Genetics and Molecular Biology, 23, 3, 589-593 (2000)

Cytogenetics of species of the families Pimelodidae and Rhamdiidae (Siluriformes)

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Abstract

Only 33 species among about 300 belonging to the families Pimelodidae and Rhamdiidae have been studied cytogenetically. The diploid number varies from 2n = 46 to 2n = 63 chromosomes, with the karyotypes often being of the meta/submetacentric type. As a result, there is generally a very elevated fundamental number.

INTRODUCTION

The family Pimelodidae is the most diversified of the neotropical Siluriformes, with about 300 species in 50-60 genera (Mees, 1974). Although several taxonomic revisions of this family have appeared, the systematics of these genera is still confused.

The subfamily Rhamdiinae was recently elevated to the category of family by Pinna (1993), based on a phylogenetic study of the order Siluriformes, which demonstrated the polyphyletic nature of the traditional family Pimelodidae. Some genera of the family Pimelodidae, including *Pimelodella, Rhamdia, Imparfinis, Cetopsorhamdia* and *Rhamdella,* were grouped into the new family Rhamdiidae based on morphological characters. Similarly, the subfamily Pseudopimelodinae is now considered as the family Pseudopimelodidae, and contains the genera *Microglanis* and *Lophyosilurus* (Pinna, 1993).

The current classification of the families Pimelodidae, Rhamdiidae and Pseudopimelodidae is therefore:

Superorder: Ostariophysi
Order: Siluriformes
Sub-Order: Eusiluroidei
Family: Pimelodidae
Sub-Order: Rhamdioidei
Family: Rhamdiidae
Sub-Order: Loricarioidei
Family: Pseudopimelodidae

This classification was adopted in the present work, which summarizes cytogenetic data for species of the families Pimelodidae and Rhamdiidae mainly found in unpublished thesis and congress abstracts. The diploid number, haploid number, the presence of B chromosomes and other relevant data were examined (Tables I and II). The classification of the hydrographic basin was performed as described by Vari (1992).

DISCUSSION

The chromosomal number among the 33 species of the families Pimelodidae and Rhamdiidae studied cytogenetically ranged from 2n = 46 to 2n = 63 (Tables I and II). For a more conclusive analysis, the FN of some species of the two families was recalculated (in parentheses) and to others species the FN was calculated for the first time in the present study (asterisk), considering M and SM with 2 arms and ST-A with 1 arm. In some species it was not possible to describe the FN, and they were therefore not karyotyped. A relatively high fundamental number was observed in the two families (from 78 to 116) (Tables I and II), with a frequently asymmetrical karyotype that included elements with one or two arms and a preponderance of metacentric chromosomes.

The extensive karyotypic variability between these two families suggests that chromosomal readjustments were involved in speciation within this group, as proposed by Oliveira et al. (1988). In the family Pimelodidae, the genera *Bergiaria, Iheringichthys, Parapimelodus, Pimelodus, Hemisorubim, Pseudoplatystoma, Sorubim* and *Paulicea* have a diploid number of 2n = 56 chromosomes (Toledo and Ferrari, 1976b; Costa and Reggi, 1986; Dias and Foresti, 1990, 1993; Garcia *et al.*, 1990; Souza *et al.*, 1992; Fenocchio and Bertollo, 1992; Fenocchio, 1993; Fenocchio *et al.*, 1994; Vissotto, 1995; Abucarma and Martins-Santos, 1996; Martins-Santos *et al.*, 1996; Silva *et al.*, 1996; Swarça, 1998; Marques *et al.*, 1998), exceptions being *Pimelodus blochii* with 2n = 58 (Della-Rosa *et al.*, 1980**)** and the genera *Callophysus* and *Pinirampus* with 2n = 50 chromosomes (Gil, 1993; Vasconcelos, 1994; Swarça, 1998). The diploid number of 56 chromosomes seems to be characteristic for the Pimelodidae family; however, the basic number varied from 86 to 106 (Table I). The genus *Pimelodus*, besides displaying a conservation in the diploid

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Table I - Cytogenetic data for the family Pimelodidae.

