A checklist of chromosome numbers and karyotypes of Amazonian freshwater fishes

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RÉSUMÉ

CATALOGUE DES NOMBRES DE CHROMOSOMES ET CARYOTYPES DES POISSONS DU BASSIN AMAZONIEN

Une liste des nombres de chromosomes de 211 espèces de poissons du bassin amazonien est présentée. Ces espèces, appartenant à 5 ordres, sont caractérisées par une grande variabilité du nombre de chromosomes (2n = 22 à 2n = 134), par la présence de chromosomes sexuels et de polymorphisme chromosomique chez certaines espèces, et enfin par une grande spécificité des bandes C et des sites des régions de l'organisateur du nucléole.

MOTS CLÉS : Chromosomes — Poissons — Eaux douces — Bassin amazonien.

ABSTRACT

A CHECKLIST OF CHROMOSOME NUMBERS AND KARYOTYPES OF AMAZONIAN FRESHWATER FISHES

A checklist of chromosome numbers of Amazonian freshwater fishes is presented. 211 nominal species belonging to 5 orders have had their haploid/diploid number listed. These species are characterized by a high karyotypic diversity including a wide chromosome number range (2n=22 to 2n=134), different sex chromosomal mechanisms, chromosomal polymorphisms and nearly always a species-specific pattern of C-banding and nucleolar organizer regions.

KEY WORDS : Chromosomes — Fishes — Freshwaters — Amazon Basin.

RESUMEN

LISTA DE LOS NUMEROS CROMOSÓMICOS Y CARIOTIPOS DE PECES AMAZONICOS DE AGUA DULCE

Es presentada una lista con los datos cromosómicos de peces de la cuenca amazonica. 211 especies pertenecientes a 5 ordenes ya fueron estudiados citogeneticamente, determinandose por lo menos su numero cromosómico haploide/diploide. La variación del numero diploide va desde 2n=22 hasta 2n=134. Tanbien fueron observado mecanismos cromosómicos sexuales y polimorfismos cromosómicos en algunas especies, seguido de padrones casi siempre especie-specificos de la banda-C y de las regiones organizadoras del nucleolo.

PALABRAS CLAVES : Cromosomos — Peces — Agua dulce — Cuenca amazonica.

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INTRODUCTION

In the neotropics, chromosomal data have contributed to the studies of the biology, genetics and systematics of fishes. This is particularly true with respect to species characterization and diagnosis (Bertollo, 1978; Almeida-Toledo, 1978), detection of inter and intraspecific polymorphism (Giuliano-Caetano and Bertollo, 1988; Oliveira *et al.*, 1990 a), data on sex chromosome systems (Moreira Filho *et al.*, 1980; Galetti Jr. *et al.*, 1981; Bertollo *et al.*, 1983; Galetti Jr. and Foresti, 1986; Feldberg *et al.*, 1987; Falcão, 1988), supernumerary chromosomes (Falcão *et al.*, 1984; Pauls, 1985; Venere and Galetti Jr., 1985; Oliveira *et al.*, 1988b; Foresti *et al.*, 1989; Erdtman *et al.*, 1990) and natural triplody (Almeida-Toledo *et al.*, 1985; Venere and Galetti Jr., 1985; Giuliano-Caetano and Bertollo, 1990). All of the above mentioned findings are important for the understanding of fish or even animal chromosomal evolution.

Checklists containing chromosome data of fish have been published since 1971 (Gyldenholm and Scheel, 1971; Chiarelli and Capanna, 1973; Denton, 1973; Park, 1974; Ojima *et al.*, 1976; Gold *et al.*, 1980; Sola *et al.*, 1981; Oliveira *et al.*, 1988a). Sola *et al.* (1981) stated that the elaboration of fish chromosome lists is important because they allow for easy access to condensed information and identification of the cytogenetic characters important for the elaboration of evolutionary and phylogenetic models.

The Amazon basin is an excellent field for ichthyogenetic study (Almeida-Val *et al.*, 1991) and we believe that a checklist of Amazonian fish chromosome data will contribute to a better understanding of the diversity of fish species.

CYTOGENETIC FEATURES OF AMAZONIAN FISHES

In 1988, Oliveira *et al.* listed the chromosome formulae of 433 neotropical fish species. In this study the origin of 55 % of the fish is unknown, some of them undoubtedly obtained from aquarium dealers.

In elaborating our list, we attempted to identify, among the species of unknown origin, the Amazonian freshwater species, and we updated the taxonomic status of many species. Thus, we have listed species belonging to the Amazon basin based on the compilation of Oliveira *et al.* *(op. cit.)*, and new data obtained by us (Table I). For the taxonomy and origin of the species with diploid/haploid numbers already determined, several papers were consulted : Goldstein (1973), Géry (1977), Nijssen and Isbrucker (1980), Kullander (1983, 1986), Ortega and Vari (1986), Goulding *et al.* (1988), Burgess (1989). The classification of the higher taxa of the listed species is arranged according to Greenwood *et al.* (1966) and Lauder and Liem (1983) with the exception of the Serrasalmidae which is considered at a family level, according to Géry (1977).

