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Cytogenetic studies of three species of Glandulocaudinae (Pisces, Characiformes, Characidae)

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ABSTRACT

Cytogenetic studies of three species of the subfamily Glandulocaudinae showed that *Mimagoniates microlepis* presents 2n=52 chromosomes (6M+20SM+18ST+8A), *Mimagoniates lateralis* presents 2n=52 chromosomes (6M+20SM+16ST+10A) and *Glandulocauda melanogenys* presents 2n=52 chromosomes (4M+12SM+22ST+14A). The number of NOR-bearing chromosome pairs ranged from two to four. Differences in number and position of NORs at the species and population levels were detected, suggesting that several chromosome rearrangements occurred in the evolutionary process of this group. Some aspects related to the chromosome evolution of the Glandulocaudinae are discussed.

INTRODUCTION

The family Characidae represents the largest group of freshwater fishes in South America with 170 genera and over 885 species (Nelson, 1994). This group shows a large karyotypic diversity with diploid numbers ranging from 2n=28 chromosomes for a *Hemigramus* species to 2n=64 for *Serrasalmus holandi*, with a clear predominance of karyotypes ranging from 2n=48 to 2n=54 chromosomes (Oliveira *et al.*, 1988a).

The subfamily Glandulocaudinae includes 50 species in about 17 genera (Weitzman *et al.*, 1988) for which only the haploid numbers of two species have been described (Scheel, 1973).

The objective of the present investigation was to determine the diploid number, karyotypic formulae and number and position of nucleolus organizer regions (NORs) of three species of this subfamily.

MATERIAL AND METHODS

Three species belonging to the subfamily Glandulocaudinae (tribe Glandulocaudini) were analyzed: *Mimagoniates microlepis* (six local populations); *M. lateralis* (one local population); and *Glandulocauda melanogenys* (one local population). Table I shows the collection sites and the number and sex of specimens analyzed.

Mitotic chromosome preparations were obtained from kidney and gill cells using the air-drying technique (Oliveira *et al.*, 1988b). Chromosome morphology was determined on the basis of arm ratio, as proposed by Levan *et al.* (1964) and the chromosomes were classified as metacentrics (M), submetacentrics (SM), subtelocentrics (ST) and acrocentrics (A). NF

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(chromosome arm number) was determined considering M/SM chromosomes to have two arms and ST/A chromosomes to have one arm. NOR silver staining was performed by the method of Howell and Black (1980).

RESULTS AND DISCUSSION

The three species analyzed presented 2n=52 chromosomes (Figure 1), suggesting that this group has a constant diploid number. A previous description of the occurrence of n=26 chromosomes in two species of *Gephyrocharax* (Scheel, 1973) is consistent with this idea.

A diploid number of 2n=52 chromosomes is one of those most frequently found among species of several Characidae subfamilies (Oliveira *et al.*, 1988a). However, a constant diploid number of 2n=52 chromosomes in the family Characidae has been described only for the subfamily Triportheinae (Falcão, 1988; Bertollo and

