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Karyotypes of three species of marine catfishes from Brazil

Vicente GOMES; PHAN Van Ngan & Maria José de Arruda Campos Rocha PASSOS

Instituto Oceanográfico da Universidade de São Paulo
(Caixa Postal 66149, 05389-970, São Paulo, SP, Brasil)

- *Abstract:* The chromosomes of three species of fishes belonging to the family Ariidae - *Netuma barba, Genidens genidens* and *Arius parkeri* - were studied after conventional Giemsa staining. All three species have a diploid chromosome number of 2n = 56. The karyotype comprises 18 metacentric (**m**), 18 submetacentric (**sm**), 18 subtelocentric (**st**) and 2 telocentric (**t**) pairs for *N. barba;* 12 **m**, 20 **sm**, 20 **st** and 4 **t** pairs for *G. genidens*; 16 **m**, 16 **sm**, 22 **st** and 2 **t** pairs for *A. parkeri*. The results obtained from these three species are compared with each other and with those found in literature.

- *Resumo:* Os cromossomos de 3 espécies de peixes da família Ariidae - *Netuma barba, Genidens genidens* e *Arius parkeri* - foram estudados após coloração convencional com Giemsa. As três espécies apresentaram número modal diplóide de 2n=56. O cariótipo de *N. barba* compreende 18 pares de cromossomos metacêntricos (**m**), 18 submetacêntricos (**sm**), 18 subtelocêntricos (**st**) e 2 telocêntricos (**t**); o de *G. genidens* compreende 12 pares **m**, 20 **sm**, 20 **st** e 4 **t**; o de *A. parkeri* compreende 16 **m**, 16 **sm**, 22 **st** e 2 **t**. Os resultados obtidos são comparados entre si e com os de outros ariídeos encontrados na literatura.

- *Descriptors*: Chromosome, karyotype, Siluriformes, Ariidae.

- *Descritores:* Cromossomos, cariótipo, Siluriformes, Ariidae.

Introduction

There are about 2000 species of catfishes belonging to 31 families of which 13 are endemic to South America (Lauder & Liem, 1983). Two of the catfish families became secondarily marine: the Plotosidae (eeltail catfishes) and the Ariidae (marine catfishes) (Kramer, 1990).

Members of Ariidae have circumtropical distribution and can be found along all the Brazilian coast. They are of great economical importance in certain regions, mainly for the Brazilian southern sea-side populations (Figueiredo & Menezes, 1978). Numerous studies about this group covering various fields of scientific research have been developed; nevertheless, the systematics and the relationship between its members are still highly controversial (Higuchi *et al.*,1982; Suzuki & Phan, 1990a).

Cytogenetical investigation has been used as one important tool that can help to elucidate problems related to systematics, evolution (Denton, 1973; Kirpichnikov, 1981) and population structure (e.g. Cestari & Galetti Jr., 1992) of fishes. Karyotypes of only 129 species of freshwater and marine Siluriformes belonging to 13 families are available (Fitzsimons *et al.*, 1988). Just five species of the family Ariidae have been karyotyped until now.

This work belongs to a series of studies that aims to verify genetical aspects of the ariid fishes of the estuarine region of Cananéia, using biochemical (Suzuki & Phan, 1990 a,b), immunological (Gomes *et al.*, in preparation) and cytogenetical (Gomes *et al.*, 1990, 1992) methods. In this paper the karyotypes of *Netuma barba* (Lacépéde, 1803), *Genidens genidens* (Valenciennes, 1893) and *Arius*

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parkeri (Trail, 1832) (Siluriformes, Ariidae) are described and compared to the karyotypes of other ariids found in the literature.

Materials and methods

Specimens of *N. barba, G. genidens* and *A. parkeri* were collected in the estuarine region of Cananéia, São Paulo, Brazil (25°01'S; 47°56'W) from May 1981 to November 1986. Identification and denomination of the species were made after Taylor & Menezes (1977) and Figueiredo & Menezes (1978). The specimens were kept alive in tanks with running sea water and were injected intraperitoneally with 0.2ml/100g body weight of 0.5% colchicine in saline solution. Four to six hours after the injection the animals were sacrificed and the kidney was removed for chromosome preparation following the method described by LeGrande & Fitzsimons (1976) with few modifications (Gomes *et al.*, 1990).