211 nominal species belonging to the Amazonian ichthyofauna have had their diploid/haploid number determined. However, few of these species have had their karyotypes described. These listed species correspond to 49 % of the neotropical fish species listed by Oliveira *et al.* *(op. cit.)*. We also detected that a vast amount of cytogenetic data is available in abstracts of Brazilian scientific meetings and others not readily available sources.

Diploid numbers

Diploid numbers (2n) of Amazonian fishes range widely : 2n = 22 *(Nannostomus unifasciatus)* to 2n = 134 *(Corydoras aeneus)*. Also, species differ in having single or multiple nucleolar organizer regions (NORs) as well as different sex chromosomal mechanisms, including multiple systems. This karyotype diversity is apparently correlated with the rich specific diversity of Amazonian ichthyofauna.

Karyologicaly, the characiforms are the most studied fish group of the Amazon, followed by siluriforms (including the gymnotoids - electric fishes), perciforms (cichlids) and then on a minor scale, osteoglossiforms (bonytongue fishes) and lepidosireniforms (lungfishes).

In the characiforms, the diploid numbers vary from 2n = 22 to 2n = 102. However, in the families Anostomidae, Curimatidae, Prochilodidae, Hemiodidae and Chilodidae the chromosome numbers and karyotype morphology are very similar, usually with 2n = 54, and meta-submetacentric (M-SM) chromosomes in their karyotypes and single NORs. On the other hand, there are karyotypicaly divergent families such as the Erythrinidae, Lebiasinidae, Characidae and Serrasalmidae each of which shows diversification in their diploid numbers, karyotype morphologies and multiple NORs. Erythrinidae, Lebiasinidae, Characidae plus Ctenoluciidae are characterized by diploid numbers smaller than 2n = 54 (considered primitive in characiforms). Serrasalmidae, on the other hand, contains species with diploid numbers equal to or greater than 2n = 54. This cytogenetic feature of serrasalmids (2n = 54) has lead Arefjev (1989) and Porto *et al.* (1989, 1991) to consider them a distinct group at a family level, and not a subfamily of Characidae, as postulated by some authors.

In the siluriforms, different from characiforms, there are few cytogenetic studies, although this group also has a large number of species in the Amazon basin. Diploid numbers of siluriforms vary from $2n = 24$ to $2n = 134$. The available data indicate that they are characterized by high karyotypic diversity, especially the families Callychthyidae (Siluroidei) and Sternopygidae (Gymnotoidei). It should be pointed out that the karyotypic diversity detected in Callichthyidae is related to gene duplication and/or polyploid events (Oliveira *et al.*, *op. cit.*).

In the perciforms, especially the cichlids, the diploid numbers vary from $2n = 38$ ($n = 19$) to $2n = 60$. Almost all species present $2n=48$, dominated by subtelo-acrocentic (ST-A) chromosomes, although there are some different diploid numbers and karyotype morphologies in this group, for example $2n=60$ predominating M-SM chromosomes.

Finally, in the osteoglossiforms, three species of osteoglossids were karyotyped and their diploid numbers vary from $2n=54$ to $2n=56$. In lepidosireniformes, a single species was karyotyped and a small diploid number ($2n=38$) was detected, with enormous chromosomes and an extremely high DNA value.

Nucleolar organizer region (NOR)

The NOR chromosome data from Amazonian freswater fish families presented in Table I makes it possible to detect three groups in terms of patterns of specific localization of NORs sites : 1) single NORs, 2) multiple NORs, and 3) both single and multiple NORs. In the first group, the following families can be listed : Osteoglossidae, Anostomidae, Curimatidae, Prochilodidae, Hemiodidae, Pimelodidae, Apteronotidae, Sternopygidae and Cichlidae ; in the second group : Serrasalmidae and Lebiasinidae ; and in the third group : Erhythrinidae, Characidae and Callichthyidae.

C-banding

Most of the species analyzed thus far present C-bands at, or around, the centromeres (centro/pericentromeric band). Less frequently they occur at the chromosome tips (telomeric band). Positive C-bands can also be found associated with NOR regions (in almost all of the serrasalmid species) or along chromosome arms (interstitial band) or as entirely heterochromatic short or long chromosome arms (particularly the sex chromosomes). All types of C-bands can occur in the same species. Thus, when different species are compared, almost always a species-specific pattern of constitutive heterochromatin distribution is apparent.

Sex chromosomes

Based on cytological heteromorphy, heterologous sex chromosomes (ZZ/ZW and XX/XY_1Y_2 types) have been described for 6 Amazonian species, corresponding to 2.8 % of the total number of species listed. The occurrence of the same kind of sex chromosome mechanisms (ZZ/ZW) in different genera (*Triportheus*, *Semaprochilodus* and *Eigenmannia*) shows that this kind of heterogamety has evolved several times among the Amazonian Ostariophysi fishes. Falcão (1988) suggests that in *Triportheus*, the W chromosome differenciated through a heterochromatinization process, followed by deletions.

Hibridization and Triplody

Artificial crossing has shown that serrasalmids species, *Mylossoma duriventris* X *Colossoma macropomum* and *Piaractus brachypomus* X *Colossoma macropomum*, have a capacity to hybridize even when the taxa belongs to distinct genera (Kossowski *et al.*, 1983 and Nakayama *et al.*, *pers. comm.*, respectively).