Genera, Species	Locality	HB	n	2n	Karyotype	FN	Bs	Size B	HS	References
Bergiaria										
B. westermanni	R. São Francisco, MG	SF		56	42m,sm + 14st	98	0-5	small		Dias and Foresti (1993)
Callophysus										
C. macropterus	R. Negro; R. Solimões, AM	AM		50	22m + 18sm + 10a	(90)				Gil (1993)
Iheringichthys										
I. labrosus	R. Mogi-Guaçu, SP	UP		56	26m + 14sm + 12st + 4a	96*	0-2	micro		Dias and Foresti (1990)
I. labrosus	R. Paraná, PR	UP		56	42m,sm + 14st,a	98				Garcia *et al.* (1990)
I. labrosus	R. Tibagi, PR	UP		56	18m + 16sm + 12st + 10a	90*	0-1	micro		Silva *et al.* (1996)
I. labrosus	D. Jurumirim, SP	UP		56	22m + 18sm + 10st + 6a	96	0-1	micro		Vissotto (1995)
Parapimelodus										
P. valenciennes	R. Guaíba, RS	PA		56						Costa and Reggi (1986)
Pimelodus										
P. blochii	R. Solimões, AM	AM		58						Della-Rosa *et al.* (1980)
P. clarias	Argentina	PA		56						Fenocchio *et al.* (1994)
P. clarias	Uruguai	PA	26							Gonzales (1994)
P. fur				56	30m + 14sm + 12a	100*				Toledo and Ferrari (1976b)
P. maculatus				56	30m + 14sm + 12a	100*				Toledo and Ferrari (1976b)
P. maculatus	R. São Francisco, MG; R. Mogi-Guaçu, SP	SF;UP		56	40m,sm + 16st,a	96				Dias and Foresti (1993)
P. maculatus	R. Guaíba, RS	PA		56						Costa and Reggi (1986)
P. maculatus	R. Tibagi; R. Congonhas, PR	UP		56	20m + 20sm + 10st + 6a	(96)				Swarça (1998)
P. maculatus	R. Sapucaí; D. Furnas, MG	UP		56	40m/sm + 16st/a	96				Marques *et al.* (1998)
P. maculatus	R. Paranapanema; D. Jurumirim, SP	UP		56	20m + 20sm + 10st + 6a	96				Vissotto (1995)
P. ornatus	R. Paraná, PR	UP		56	18m + 22sm + 6st + 10a	96*				Abucarma and Martins-Santos 1996)
P. sp.				56	30m + 14sm + 12a	100*				Toledo and Ferrari (1976b)
P. sp.			26							Scheel (1973)
P. sp.	R. São Francisco, MG	SF		56	40m,sm + 16st,a	96*				Dias and Foresti (1993)
Pinirampus										
P. pirinampu	R. Paraná, PR	UP		50	22m + 12sm + 4st + 12a	(84)				Vasconcelos (1994)
P. pirinampu	R. Tibagi, PR	UP		50	26m + 12sm + 2st + 10a	(88)				Swarça *et al.* (1999)
Hemisorubim										
H. platyrhynchos	R. Paraná, PR	UP		56	22m + 18sm + 6st + 10a	(96)				Martins-Santos *et al.* (1996)
Pseudoplatystoma										
P. coruscans	R. Paraná, PR	UP		56	18m + 16sm + 10st + 12a	(80)				Martins-Santos *et al.* (1996)
P. coruscans	Coxim, MS	PA		56	42m,sm + 14st,a	(98)				Souza *et al.* (1992)
P. coruscans	R. Mogi-Guaçu, SP	UP		56	18m + 18sm + 10st + 10a	92*				Bigoni *et al.* (1992)
P. coruscans	D. Três Marias, MG	SF		56	20m + 12sm + 12st + 12a	(88)				Fenocchio (1993)
P. fasciatum	R. Solimões, AM	AM		56	18m + 14sm + 10st + 14a	(88)				Fenocchio and Bertollo (1992)
P. tigrinum	R. Solimões, AM	AM		56	18m + 16sm + 8st + 14a	(90)				Fenocchio and Bertollo (1992)
Paulicea										
Paulicea luetkeni	R. Paraná	UP		56	26m + 10sm + 6st + 14a	(92)				Martins-Santos *et al.* (1996)
Sorubim										
S. lima	R. Solimões, PR	AM		56	18m + 12sm + 14st + 12a	86				Fenocchio and Bertollo (1992)
S. lima	R. Paraná, PR	UP		56	20m + 14sm + 10st + 12a	(90)				Martins-Santos *et al.* (1996)

HB = Hydrographic basin; n = haploid number; 2n = diploid number; FN = fundamental number; B = supernumerary chromosomes; HS = heterogametic sex; m = metacentrics; sm = submetacentrics; st = subtelocentrics; a = acrocentrics; R = river; b = brook; L = lagoon; S = stream; D = dam; PA = Paraguay; UP = Upper Paraná; SF = São Francisco; AM = Amazon; MG, AM, SP, PR, RS, MS, BA = Brazilian states; ( ) FN recalculated; * FN calculated in the present study.

