Karyology of *Apareiodon affinis* from Paraná River (Argentina). I. Chromosome Polymorphism

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**Summary** Karyotypic studies on a population of *Apareiodon affinis* from Paraná river (Argentina) were carried out. Although the modal diploid number of the population was 54 chromosomes, some structural and numerical polymorphisms were detected. In the first case these variations deal with the number of mono- and biarmed chromosomes and in the second with the presence of an additional unpaired chromosome that appeared only in female individuals, suggesting some kind of linkage with a chromosomal system of sex determination. These data were compared with the available cytogenetic information and the geographic distribution of *A. affinis*.

**Key words** Chromosome polymorphism, *Apareiodon affinis*, Neotropical fishes, Paraná river.

Parodontidae is a relatively small family of neotropical fishes with only three genera, *Apareiodon*, *Parodon* and *Saccodon* (Garavello 1977) distributed from Panamá to the La Plata basin in Argentina. *Apareiodon* and *Parodon* are widely distributed in South America, their tooth being the principal diagnostic characters (Travassos 1955, Britski 1972, Roberts 1974).

This family constitute a major group of Characiformes with Anostomidae, Curimatidae, Prochilodontidae and Chilodontidae showing a general cytogenetic uniformity with a diploid number of 54 biarmed chromosomes (FN = 108) in almost all the studied species (Galetti Jr. et al. 1994). However, in some cases in Parodontidae and Anostomidae the occurrence of sexual chromosome systems with female heterogamety (ZZ/ZW) has been reported (Galetti Jr. and Foresti 1986, Galetti Jr. et al. 1995, Moreira 1983, Centofante et al. 2002). Additionally, a special multiple sexual chromosome system was described in *Apareiodon affinis* from the Upper Parana river basin, also with female heterogamety, but with multiple W chromosomes (Moreira et al. 1980). In this case males have 2n = 54 (FN = 108) (ZZ) and females have 2n = 55 (FN = 110) (ZW\(_1\)W\(_2\)) (Moreira et al. 1980). A comparative study among *A. affinis* from Paraná and Paraguay rivers reports that in the last population males and females show 2n = 54 without sexual chromosome heteromorphisms but with a FN = 98, due to the presence of acrocentric elements in the karyotype (Jesus et al. 1999). Jorge and Moreira (2000) comparing populations of this species from the Paraná river at Brazil and Argentina locations corroborate that the first ones present well established multiple sex chromosomes that are not present in Argentinean population. In the former, however, a wide chromosomal polymorphism was observed due to the presence of variable number of acrocentric chromosomes, performing 10 different cytotypes.

In this paper was cytogenetically studied *A. affinis* from an Argentinean population geographically located between the both analyzed by Jorge and Moreira (2000).

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Material and methods

Were cytogenetically studied 34 individuals (14 females, 16 males and 4 of undetermined sex) of *Apareiodon affinis* from the Paraná river at Posadas (Misiones Province, Argentina). Chromosome preparations were obtained from kidney cells by means of direct and culture techniques (Bertollo *et al.* 1978, Fenocchio *et al.* 1991). C and NOR bands were obtained following the methods of Sumner (1972) and Howell and Black (1980) respectively. Chromosomes in karyotypes were arranged in the order of meta-submetacentrics, subtelocentrics and acrocentrics.

Results and discussion

All the analyzed males showed 2\(n=54\) chromosomes but were found females with 2\(n=54\) and 2\(n=55\) chromosomes. An accentuated structural polymorphism were detected, with at least seven different cytotypes: a) female 2\(n=55\) (47 M-SM; 8 ST–NF=110); b) female 2\(n=55\) (43 M-SM; 10 ST and 2 A–NF=108); c) female 2\(n=55\) (43 M-SM; 10 ST-A and 2 A–NF=108); d) female 2\(n=54\) (45 M-SM; 8 ST and 1 A–NF=107) (Fig. 1); a) male 2\(n=54\) (40 M-SM; 12 ST and 2 A–NF=106); b) male 2\(n=54\) (40 M-SM; 9 ST and 5 A–NF=103) and c) male 2\(n=54\) (42 M-SM; 8 ST and 4 A–NF=104) (Fig. 2).

These results show that only females have 2\(n=55\) chromosomes and the structural polymorphism is related to the number of the diverse chromosome types, varying principally the number of acrocentrics, changing, in consequence, the FN.

NORs were observed distally on the long arm of a subtelocentric chromosome pair, as was reported in the literature. C banding shows heterochromatic blocks in centromeric regions, few telomeric ones and a single pair with the short arms entirely stained (results not showed).

Present results disagree with the first cytogenetic data reported for Parodontidae and specially for *A. affinis* studied by Moreira *et al.* (1980, 1985) in Brazil. Differences raise first, on the absence of a well established sex chromosome system and second, on the presence of acrocentric chromosomes into the complement. Occurrence of polymorphism and monoarmed chromosomes were recently reported by Jorge and Moreira (2000) in *A. affinis* from Paraná river at Corrientes (Argentina) and the authors suggested that acrocentrics could be originated from pericentric inversions involving more than one chromosome. For the population of *A. affinis* studied here belonging also to the Paraná river at Posadas (Argentina), it is possible to suggest that the same mechanism could have originated the complex structural polymorphism now reported.

Additionally, in the present study females with 55 chromosomes resembling those from Brazil were observed, having ZZ/ZW,W2 sex chromosome system. This fact suggests that, in addition to the occurrence of chromosomal rearrangements into the populations, actually a hybridization process among the brazilian sexually well differentiated populations and Argentinean ones could have occurred.

The populations of *A. affinis* studied now throughout the Parana river have actually a disjunct distribution, being separate by an important geographical barrier (Sete Quedas or Saltos del Guairá) that should have contributed to establish in Brazil a more conservative karyotype, showing a differentiated sex chromosome system without conspicuous chromosome polymorphisms (Moreira *et al.* 1980, 1985). In contrast, populations from Argentina, Corrientes (Jorge and Moreira 2000) and Posadas (present study), show variable karyotypes, that could be due to specially favorable ecological conditions of the habitat, leading to numerically large population and maintaining a wide chromosomal polymorphism.

Present report reinforces former data about structural polymorphisms in *A. affinis* from Argentina additionally showing not previously observed numerical variation in females that could be related to sexual determination and needs further carefully investigation.
Fig. 1. Cytotypes of females of *Apareiodon affinis* a) 2n=55 (M-SM-ST), b) 2n=55 (M-SM-ST-A), c) 2n=55 (M-SM-ST-A), d) 2n=54 (M-SM-ST-A).
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References