In the Amazon basin two cases of natural triploidy have been reported in fish : *Eigenmannia* sp. and *Hoplerythinus unitaeniatus*. In both cases diploid and triploid forms were found. The fertilization of a non-reduced ovule by a haploid spermatozoon was considered to be the most probable origin of the triploids observed (Almeida-Toledo *et al.*, 1985; Giuliano-Caetano and Bertollo, 1990).

CONCLUSION

There still are too few cytogenetic data on Amazonian fishes. The lack of published karyograms or metaphase photographs as well as the problem of taxonomic determination and origin of analyzed material constitute the main problems in the cytogenetic study of Amazonian fishes, especially in the characiforms whose cytogenetic data forms a substantial part of the checklist. Thus, these data must be considered with care.

Considering the existence of approximately 3000 species in the Amazon Basin and the high karyotypic diversity detected so far, cytogenetic studies of

Amazonian fishes should be carried out preferably on monophyletic groups of fishes, taking into account their biogeography and the utilization of high resolution chromosome banding. In this way, it will be possible to determine the karyotypic characters that better elucidate the taxonomic and evolutionary problems.

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TABLE I (1)

ORDER FAMILY Species	n	2n	KF	NOR numb	 pair	 type	 arm	 location	CBA I	 P	 T	 HSex	reference
OSTEOGLOSSIFORMES													
ARAPAIMIDAE													
Arapaima gigas	-	56	4M+12SM-ST+40T	-	-	-	-	-	-	-	-	-	Urushido *et al.* (1975)
OSTEOGLOSSIDAE													
Osteoglossum bicirrhosum	27	-	-	-	-	-	-	-	-	-	-	-	Hinegardner & Rosen (1972)
O. bicirrhosum	-	56	1SM+1ST+54A	-	-	-	-	-	-	-	-	-	Uyeno (1973)
O. bicirrhosum	-	56	3ST+53A	2	-	ST,A	p	TERM	-	-	-	-	Suzuki *et al.* (1982)
O. ferreirai	-	54	2M+4SM+14ST+34A	-	-	-	-	-	-	-	-	-	Suzuki *et al.* (1982)
CHARACIFORMES													
ANOSTOMIDAE													
Abramites hypselonotus	27	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
Anostomus anostomus	27	-	-	-	-	-	-	-	-	-	-	-	Hinegardner & Rosen (1972)
A. anostomus	27	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
A. anostomus	27	54	54M-SM	-	-	-	-	-	-	-	-	-	Ojima *et al. (*1976)
A. anostomus	-	54	54M-SM	-	-	-	-	-	-	-	-	-	Cestari *et al.* (1990)
A. ternetzi	27	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
Leporinus affinis	-	54	54M-SM	-	-	-	-	-	-	-	-		Venere (1988)
L. brunneus	-	54	54M-SM	2	-	-	-	-	-	-	-	-	Venere & Galetti Jr.(1986b)
L. cylindriformes	-	54	54M-SM	2	-	-	-	-	-	-	-	-	Venere & Galetti Jr.(1986b)
L. friderici	-	54	32M+22SM	2	2	M	p	TERM.	X	X	-	-	Galetti Jr. *et al.* (1991)
L. ortomaculatus	-	54	-	2	-	-	-	-	-	-	-	-	Venere & Galetti Jr.(1986b)
L. tigrinus	-	54	-	-	-	-	-	-	-	-	-	-	Venere (1988)
Rhytiodus microlepis	-	54	-	-	-	-	-	-	-	-	-	-	Bertollo *et al.* (1980)
Schizodon fasciatus	-	54	54M-SM	-	-	-	-	-	-	-	-	-	Mestriner & Galeti Jr.(1987)
S. fasciatus	-	54	28M+26SM	2	12	M	q	TERM.	-	X	X	-	Galetti Jr. *et al.* (1991)
Schizodon sp.	-	54	54M-SM	2	-	-	-	-	-	-	-	-	Venere & Galetti Jr. (1986a)
CHARACIDAE													
BRYCONINAE													
Brycon cf.cephalus	-	50	20M+22SM+8ST	2	-	ST	q	TERM.	X	X	X	-	Santos *et al.* (1985)
B. cf. *erythropterum*	-	50	20M+22SM+8ST	2	-	ST	q	TERM.	X	X	X	-	Santos *et al.* (1985)
B. cf. *pesu*	-	50	20M+22SM+8ST	2	-	ST	q	TERM.	X	X	X	-	Feldberg *et al.*, unpubl.
CHALCIDIINAE													
Chalceus macrolepidotus	-	54	32M+22ST	-	-	-	-	-	-	-	-	-	Muramoto *et al.* (1968)
C. macrolepidotus	-	52	44M-SM+8ST-T	-	-	-	-	-	-	-	-	-	Ojima *et al.* (1976)
CHEIRODONTINAE													
C. troemneri	25	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
Megalomphodus megalopterus	24	-	-	-	-	-	-	-	-	-	-	-	Post (1965)
M. megalopterus	26	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
M. sweglesi	26	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
Microschemobrycon casiquiare	21	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
Paracheirodon axelrodi	24	-	-	-	-	-	-	-	-	-	-	-	Post (1965)
P. axelrodi [1]	-	52	-	-	-	-	-	-	-	-	-	-	Scheel & Christensen (1970)
P. axelrodi	26	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
P. innesi	-	36	-	-	-	-	-	-	-	-	-	-	Lueken & Foerster (1969)
P. innesi	-	32	-	-	-	-	-	-	-	-	-	-	Scheel & Christensen (1970)
P. innesi	16	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
P. simulans [2]	25	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
P. simulans	-	50	-	-	-	-	-	-	-	-	-	-	Scheel (1972)
Pristella riddlei	24	-	-	-	-	-	-	-	-	-	-	-	Post (1965)
P. riddlei	26	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
IGUANODECTINAE													
Iguanodectes spilurus	25	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
STETHAPRIONINAE													
Poptella compressa [3]	25	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
TETRAGONOPTERINAE													
Bryconella palidifrons [4]	25	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
Ctenobrycon aff. *hauxwellianus*	25	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
Exodon paradoxus	26	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
Hemigrammus analis	27	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
H. erythrozonus	-	48	-	-	-	-	-	-	-	-	-	-	Lueken & Foerster (1969)

