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The Karyotype of a Marine Catfish, *Bagre bagre*, from Brazil

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Members of the family Ariidae have a large distribution along the Brazilian coast. In the southeast region of the country, where materials for this study were collected, there have been described at least eight species belonging to seven genera (Figueiredo and Menezes, 1978). The systematics of this family, however, is still controversial and is considered chaotic by Higushi (1982).

Cytogenetical methods have been used to elucidate problems related to systematics and evolution. The numerical and morphological changes that karyotypes have undergone during evolution and the relationship between these alterations and speciation have been subject to many studies (Denton, 1973; Kirpichnikov, 1981). Chromosome information on 129 species belonging to 13 families of marine and freshwater catfishes is available (Fitzsimons et al., 1988); little is known, however, about chromosomes of members of the family Ariidae.

In this paper, the karyotype of *Bagre bagre* is described and discussed in relation to that of *Bagre marinus*, a congeneric species, and other ariids found in the literature.

Materials and methods

Specimens of *Bagre bagre* were collected in the estuarine region of Cananéia, São Paulo, Brazil (25° 01′S; 47°56′W) in November, 1986. The specimens were kept alive in tanks with running sea water and were injected intraperitoneally with 0.2 m*l*/100 g body weight of 0.5% colchicine in saline solution. Four to six hours after the injection, they were sacrificed and the kidney was removed for chromosome preparations following the procedures described by LeGrande and Fitzsimons (1976) with slight modifications.

The kidney was minced into small pieces and hypotonized in 10 m*l* of 0.9% sodium citrate solution for 40 min with frequent mixing by aspiration-expiration using a Pasteur pipette. The suspension was filtered through cheesecloth and then centrifuged at about 1,000 rpm for 10 min. The supernatant was decanted and the cell suspension was fixed in 10 m*l* Carnoy solution (3 : 1, methanol : acetic acid) for 30 min. After two rinses in the fixative the cells were resuspended in 0.5 m*l* of the same solution. The suspension was then dropped onto cold glass slides and air-dried. The slides were stained with Giemsa diluted to 1 : 10 by pH 7.0 phosphate buffer and dried. The metaphases were photographed, the chromosomes were counted and the karyograms mounted from photographic prints. The size of the chromosomes in micrometer was estimated by measuring one or two easily identifiable chromosomes of a set with a micrometric eyepiece and then correlating these measures with the chromosomes of the same set in a photographic print. The arm ratios (long arm/short arm) were calculated and terminology for centromeric position followed the criteria of Levan et al. (1964). Grouping of the types of chromosomes followed Uyeno et al. (1983). The arm numbers (AN) were calculated considering m (metacentric) and sm (submetacentric) chromosomes as biarmed and st (subtelocentric) and t (telocentric) as uniarmed.

Results

Three male *Bagre bagre* specimens of 284 mm, 287 mm and 291 mm in total length provided good mitotic metaphase cells for this work. A total of 25 spreads were counted. Twenty-one of them, representing 84% of the total, were of 2n = 56 chromosomes. One metaphase spread of 2n = 53 and three of 2n = 54 are probably due to loss of chromosomes during the slide preparation. The chromosome size taken from 5 selected spreads ranged from 3.45 to 1.90 μm.

The karyotype consisted of 12 m pairs, 13 sm pairs and 3 st pairs (Fig. 1).

Discussion

The diploid chromosome number of catfishes varies from nearly 20 to 132 (LeGrande, 1981; Fitzsimons et al., 1988). Studying the karyological evolution of the order Siluriformes, particularly of the family Ictaluridae, LeGrande (1981) came to the conclusion that the ancestral karyotype of this family, and probably of the whole order, should be of