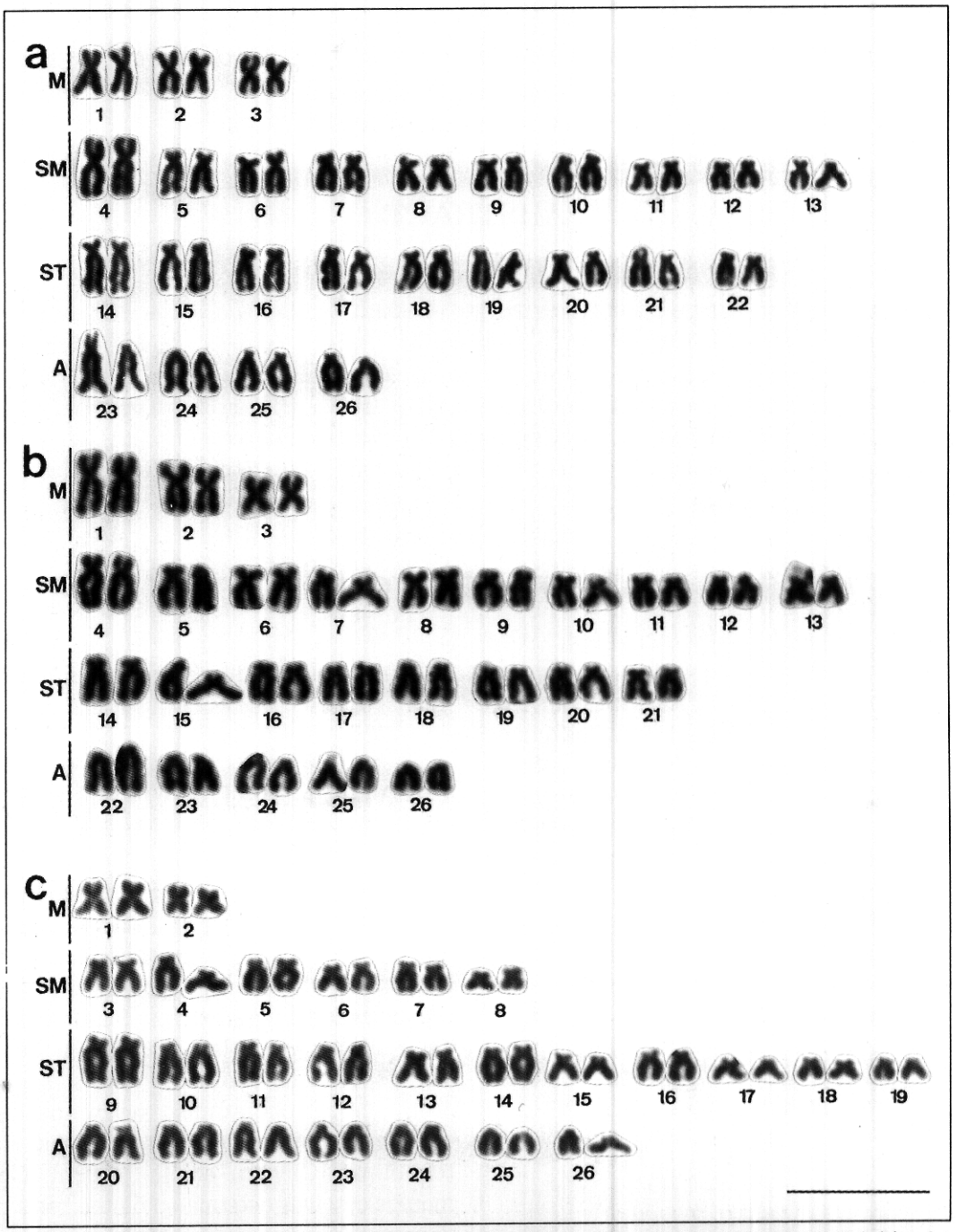

Figure 1 - Giemsa stained karyotypes of a *Mimagoniates microlepis* female from Mongaguá (a), of a *Mimagoniates lateralis* female from Itanhaém (b) and of a *Glandulocauda melanogenys* female from Paranapiacaba (c). Bar = 10 μm.

Table I - Cytogenetic data from fishes of the subfamily Glandulocaudinae.

Species	Locality	No. of fish			2n	NF	Karyotype				Pairs with NORs
		Male	Female	?			M	SM	ST	A	
Mimagoniates microlepis	Bertioga, SP	5	2	1	52	96	6	20	18	8	4
Mimagoniates microlepis	Mongaguá, SP	9	6		52	96	6	20	18	8	3
Mimagoniates microlepis	Itanhaém, SP	4		1	52	96	6	20	18	8	2
Mimagoniates microlepis	Peruíbe, SP	1			52	96	6	20	18	8	3
Mimagoniates microlepis	Juquiá, SP	1			52	96	6	20	18	8	4
Mimagoniates microlepis	Pirabeiraba, SC	2		1	52	96	6	20	18	8	2
Mimagoniates lateralis	Itanhaém, SP	4	2		52	94	6	20	16	10	3
Glandulocauda melanogenys	Paranapiacaba, SP	1	2		52	90	4	12	22	14	3

? = fish not sexed.
NF = chromosome arm number. M and SM are considered to have two arms and ST and A to have one.
M = metacentric, SM = submetacentric, ST = subtelocentric and A = acrocentric;
NOR = nucleolus organizer regions.

Cavallaro, 1992). A clear difference between Triportheinae and Glandulocaudinae is the presence in the former of sex chromosomes distinguishable by Giemsa staining.

On the other hand, many species of Characidae present one metacentric pair about twice as large as the second chromosome pair of the complement (Scheel, 1973; Morelli *et al.*, 1983; Portela, 1987 among others). This large chromosome pair is not present in the species of Glandulocaudinae studied (Figure 1), suggesting that chromosome rearrangements have occurred at the origin of the group or that Glandulocaudinae and other Characidae may not have a common ancestor.

Analysis of the karyotypic structure showed that there are small differences between *M. microlepis* and *M. lateralis* and marked differences between the karyotypes of the *Mimagoniates* species and the karyotype of *G. melanogenys* (Table I). This pattern was expected since different genera were compared, and because species of *Mimagoniates* inhabit a closely related geographical area (the Leste basin), while species of *Glandulocauda* are found in another hydrographic basin (Tiete river basin).