TABLE I (2)

H. erythrozonus	26	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
H. gracilis [5]	24	48	-	-	-	-	-	-	-	-	-	-	Post (1965)
H. hyanuary	-	52	22M-SM+30ST-A	-	-	-	-	-	-	-	-	-	Arefjev(1990b)
H. marginatus	25	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
H. micropterus	26	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
H. ocellifer	24	48	-	-	-	-	-	-	-	-	-	-	Post (1965)
H. ocellifer	19	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
H. pulcher	24	-	-	-	-	-	-	-	-	-	-	-	Post (1965)
H. pulcher	25	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
H. rhodostomus	25	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
H. aff. *rhodostomus*	25	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
H. aff. *rodwayi*	25	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
H. aff. *schmardae*	-	52	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
H. aff. *schmardae*	26	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
H. stictus [6]	-	52	-	-	-	-	-	-	-	-	-	-	Scheel & Christensen (1970)
H. stictus	25	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
H. unilineatus	26	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
H. vorderwinkleri	24	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
Hyphessobrycon agulha	24	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
H. aff. *agulha*	25	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
H. belloti	24	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
H. bentosi bentosi	26	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
H. aff. *copelandi*	26	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
H. erythrostigma [7]	26	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
H. haraldschultzi	24	-	-	-	-	-	-	-	-	-	-	-	Post (1965)
H. heterorhabdus	24	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
H. loretoensis	24	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
H. peruvianus	25	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
H. pulchripinnis	24	-	-	-	-	-	-	-	-	-	-	-	Post (1965)
H. pulchripinnis	25	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
H. scholzei	-	50	8M+20SM+8ST+14A	-	-	-	-	-	-	-	-	-	Arefjev (1990b)
H. serpae	24	-	-	-	-	-	-	-	-	-	-	-	Post (1965)
H. serpae	26	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
H. stictus	-	52	-	-	-	-	-	-	-	-	-	-	Gyldenholm & Scheel (1971)
H. stictus	25	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
H. tropis	23	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
Inpaichthys kerri	-	52	12M+26SM+14ST-A	-	-	-	-	-	-	-	-	-	Arefjev (1989)
Moenkhausia colleti	24	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
M. oligolepis	25	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
Thayeria boehkei	25	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
T. obliqua	24	-	-	-	-	-	-	-	-	-	-	-	Post (1965)
TRIPORTHEINAE													
Triportheus albus	-	52	14M+20SM+14ST+4A	1-4	6,11	ST	p	SUB,TER	-	X	X	ZW	Falcão (1988)
T. culter	-	52	14M+16SM+16ST+6A	-	-	-	-	-	-	-	-	-	Falcão (1988)
T. elongatus	-	52	22M+12SM+16ST+2A	1-4	3,11	ST	p	TERM.	-	X	X	ZW	Falcão (1988)
T. flavus	-	52	22M+14SM+12ST+4A	1-4	6,7	M,ST	p,q	SUB,INT	-	X	X	ZW	Falcão (1988)
T. pictus	26	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
CHILODIDAE													
Chilodus punctatus	27	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
C. punctatus	-	54	54M,SM	-	-	-	-	-	-	-	-	-	Cestari *et al.* (1990)
CTENOLUCIIDAE													
Boulengerella sp	-	36	-	-	-	-	-	-	-	-	-	-	Porto *et al.*, unpubl.
CURIMATIDAE													
Curimata cyprinoides	-	54	44M+10SM	2	3	M	q	TERM.	-	X	X	-	Feldberg *et al.* (1992)
C. kneri	-	54	40M+12SM+2ST	2	15	ST	p	TERM.	-	X	X	-	Feldberg *et al.* (1992)
C. inornata	-	54	40M+14SM	2	4	SM	p	INTERST.	-	X	X	-	Feldberg *et al.* (1992)
C. ocellata	-	56	40M+16SM	2	22	SM	p	INTERST.	-	-	-	-	Feldberg *et al.* (1992)
C. vittata	-	54	42M+12SM	1	9	SM	q	TERM.	-	-	-	-	Feldberg *et al.* (1992)
Curimatella alburna	-	54	46M+8SM	2	14	M	q	TERM.	-	X	X	-	Feldberg *et al.* (1992)
C. meyeri	-	54	46M+8SM	2	9	M	q	TERM.	-	X	X	-	Feldberg *et al.* (1992)
Curimatopsis aff. *macrolepis* (CYT A)	26	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
C. aff. *macrolepis* (CYT B)	23	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
Cyphocharax cf. *spilura*	-	54	-	2	10	M	q	TERM.	-	-	-	-	Venere & Galetti Jr.(1989)
Potamorhina altamazonica	51	102	2M+2SM+98A	2	5	A	q	TERM.	X	X	X	-	Feldberg *et al.* (in press)
P. latior	-	56	58M+2SM+2ST	2	27	M	q	TERM.	X	X	X	-	Feldberg *et al.* (in press)
P. pristigaster	-	54	42M+12SM	2	16	SM	q	TERM.	-	X	-	-	Feldberg *et al.* (in press)
Psectrogaster rutiloides	-	54	42M+12SM	2	11	M	q	TERM.	X	X	X	-	Feldberg *et al.* (1992)
Steindachnerina leuciscus	-	54	48M+6SM	2	16	M	q	TERM.	-	-	-	-	Feldberg *et al.* (1992)
ERYTHRINIDAE													
Erythrinus erythrinus	-	52	-	1-8	-	M	q,p	TERM.	-	-	-	-	Bertollo (1988)
Hopleryhtrinus unitaeniatus	-	48	48M-SM	-	-	-	-	-	-	-	-	-	Giuliano-Caetano (1986)