Table II - Cytogenetic data for the family Rhamdiidae

Genera, Species	Locality	HB	n	2n	Karyotype	FN	Bs	Size B	HS	References
Pimelodella										
P. aff. gracilis	R. Tibagi, PR	UP		52	24m + 18sm + 4st + 6a	(94)				Swarça (1998)
P. kronei	Iporanga, SP	UP		58	54m,sm + 4st	(112)	1	micro		Almeida-Toledo *et al.* (1992)
P. transitoria	Iporanga, SP	UP		58	54m,sm + 4st	(112)				Almeida-Toledo *et al.* (1992)
P. sp.	R. Mogi-Guaçu, SP	UP		46	40m,sm + 6st,a	86			XY	Dias and Foresti (1993)
P. sp.	R. Mogi-Guaçu, R. Pardo, SP	UP		46	28m + 10sm + 8a	84				Toledo and Ferrari (1976a)
P. sp.	R. Araquá, SP; R. Capivara, SP	UP		46	32m,sm + 14st,a	78*				Braga (1989)
P. sp.	Argentina	PA		46						Fenocchio *et. al* (1994)
P. sp.	R. Araquá, R. Capivara, SP	UP		46	20m + 20sm + 6st	86				Vissotto (1995)
P. sp.	R. Tibagi, PR	UP		46	34m,sm + 12st,a	80*				Silva *et al.* (1996)
P. sp.	R. Paraná, PR	UP		46	20m + 20sm + 6st	(86)				Vasconcelos (1994)
P. sp.	R. Paraná, PR	UP		52	22m + 22sm + 8st	(96)				Vasconcelos (1994)
P. sp.	R. Tibagi	UP		46	34m + 12sm	(92)				Swarça (1998)
Rhamdella										
R. sp.	Itaetê, BA	SF		56	26m,sm + 30st,a	82*				Souza *et al.* (1994)
Cetopsorhamdia										
C. cf. iheringi	D. Três Marias, MG	SF		58	22m + 16sm + 10st + 10a	96*				Fenocchio (1993)
C. sp.	b. Canta Galo, SP	UP		58	22m + 18sm + 10st + 8a	98*				Fenocchio (1993)
C. sp.	R. Capivara, R. Pardo, SP	UP		58	28m + 24sm + 6st	110				Vissotto (1995)
Rhamdia										
R. hilarii	R. Onça, SP	UP		62	36m + 18sm + 8a	116				Toledo and Ferrari (1976a)
R. hilarii	D. Monjolinho, SP	UP		58		>100	0-5	small		Fenocchio and Bertollo (1990)
R. hilarii	D. Lobo, SP	UP		58		>100	0-3	small		Fenocchio (1993)
R. hilarii	D. 29, SP	UP		58		>100	0-5	small		Fenocchio (1993)
R. hilarii	R. Mogi-Guaçu, SP	UP		58		>100				Fenocchio (1993)
R. hilarii	R. São Francisco, MG	SF		58		>100	0-2	small		Fenocchio (1993)
R. hilarii	R. Aguapey, Corrientes, Argentina	PA		58		>100				Fenocchio (1993)
R. hilarii	L. Nova; L. Jataí, SP	UP		58		>100	0-2	small		Fenocchio (1993)
R. hilarii	Center of Aquiculture-UNESP, Jaboticabal, SP	UP		58	58m,sm	116*	0-2	medium		Maistro (1996)
R. sp.	b. Jacutinga, R. Araquá, R. Pardo, S. Quinta, S. Hortelã, S. Jurumirim, SP	UP		58	30m + 18sm + 10st	106	0-3	small		Vissotto (1995)
R. sp.	R. Iguaçu, Usina de Salto Segredo, PR	UP		58	36m + 14sm + 4st + 4a	(108)	0-1	small		Abucarma (1998)
R. sp.	Sapucaí, D. Furnas, MG	UP		58-			0-3			Andrade *et al.* (1998)
R. branneri	R. Iguaçu, Usina de Salto Segredo, PR	UP		58	36m + 14sm + 4st + 4a	(108)	0-2	medium		Abucarma (1998)
R. voulezi	R. Iguaçu, Usina de Salto Segredo, PR	UP		58	36m + 14sm + 4st + 4a	(108)	0-1	medium		Abucarma (1998)
R. quelen	R. Iguaçu, PR	UP		58			0-1	small		Fenocchio (1993)
R. quelen	R. Paraná, Posadas, Argentina	PA		58						Fenocchio (1993)
R. quelen	L. Nova and Jataí, SP	UP		58			0-4	small		Fenocchio (1993)
R. quelen	R. Guaíba; L. dos Quadros, RS	PA		58	52m,sm,st + 6a	110	0-1	small		Hochberg and Erdtmann (1988)
R. sapo	Buenos Aires, Argentina	PA		58	44m,sm + 14st,a	102	0-1	medium		Valcarcel *et al.* (1993)
R. sapo	Uruguai	PA	28	56						Gonzales (1994)
Heptapterus										
H. sp.	S. Quinta, SP	UP		52	22m + 26sm + 4st	100				Vissotto (1995)
Imparfinis										
I. piperatus	R. São João, SP	UP		56	56m,sm	112*				Vicente *et al.* (1994)
I. cf. piperatus	R. Juquiá, SP	UP		56	24m + 12sm + 20st	(92)				Fenocchio (1993)
I. sp.	b. Canta Galo, SP	UP		58						Fenocchio (1993)
I. mirini	b. Jacutinga, S. Quinta, SP	UP		58	22m + 34sm + 1m + 1m	116			ZZ/ZW	Vissotto *et al.* (1997)
					22m + 34sm + 1m + 1sm	116				