The metaphases were photographed, the chromosomes were counted and the karyograms mounted from photographic prints. The size of the chromosomes in micrometers was estimated by measuring on the microscope one easily identifiable chromosome of a set with a micrometric eyepiece and then correlating these measures with those of all chromosomes of the same set taken from a photographic print (Denton, 1973). The arm ratios (long arm/ short arm) were calculated and terminology for centromeric position followed the criteria of Levan *et al.* (1964). To facilitate comparisons between species the chromosomes were also grouped in **msm** and **stt** types following Uyeno *et al.* (1983). To calculate arm numbers (AN), **m** (metacentric) and **sm** (submetacentric) chromosomes were considered as biarmed and **st** (subtelocentric) and **t** (telocentric) as uniarmed.

Results

Metaphase plates were obtained from 20 specimens of *N. barba*, 11 males and 9 females, ranging from 181mm to 293 mm in total length; 12 specimens of *G. genidens*, 4 males and 8 females, ranging from 145 mm to 240 mm in total length and 13 specimens of *A. parkeri*, 6 males and 7 females, ranging from 206 mm to 356 mm in total length.

In relation to *N. barba*, 203 mitotic spreads were examined, 132 for the males and 71 for the females. The cells with diploid number of 2n = 56 chromosomes account for 77.27% of male and 74.65% of female metaphases. The total length of the chromosomes in micrometers (μm) taken as an average of 10 selected spreads ranged from 6.29 μm to 1.81 μm. The karyotype consisted of 9 **m** pairs, 9 **sm** pairs, 9 **st** pairs and 1 **t** pair (Fig. 1, A and B); AN is, therefore, 92. The 19th **sm** pair is heteromorphic for the males and is constituted by the largest chromosome of the complement, averaging 4.13 μm, and by a smaller one with average total length of 2.49 μm (Fig. 1, A).

Regarding to *G. genidens*, 112 mitotic plates were examined, 69 for the males and 43 for the females. The modal diploid number is 2n = 56, representing 79.07% of the total countings for the males and 79.71% for the females. The total length of the chromosomes in micrometers (μm) taken as an average of 10 selected metaphases ranged from 5.18 μm to 1.77 μm. The karyotype consisted of 6 **m** pairs, 10 **sm** pairs, 10 **st** pairs and 2 **t** pairs (Fig. 2, A and B). The AN is 88. No heteromorphism was observed between males and females.

From the preparations on *A. parkeri* it was obtained 193 mitotic spreads, 77 for the males and 116 for the females. The modal diploid number is 2n = 56, representing 90.90% of the total countings for the males and 87.07% for the females. The total length of the chromosomes in micrometers (μm) taken as an average of 10 spreads ranged from 4.25 μm to 1.54 μm. The karyotype consisted of 8 **m** pairs, 8 **sm** pairs, 11 **st** pairs and 1 **t** pair (Fig. 3, A and B). The AN is 88. No heteromorphism between males and females was observed in the chromosome plates examined.

Table 1 summarizes the results obtained in this and in other works ariid fishes.

Discussion

Comparisons of chromosome types between different species or even between the same species studied by different authors may present some problems due to possible mistakes in classifying the elements which are at the boundaries of two distinct morphological categories (LeGrande *et al.*, 1984). For instance, the AN estimated for *Ictalurus catus* by LeGrande *et al.* (*op. cit.*) was 84 while by Hudson (1976) it was 64 to 68. Due to this kind of difficulties the differences in AN could be less evident between some species and more obvious between others. This may, in part, be responsible for the great differences in arm number between the karyotypes of *Bagre marinus* and *Bagre bagre* reported by Fitzsimons *et al.* (1988) and by Gomes *et al.* (1990), respectively. On the other hand, it's also probable that most of the size variabilities of chromosome arms that alters AN among populations or species is natural and results from mechanisms such as deletions or duplications during karyologycal evolution. Bearing this in mind, useful comparisons can frequently be made.

Fig. 1. Selected karyotype of a male (A) and a female (B) *Netuma barba*.

Examining the Table 1 it can be seen that all the fishes, including the three species presented here, have 2n = 54 or 56 chromosomes, and AN = 80 or more, except *B. marinus* (AN = 74). The number 2n = 56 ± 2 with high AN (around 80) has been considered by LcGrande (1981) as characteristics of the ancestral stock from where Siluriformes have evolved.