TABLE I (3)

H. unitaeniatus (CYT A)	24	48	48M-SM	-	-	-	-	-	-	-	-	-	Giuliano-Caetano (1986)
H. unitaeniatus (CYT B)	24	48	46N-SM+2ST-A	3-4	-	M,A	q	INTERST.	-	-	-	-	Giuliano-Caetano (1986)
H. unitaeniatus (CYT C)	24	48	46N-SM+2ST-A	2	-	M	q	TER,INT.	X	X	X	-	Giuliano-Caetano (1986)
H. unitaeniatus (CYT D)	24	48	47M-SM+1ST-A	4	-	M,A	q	INTERST.	X	X	X	-	Giuliano-Caetano (1986)
H. unitaeniatus (Tryploid)	-	72	69M-SM+3ST-A	3	-	M-SM	q	TERM.	-	-	-	-	Giuliano-Caetano (1986)
Hoplias malabaricus	-	40	-	-	-	-	-	-	-	-	-	-	Bertollo *et al.* (1980)
Hoplias sp.	20/21	41	29M+11SM+1A (M)	-	-	-	-	-	-	-	XY_1	Y_2	Bertollo *et al.* (1983)
	-	40	30M+10SM (F)	-	-	-	-	-	-	-	-	XX	Bertollo *et al.* (1983)
Hoplias sp.	-	50	-	-	-	-	-	-	-	-	-	-	Bertollo & Moreira F° (1983)
GASTEROPELECIDAE													
Carnegiella strigata	25/26	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
C. strigata	24	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
Gasteropelecus sternicla	27	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
HEMIODIDAE													
ANODINAE													
Anodus elongatus	-	54	24M+26SM+4ST	2	26	ST	q	TERM.	-	-	-	-	Porto (1992)
Anodus melanopogon	-	54	20M+28SM+6ST	2	25	ST	q	TERM.	-	-	-	-	Porto (1992)
Anodus sp.	-	54	24M+24SM+6ST	2	25	ST	q	TERM.	-	-	-	-	Porto (1992)
BIVIBRANCHIINAE													
Argonectes scapularis	-	54	50M-SM+4ST	2	-	ST	q	TERM.	-	-	-	-	Porto, unpubl.
HEMIODINAE													
Hemiodus immaculatus	27	54	22M+26SM+6ST	2	25	ST	q	TERM.	-	-	-	-	Porto (1992)
H. cf. *microlepis*	-	54	20M+30SM+4ST	2	-	SM	q	TERM.	-	-	-	-	Porto (1992)
H. ocellatus	27	54	26M+24SM+4ST	2	15	SM	q	SUBT.	-	-	-	-	Porto (1992)
H. unimaculatus	27	54	26M+24SM+4ST	2	17	SM	q	TERM.	-	-	-	-	Porto (1992)
LEBIASINIDAE													
Copeina guttata	21	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
Copella arnoldi (CYT A)	22	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
Copella arnoldi (CYT B)	22	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
Copella nattereri	18	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
Nannostomus beckfordi (CYT A)	22	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
N. beckfordi (CYT B)	18	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
N. beckfordi (CYT C)	-	42	2M+40A	-	-	-	-	-	-	-	-	-	Arefjev (1990a)
N. erythrurus	23	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
N. marginatus	21	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
N. trifasciatus (CYT A)	19	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
N. trifasciatus (CYT B)	15	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
N. trifasciatus (CYT C)	12	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
N. eques [8]	-	34	34A	-	-	-	-	-	-	-	-	-	Arefjev (1990a)
N. harrisoni [9]	20	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
N. unifasciatus [10]	11	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
Pyrhulina sp	-	42	2M+2SM+38ST-A	-	-	-	-	-	-	-	-	-	Oliveira & Falcão (1992)
Pyrhulina sp	-	42		2-4	-	-	-	-	-	-	-	-	Sangüino & Falcão (1992)
PROCHILODIDAE													
P. nigricans	-	54	40M+14SM	2	2	M	q	INTERST.	-	X	-	-	Pauls & bertollo (1990)
Semaprochilodus insignis	27	54	40M+14SM	2	3	M	p	INTERST.	-	X	-	-	Feldberg *et al.* (1987)
S. taeniurus	27	54	40M+14SM	2	3	M	p	INTERST.	X	X	X	ZW	Feldberg *et al.* (1987)
SERRASALMIDAE													
Catoprion mento	-	60	-	-	-	-	-	-	-	-	-	-	Porto *et al.*, unpubl.
Colossoma macropomum [11]	27	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
C. macropomum	-	54	-	-	-	-	-	-	-	-	-	-	Bertollo *et al.* (1980)
C. macropomum	-	54	18M+36SM	-	-	-	-	-	-	-	-	-	Kossowski *et al.* (1983)
C. macropomum	-	54	20M+34SM	1-4	-	M	q	TERM.	-	X	X	-	Almeida-Toledo *et al.* (1987)
C. macropomum	-	54	26M+28SM	1-4	-	M	q	TER,INT	-	X	X	-	Nakayama *et al.* (1990)
Metynnis argenteus	31	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
M. lippincottianus	-	62	30M+30SM+2A	-	-	-	-	-	-	-	-	-	Arefjev (1989)
M. schreitmuelleri [12]	-	62	60M-SM+2ST	-	-	-	-	-	-	-	-	-	Ojima *et al.* (1976)
M. sp.	-	62	54M-SM+8ST-A	3-4	-	ST-A	q	INTERST.	-	-	-	-	Porto *et al.* (1989;1991)
Mylesinus paraschomburgkii	-	58	-	6-12	-	ST-A	p	TERM.	-	-	-	-	Porto *et al.* (1989; 1991)
Myleus pacu	-	58	40M-SM+18ST-A	5-9	-	ST-A	p	TERM.	-	-	-	-	Porto *et al.* (1989; 1991)
M. rubripinnis	-	58	-	5-8	-	ST-A	p	TERM.	-	-	-	-	Porto *et al.* (1989; 1991)
M. shomburgkii	-	58	42M-SM+16ST-A	5-8	-	ST-A	p	TERM.	-	-	-	-	Porto *et al.* (1989; 1991)
Mylossoma aureum	-	54	54M-SM	6-14	-	M,SM	p,q	TERM.	-	-	-	-	Porto *et al.* (1989; 1991)
M. duriventris	-	54	50M-SM+4T	-	-	-	-	-	-	-	-	-	Ojima *et al.* (1976)
M. duriventris	-	54	18M+34SM+2A	-	-	-	-	-	-	-	-	-	Kossowski *et al.* (1983)
M. duriventris	-	54	54M-SM	6-14	-	M,SM	p,q	TERM.	-	-	-	-	Porto *et al.* (1989; 1991)
n. gen. 1 [13]	-	58	42M-SM+16ST-A	6-12	-	ST-A	p	TERM.	-	X	-	-	Porto *et al.* (1989; 1991)