For abbreviations see legend toTable I.

number also proved to be conservative with regard to the FN, as the majority of species have an FN = 96 (Table I).

The variability in chromosome number was greater among genera of the family Rhamdiidae. Thus, in *Pimelodella* 2n varied from 46 to 58 (Almeida-Toledo *et al.*, 1992; Dias and Foresti, 1993; Swarça, 1998), in *Imparfinis* sp. there were 56-58 chromosomes (Fenocchio, 1993; Vicente *et al.*, 1994; Vissotto *et al.*, 1997) and in *Rhamdia* the number varied from 58 to 63 because of the presence of B chromosomes (Fenocchio and Bertollo, 1990; Fenocchio, 1993; Vissotto, 1995, Abucarma, 1998). However, 2n in this genus is most frequently 58 (Table II). The variation of the FN (from 78 to 116) was also greatest among member species of this family. *Pimelodella* sp., with 2n = 46, had an intraspecific variation of 78 to 92 in the FN (Toledo and Ferrari, 1976a; Braga, 1989, Vissotto, 1995; Silva *et al.*, 1996; Swarça, 1998). Some of these variations could have been occurring due to different degrees of chromosome condensation leading to different chromosome classifications among authors. Others may be suffering rearrangements, as inversions, leading to a true polymorphism.

In the Pimelodidae family, B chromosomes have been identified in two genera: *Bergiaria* (Dias and Foresti, 1993) and *Iheringichthys* (Dias and Foresti, 1990; Vissotto, 1995; Silva *et al.*, 1996). In the family Rhamdiidae, B chromosomes were observed in a species of *Pimelodella* (Almeida-Toledo *et al.*, 1992) and in almost all of the species of the genus *Rhamdia* (Fenocchio, 1993; Vissotto, 1995; Maistro, 1996; Abucarma, 1998). This extra chromosome is highly conserved in the latter genus, and is therefore most likely an important characteristic in its karyotypic evolution.

Sexual chromosomes have been observed only in the Rhamdiidae family. In a species of *Pimelodella* the male individuals are characterized as heterogametic, possessing a sexual chromosomal system of the type XX/XY (Dias and Foresti, 1993). In *Imparfinis mirini* the females were heterogametic, thus displaying sexual chromosomic system ZZ/ZW (Vissotto *et al.*, 1997).

Although the diploid number in pimelodids is relatively constant, the karyotypic evolution between these two families is more divergent than uniform. The Rhamdiidae family has a greater karyotypic variability than the Pimelodidae family, which corroborates the data of Pinna (1993), who grouped some genera of pimelodids into the new Rhamdiidae family.

ACKNOWLEDGMENTS

We thank Dr. Oscar Shibatta for reviewing the manuscript. Research supported by CAPES and CNPq.

RESUMO

No presente trabalho foi realizado um levantamento citogenético de espécies de peixes das famílias Pimelodidae e Rhamdiidae, onde foi observado que das 300 espécies pertencentes a estas famílias, apenas 33 foram caracterizadas citogeneticamente. O número diplóide variou de 2n = 46 a 2n = 63 cromossomos, os cariótipos são freqüentemente assimétricos, com uma predominância de cromossomos do tipo meta/submetacêntricos, resultando portanto, em um número fundamental alto.

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(Received March 9, 1999)