The number and position of NORs visualized by the silver-staining technique were highly variable (Table I, Figure 2); however all three species studied presented multiple NORs. The analysis of six local

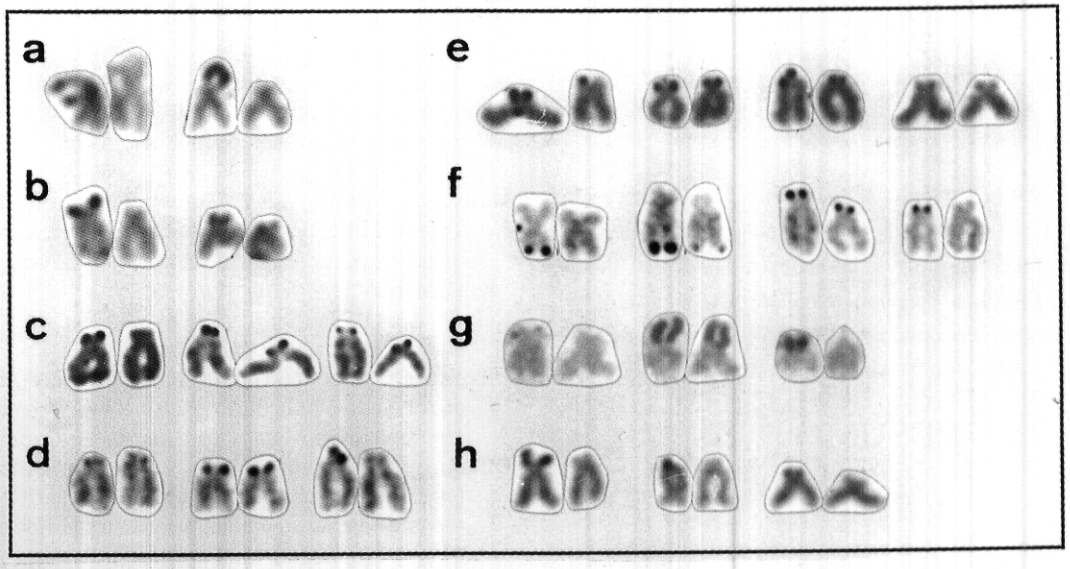

Figure 2 - NOR-bearing chromosome pairs, stained by the Ag-NOR technique, of *Mimagoniates microlepis* from Pirabeiraba (a), Itanhaém (b), Peruíbe (c), Mongaguá (d), Bertioga (e), and Juquiá (f); of *Mimagoniates lateralis* from Itanhaém (g); and *Glandulocauda melanogenys* from Paranapiacaba (h).

populations of *M. microlepis* showed that there is a marked local differentiation for this characteristic in some populations. Since several authors have suggested that the number and position of NORs could be species-specific (Galetti Jr. *et al.*, 1984; Amemyia and Gold, 1988; Venere and Galetti Jr., 1989 among others), the differences found in local populations of *M. microlepis* may have an important taxonomic meaning. Some of these local populations may in fact represent different species.

Some differences in karyotypic formulae and/or in the number and position of NORs in the *Mimagoniates* species could be ascribed to technical problems, such as chromosome measurements; however, the occurrence of different karyotypes in local populations of other fish species which also inhabit strams or small rivers belonging to the Leste basin (Oliveira *et al.*, 1990, 1993; Andreata *et al.*, 1993, 1994) suggest that this difference could be real. Considering that many coastal rivers which drain into the Atlantic Ocean were affected by the large fluctuations in sea level during alternating glacial and interglacial periods of Pleistocene which joined and separated many of the those coastal rivers (Weitzman *et al.*, 1988), the fixation of different karyotypes in several populations of species of different groups in this area could have being facilited by geographical isolation of the populations.

The chromosome diversification detected in the Glandulocaudinae is usually observed in fish which form isolated populations inhabiting small rivers and streams, as pointed out by Oliveira *et al.* (1988a). The apparent lack of morphological modification may mean that chromosome modifications were more tolerated than morphological modifications in this group.

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RESUMO

Estudos citogenéticos de três espécies pertencentes à subfamilia Glandulocaudiane mostraram que *Mimagoniates microlepis* apresenta 2n=52 cromossomos (6M+20SM+18ST+8A), *Mimagoniates lateralis* apresenta 2n=52 cromossomos (6M+20SM+16ST+10A) e *Glandulocauda melanogenys* apresenta 2n=52 cromossomos (4M+12SM+22ST+14A). O número de pares cromossômicos com NORs variou de dois a quatro. Além das diferenças a nível específico foram encontradas diferenças em número e posição das NORs a nível populacional, sugerindo que vários rearranjos cromossômicos ocorreram durante o processo evolutivo do grupo. Alguns aspectos relativos à evolução cromossômica dos Glandulocaudinae são discutidos.

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