Piaractus brachypomus	-	54	34M+20SM	3-6	-	M,SM	p,q	TERM.	X	X	X	-	Nakayama *et al.* (1990)
Pristobrycon eigenmanni	-	60	44M-SM+16ST-A	-	-	-	-	-	X	X	X	-	Porto *et al.* (1989; 1991)
P. serrulatus	-	60	44M-SM+16ST-A	6-10	-	ST-A	p	TERM.	-	X	X	-	Porto *et al.* (1989; 1991)
P. striolatus	-	62	46M-SM+16ST-A	6-7	-	ST-A	p	TERM.	-	-	-	-	Porto *et al.* (1989; 1991)
Pristobrycon sp.	-	60	48M-SM+12ST-A	6-10	-	ST-A	p	TERM.	-	-	-	-	Nakayama *et al.* (1988a)
P. sp.	-	60	50M-SM+10ST-A	6-8	-	ST-A	p	TERM.	-	-	-	-	Nakayama *et al.* (1988a)
Pygocentrus nattereri	-	60	50M-SM+10ST-A	6-8	-	ST-A	p	TERM.	X	X	X	-	Nakayama *et al.* (1988a;b)
Serrasalmus altuvei	-	60	46M-SM+14ST-A	-	-	-	-	-	-	-	-	-	Nakayama *et al.*, unpubl.
S. elongatus	-	60	40M-SM+20ST-A	6-12	-	ST-A	p	TERM	-	X	X	-	Nakayama *et al.* (1986,1988b)
S. hollandi	-	64	-	-	-	-	-	-	-	-	-	-	Muramoto *et al.* (1968)
S. manuelli	-	60	44M-SM+16ST-A	6-10	-	ST-A	p	TERM.	-	X	X	-	Porto *et al.* (1991)
S. rhombeus	-	60	44M-SM+16ST-A	-	-	-	-	-	-	-	-	-	Nakayama *et al.* (1992)
Serrasalmus sp.1	-	58	46M-SM+12ST-A	4-8	-	ST,A	p	TERM.	X	X	X	-	Nakayama *et al.* (1992)
Serrasalmus sp.2	-	60	46M-SM+14ST-A	-	-	-	-	-	-	X	X	-	Nakayama *et al.* (1988b)
S. spilopleura	-	60	44M-SM+16ST-A	6-10	-	ST-A	p	TERM.	-	X	X	-	Porto *et al.* (1991)
SILURIFORMES													
SILUROIDEI													
AGENEIOSIDAE													
Ageneiosus brevifilis	-	56	-	-	-	-	-	-	-	-	-	-	Fennocchio & Bertollo (1987)
Ageneiosus sp.	-	54	-	-	-	-	-	-	-	-	-	-	Fennocchio & Bertollo (1987)
AUCHENIPTERIDAE													
Parauchenipterus cf. *galeatus*	-	58	-	-	-	-	-	-	-	-	-	-	Fennocchio & Bertollo (1987)
CALLICHTHYIDAE													
Brochis splendens [14]	49	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
B. splendens	-	100	18M+18SM+20ST+44A	4	-	SM,ST	q	TERM.	-	X	-	-	Oliveira *et al.* (1990b)
Callichthys callichthys	-	52	-	2	-	SM,ST	p	TERM.	-	-	-	-	Porto & Feldberg (1992b)
C. callichthys	-	54	46M-SM+8ST-A	3	-	SM,ST	p	TERM.	-	-	-	-	Porto & Feldberg (1988)
C. callichthys	-	58	-	-	-	-	-	-	-	-	-	-	Porto & Feldberg (1992b)
Corydoras aeneus [15]	-	132	-	-	-	-	-	-	-	-	-	-	Scheel *et al.* (1972)
C. aeneus	66	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
Corydoras aeneus	60	-	-	-	-	-	-	-	-	-	-	-	Hinegardner & Rosen (1972)
C. aeneus [16]	-	58	-	-	-	-	-	-	-	-	-	-	Scheel *et al.* (1972)
