified by their amount of heterochromatin.

However, unlike most vertebrates, this species does not show heterochromatinization in the sex chromosomes. Heterochromatin is located only in the cen-

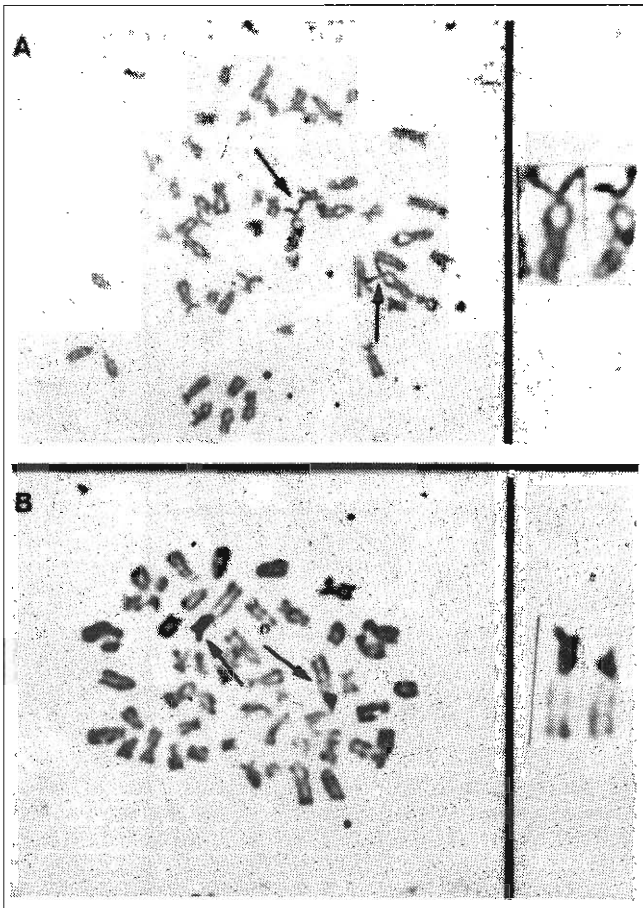


Figure 4 - Somatic metaphases of male (A) and female (B) of *Loricariichthys platymetopon*, showing the NOR-bearing chromosomes (arrows).

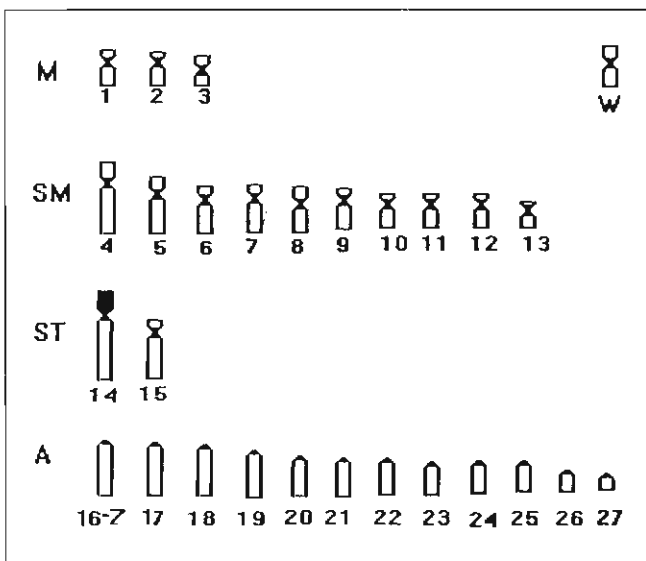


Figure 5 - Idiogram showing the C-banding pattern of *Loricariichthys platymetopon*.

centromeric regions, as also observed in the other chromosomes in the karyotype.

The initial step in sex chromosome differentiation has been frequently attributed to heterochromati-

nization. According to Moreira Filho *et al.* (1993), heterochromatinization appears to be followed by heterochromatin accumulation and by elongation of chromosome Y or W in relation to the original chromosome (X or Z) in some fish species, whereas in other species heterochromatinization is accompanied by a reduction in size during sex chromosome differentiation.

However, sex chromosomes with no heterochromatin accumulation have been detected, as in the Boidae; in *Acanthopis dumerelt* the sex pair is identical in size but differs in centromere position. G-banding indicated that centromeric change was the result of pericentric inversion (Mengden and Stock, 1980). Consequently, in this case, it may be safely concluded that the primary event involved in the sex chromosomes differentiation was not a heterochromatinization process. The C-banding patterns observed in *L. platymetopon* suggests that is also the case for this species.

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RESUMO

A espécie *Loricariichthys platymetopon* foi analisada e mostrou um número diplóide de 54 cromossomos, em machos e em fêmeas, com um heteromorfismo sexual de tipo ZZ/ZW. A heterocromatina ocorre apenas na região centromérica dos cromossomos sexuais, como ocorre no restante dos cromossomos do cariótipo, além de todo o braço menor do par cromossômico 14, onde é coincidente com a região organizadora do nucléolo.

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