N. barba, G. genidens and *A. parkeri* have few t chromosomes (one to two pairs) that have not been reported for any other ariid fish. In some cases, however, this lack of t chromosomes may be attributed to the fact that in describing karyotypes of fishes some authors prefer to group together the st and t types to avoid mistakes and to facilitate comparisons. For instance, observing the illustration of the karyotype of *B. marinus* (Fitzsimons *et al.*, 1988) one can notice that short arms are not distinguishable in some stt chromosomes that could possibly belong to t types.

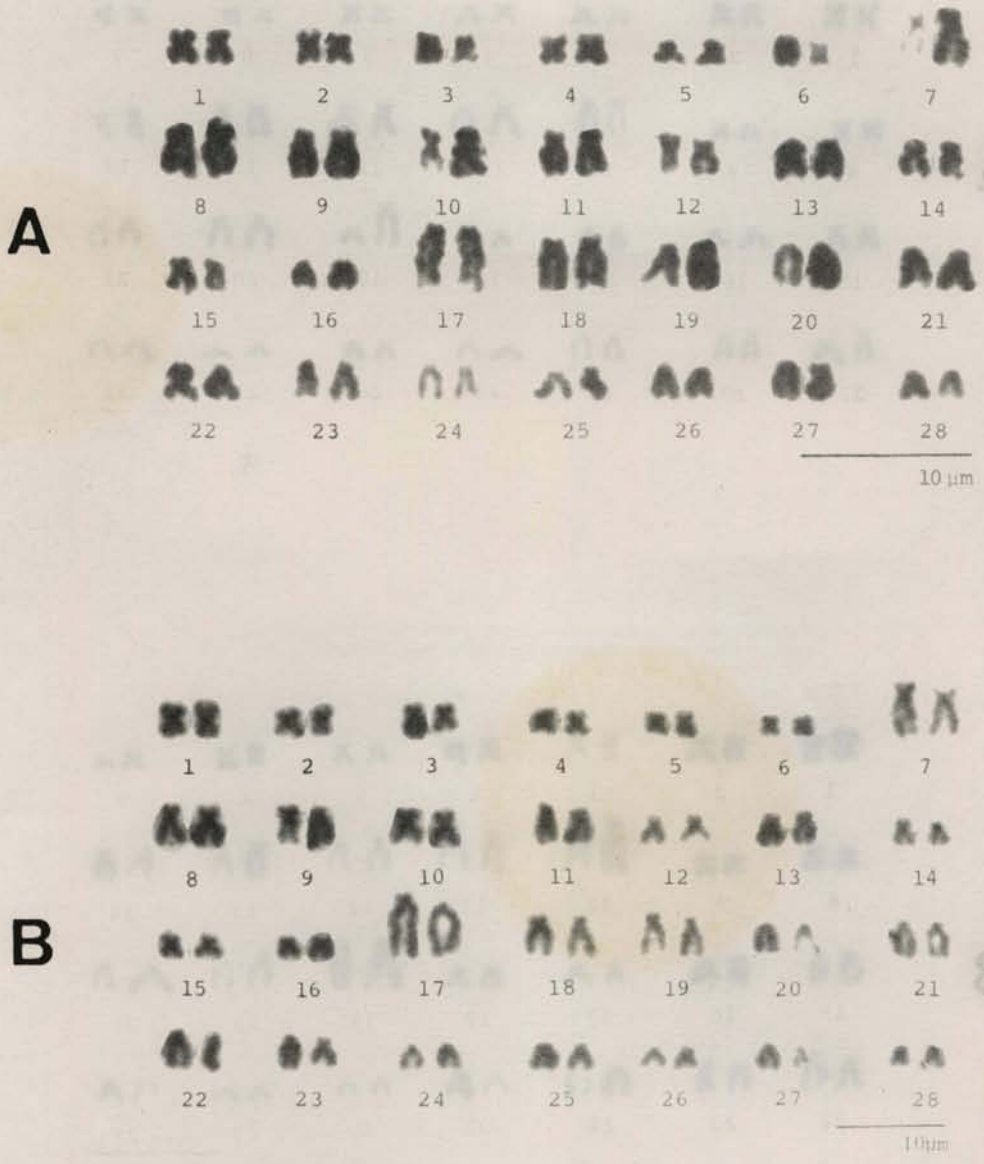

Fig. 2. Selected karyotype of a male (A) and a female (B) *Genidens genidens*.