C. aeneus	29	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
C. aeneus	-	134	-	-	-	-	-	-	-	-	-	-	Turner *et al.* (1992)
C. aeneus	-	56	-	-	-	-	-	-	-	-	-	-	Turner *et al.* (1992)
C. agassizii	-	98	-	-	-	-	-	-	-	-	-	-	Scheel *et al.* (1972)
C. agassizii	49	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
C. arcuatus	-	46	-	-	-	-	-	-	-	-	-	-	Scheel *et al.* (1972)
C. arcuatus	23	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
C. elegans	-	50	-	-	-	-	-	-	-	-	-	-	Scheel *et al.* (1972)
C. elegans	25	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
C. elegans	25	-	-	-	-	-	-	-	-	-	-	-	Hinegardner & Rosen (1972)
C. melanistus	-	46	-	-	-	-	-	-	-	-	-	-	Scheel *et al.* (1972)
C. melanistus	23	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
C. melanistus	24	-	-	-	-	-	-	-	-	-	-	-	Hinegardner & Rosen (1972)
C. punctatus	22-23	-	-	-	-	-	-	-	-	-	-	-	Hinegardner & Rosen (1972)
C. aff. punctatus	-	102	8M+14SM+20ST+60A	2	-	SM	p	TERM.	-	X	X	-	Oliveira (1987)
C. rabauti	-	58	-	-	-	-	-	-	-	-	-	-	Scheel *et al.* (1972)
C. rabauti	29	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
C. reticulatus	-	74	16M+20SM+12ST+26A	2-3	-	A	q	TERM.	-	X	X	-	Oliveira (1987)
C. schwartzi	-	46	-	-	-	-	-	-	-	-	-	-	Scheel *et al.* (1972)
C. schwartzi	23	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
C. schwartzi	-	46	32M+14SM	2	-	M	p	TERM.	-	-	-	-	Oliveira (1987)
Dianema longibarbis	-	60	-	-	-	-	-	-	-	-	-	-	Hudson (1976)
D. longibarbis	-	60	8M-SM+52ST-A	2	-	SM	p	INTERST.	-	-	-	-	Marcon *et al.* (1992)
D. urostriatum [17]	-	62	8M+4SM+4ST+46A	2	-	A	p	TERM.	-	X	X	-	Oliveira *et al.* (1990b)
D. urostriatum	-	62	6M-SM+56ST-A	2	-	ST	p	TERM.	-	-	-	-	Marcon *et al.* (1992)
H. littorale	-	60	8M-SM+52ST-A	2	-	A	q	TERM.	-	-	-	-	Porto & Feldberg (1992b)
H. thoracatum	-	64	30M-SM+34ST-A	2	-	A	q	TERM	-	-	-	-	Porto & Feldberg (1992b)
H. aff. *thoracatum*	-	66	-	-	-	-	-	-	-	-	-	-	Porto & Feldberg (1992a)
H. sp.	-	62	8M-SM+54ST	4	-	M-SM	p	TERM.	-	-	-	-	Porto & Feldberg (1992a)
DORADIDAE													
Opsodoras humeralis	-	58	-	-	-	-	-	-	-	-	-	-	Della-Rosa *et al.* (1980)
Pseudodoras niger	-	58	58M-SM-ST-A	-	-	-	-	-	-	-	-	-	Venere (1988)
LORICARIIDAE													
Pterygoplichthys multiradiatus	-	52	-	-	-	-	-	-	-	-	-	-	Della-Rosa *et al.* (1980)
Loricaria sp.	-	62	-	-	-	-	-	-	-	-	-	-	Della-Rosa *et al.* (1980)