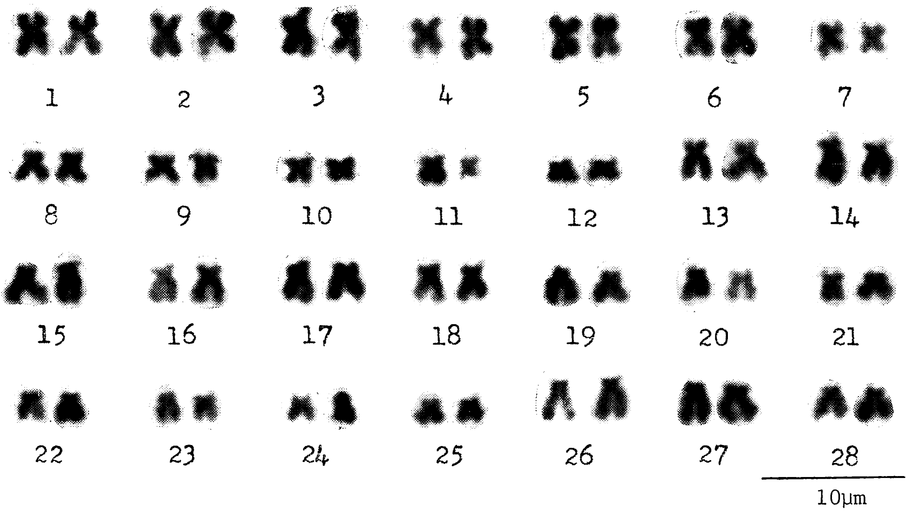

Fig. 1. A karyotype of a male *Bagre bagre*.

$2n=56\pm2$, with a high chromosome arm number (AN>80). Fitzsimons et al. (1988) pointed out that these are also the approximate karyological characteristics for ariids, bagrids, and pimelodids examined. The karyological data, according to these authors, are in accordance with osteological findings which suggest that within the order Siluriformes as a whole the Ariidae together with Bagridae, Ictaluridae, Pimelodidae, and Doradidae are close to the ancestral stock (Gosline, 1975). However, the genome size of the family Ariidae attains twice (ca. 2.5 picograms) the value of other families of the order (ca. 0.88–1.3 picograms), except the family Callichthyidae (Hinegardner and Rosen, 1972).

The chromosome number (2n=56) and the high arm number (AN=106) found for *Bagre bagre* corroborate the hypothesis of LeGrande (1981) concerning the ancestral karyotype of the family.

Fitzsimons et al. (1988) reported the karyotypes of 3 species of Ariidae, all of them with 2n=54. We have also found 2n=54 for *Cathorops spixii* and 2n=56 for *Netuma barba*, *Genidens genidens*, *Sciadeichthys luniscutis* (in preparation) and *Bagre bagre* (this paper).

As can be seen in Table 1, *Bagre bagre* has the highest (AN=106) and *Bagre marinus* the lowest (AN=74) number of biarmed elements. These elements represent 89.3% and 35.7% of the chromosome set of the respective species. Biarmed elements occupy 55.5% in *Arius dussumieri* (AN=84), and 48.1% in *Arius felis* (AN=80).

Comparing the chromosome illustrations of *Bagre marinus* (Fitzsimons et al., 1988) and *Bagre bagre* (Fig. 1), one may notice that short arms are not distinct in some chromosomes of *Bagre marinus* while they are distinct in all chromosomes of *Bagre bagre*. The differences between *Bagre marinus* and *Bagre bagre* thus involve both number and morphology of their chromosomes. Taking into consideration the possibility that some stt (subtelo-telocentric) chromosomes of *Bagre marinus* might be reclassified as biarmed elements and our very possible mistakes in classifying sm and st elements, the differences between the karyotypes of the two species

Table 1. Karyotypes of ariid catfishes. m, metacentric; msm, meta-submetacentric; sm, submetacentric; st, subtelocentric; stt, subtelo-telocentric.

Species	2n	AN	m	msm	sm	st	stt	Reference
Arius felis	54	80		26			28	LeGrande (1980)
A. dussumieri	54	84	12		18		24	Rishi et al. (1983)
Bagre marinus	54	74	12		8		34	Fitzsimons et al. (1988)
B. bagre	56	106	24		26	6		present study

would be less critical. Nevertheless, we believe that important differences would still exist between them.

Morphologically, *Bagre marinus* and *Bagre bagre* are very similar. The differences between their karyotypes may be explained by the hypothesis that siluriform fishes have undergone an exceptionally active karyological evolution due to the intense speciation found in this order (LeGrande et al., 1984). The mechanisms involved in these rearrangements are difficult to explain. Fitzsimons et al. (1988) considered the gradation from large to small chromosomes in ariid karyotypes as an indication of the contribution of fusion and non-fusion events in establishing chromosome morphology of this family. More data on chromosomes of Siluriformes are needed not only to support the hypothesis but also to clarify the uncertainty about the karyological evolution of this order.

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ブラジル産海産ナマズ *Bagre bagre* の核型

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ブラジル産海産ナマズ *Bagre bagre*（ハマギギ科）の雄の染色体が観察された．本種の核型は 2n＝56 で，中部着糸染色体 (m)＝24，次中部着糸染色体 (sm)＝26，次端部着糸染色体 (st)＝6であった．本種の核型は，従来報告されているハマギギ科 3 種の核型 (2n＝54) と比べて，2n が多いばかりか m や sm が多いことが特徴的である．