N. barba, *G. genidens* and *A. parkeri* have 2n = 56. Of these three species, *N. barba* and *G. genidens* are believed to have similar morphological (Higuchi, 1982), biochemical (Suzuki & Phan, 1990 a, b) and immunological characteristics (Gomes *et al.*, in preparation). From the osteological (Higuchi, 1982) and biochemical point of view (Suzuki & Phan, 1990 a,b) *A. parkeri* is not so similar to *N. barba* and *G. genidens* as are these two later species to each other. Of course, more evidences must be gathered before coming to any definite conclusion but with the development of systematic studies, the karyological characteristics here described could be of some help in the establishment of the relationship between ariid fishes.

Analysing the karyotypes of the three species cited above one could notice some similarities. Besides having the same chromosome number and similar number of **msm** and **stt** types they have other features in common. For instance, the first **m** pair of their karyotypes is not very big and not very different in size from the subsequent

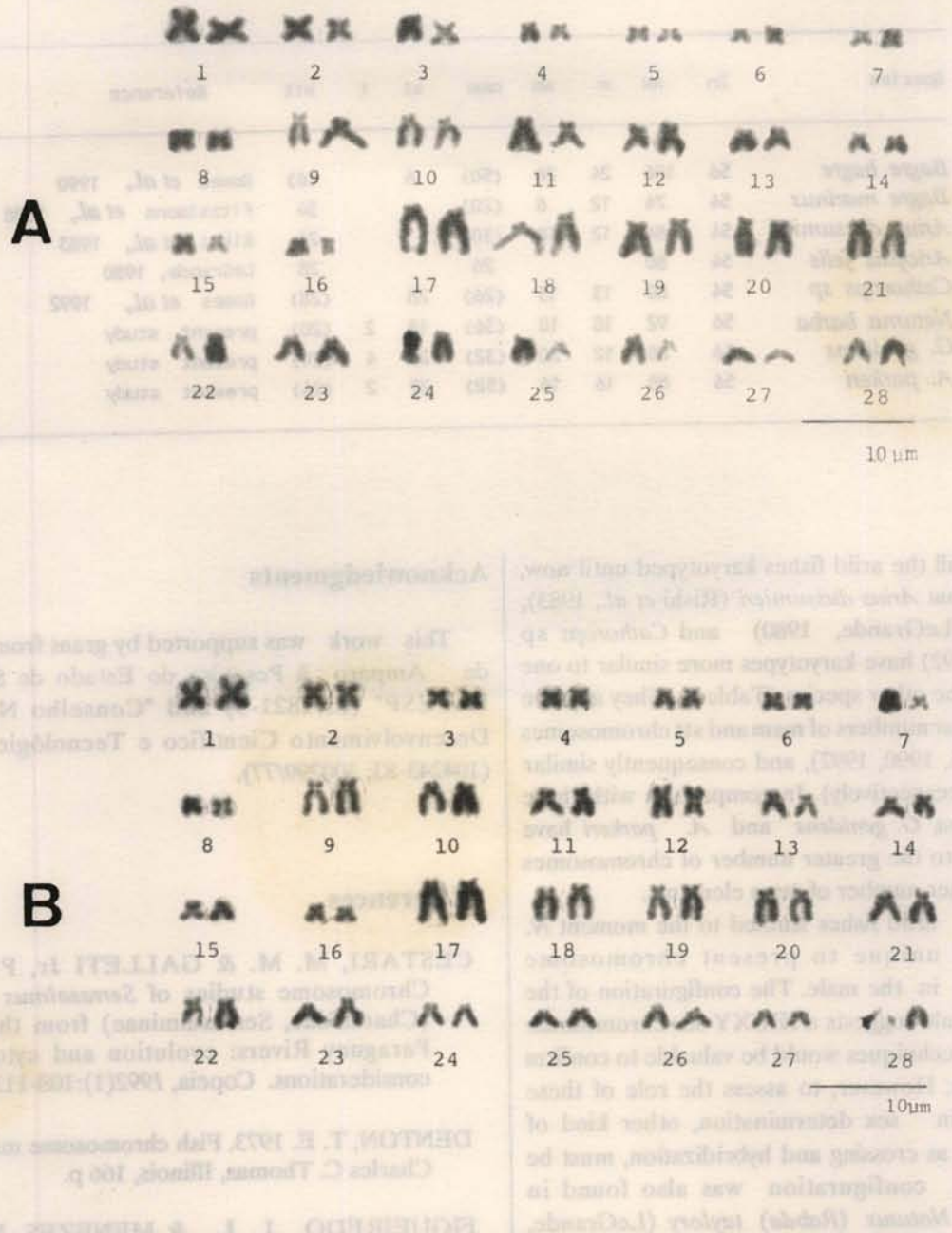

Fig. 3. Selected karyotype of a male (A) and a female (B) *Arius parkeri*.

ones. The decreasing in size of the **m** pairs is slightly more gradual in *N. barba* and *G. genidens* than in *A. parkeri*. The **sm** chromosomes also show some similarities when comparing the karyotypes of the three species. Their first **sm** pair is big, the others decrease gradually in size and the last **sm** one is constituted of small chromosomes. Another feature in common is that their first **st** pair is the biggest of the complement. Banding techniques would be very useful to verify the possible homologies between chromosome pairs.

In spite of having 2n = 56, *B. bagre* has a very distinct karyotype when compared to *N. barba, G. genidens* and *A. parkeri,* mainly due to the great differences between their number of **msm** and **stt** chromosomes (Table 1).

B. bagre and *B. marinus* belong to the same genus and are similar in many aspects in spite of having very distinct karyotypes (Gomes *et al.*, 1990). This variability in chromosome morphology could be, for instance, a characteristic of the genus. More data must be obtained before formulating any hypothesis.

Table 1. Karyotypes of some ariid catfishes. In parentheses, chromosome types grouped together. **AN**, arm number; **m**, metacentric; **sm**, submetacentric; **msm**, meta-submetacentric; **st**, subtelocentric; **t**, telocentric; **stt**, subtelo-telocentric

Species	2n	AN	m	sm	msm	st	t	stt	Reference
Bagre bagre	56	106	24	26	(50)	6		(6)	Gomes *et al.*, 1990
Bagre marinus	54	74	12	8	(20)			34	Fitzsimons *et al.*, 1988
Arius dussumieri	54	84	12	18	(30)			24	Rishi *et al.*, 1983
Ariopsis felis	54	80			26			28	LeGrande, 1980
Cathorops sp	54	80	13	13	(26)	28		(28)	Gomes *et al.*, 1992
Netuma barba	56	92	18	18	(36)	18	2	(20)	present study
G. genidens	56	88	12	20	(32)	20	4	(24)	present study
A. parkeri	56	88	16	16	(32)	22	2	(24)	present study

Examining all the ariid fishes karyotyped until now, one can notice that *Arius dussumieri* (Rishi *et al.*, 1983), *Ariopsis felis* (LeGrande, 1980) and *Cathorops* sp (Gomes *et al.*, 1992) have karyotypes more similar to one another than to the other species (Table 1). They all have 2n = 54 and similar numbers of **msm** and **stt** chromosomes (see Gomes *et al.*, 1990, 1992), and consequently similar AN (84, 80, 80, respectively). In comparison with these species, *N. barba*, *G. genidens* and *A. parkeri* have higher AN due to the greater number of chromosomes and a slightly higher number of **msm** elements.

Among the ariid fishes studied to the moment *N. barba* was the unique to present chromosome heteromorphism in the male. The configuration of the 19th pair in the male suggests a XX/XY sex chromosome system. Banding techniques would be valuable to confirm this configuration. However, to assess the role of these chromosomes in sex determination, other kind of methods such as crossing and hybridization, must be used. Similar configuration was also found in Siluriformes for *Notunus* (*Rabda*) *taylory* (LeGrande, 1981).

Conclusion

It's impossible to come to definitive conclusions about the karyological evolution of ariid catfishes with the few data available until now, but it seems that the continuation of this kind of studies, in addition to morphological, osteological and biochemical ones, can contribute to the understanding of the evolution of the family and the relationship between its members.

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