TABLE I (5)

PIMELODIDAE													
Callophysus macropterus	-	50	-	2	-	ST-A	p	TERM	-	-	-	-	Ramirez-Gil & Feldberg, 1992
Pimelodus blochii	-	58	-	-	-	-	-	-	-	-	-	-	Della-Rosa *et al.* (1980)
Pseudoplatystoma fasciatum	-	56	-	2	-	ST-A	p	-	-	-	-	-	Fennocchio & Bertollo (1992)
P. tigrinum	-	56	-	2	-	ST-A	p	-	-	-	-	-	Fennocchio & Bertollo (1992)
Sorubim lima	-	56	-	2	-	ST-A	p	-	-	-	-	-	Fennocchio & Bertollo (1992)
TRICHOMYCTERIDAE													
Vandelia cirrhosa	32	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
GYMNOTOIDEI													
APTERONOTIDAE													
Apteronotus albifrons	11	-	-	-	-	-	-	-	-	-	-	-	Hinegardner & Rosen (1972)
A. albifrons	-	24	14M+2SM+2ST+6T	-	-	-	-	-	-	-	-	-	Howell (1972)
A. albifrons	-	24	12M+4SM+2ST+6A	2	4	SM	q	INTERST.	X	X	-	-	Almeida-Toledo *et al.* (1981)
GYMNOTIDAE													
Gymnotus carapo	-	42	32M-SM+10ST-A	-	-	-	-	-	-	-	-	-	Foresti *et al.* (1984)
G. carapo	-	48	34M-SM+14ST-A	-	-	-	-	-	-	-	-	-	Foresti *et al.* (1984)
G. carapo	19	-	-	-	-	-	-	-	-	-	-	-	Hinegardner & Rosen (1972)
HYPOPOMIDAE													
Hypopomus brevirostris	-	36	4M+2SM+8ST+22A	-	-	-	-	-	-	-	-	-	Almeida-Toledo (1978)
H. artedi	-	38	32M-SM+6ST-A	-	-	-	-	-	-	-	-	-	Oliveira *et al.* (1988a)
Hypopigus lepturus	-	50	16M+20SM+10ST+4A	-	-	-	-	-	-	X	-	-	Almeida-Toledo (1978)
RHAMPHICHTHYDAE													
Ramphichthys cf. *pantherinus*	-	52	38M+10SM+4ST	-	-	-	-	-	-	-	-	-	Almeida-Toledo (1978)
STERNOPYGIDAE													
Eigenmannia humboldti	-	40	8M-SM+32ST-A	2	3	M-SM	p	TERM.	-	-	-	-	Foresti (1987)
Eigenmannia sp. (Triploid)	-	46	20M-SM+26ST-A	3	4	M-SM	p	TERM.	-	-	-	-	Almeida-Toledo *et al.* (1985)
Eigenmannia sp. (CYT-1)	-	31/32	12/13M-SM+18/20ST-A	2	4	M-SM	p	TERM.	-	-	-	-	Almeida-Toledo *et al.* (1985)
Eigenmannia sp. (CYT-2)	-	29/30	6/8M-SM+22/24ST-A	2	11	ST-A	q	INTERST.	-	-	-	-	Foresti (1987)
Eigenmannia sp. (CYT-1)	-	31/32	11/12M-SM+18/20ST-A	2	4	M-SM	p	TERM.	-	-	-	-	Foresti (1987)
Eigenmannia sp. (CYT-1)	-	31/32	12M/SM+18/20ST-A	2	4	M-SM	p	TERM.	-	-	-	-	Foresti (1987)
Eigenmannia sp. (CYT-1)	-	30	12M-SM+18ST-A	2	4	M-SM	p	TERM.	-	-	-	-	Foresti (1987)
Eigenmannia sp. (CYT-3)	-	28	14M-SM+14ST-A	2	3	ST-A	q	TERM.	-	X	X	-	Foresti (1987)
Eigenmannia sp. (CYT-B)	-	38	17M-SM+21ST-A (F)	2	6	M-SM	p	TERM.	-	X	X	ZW	
	-	38	16M-SM+22ST-A (M)	2	6	M-SM	p	TERM.	-	X	X	ZZ	Foresti (1987)
Sternopygus macrurus	-	46	46M-SM	2	1	M-SM	q	INTERST.	-	-	-	-	Foresti (1987)
S. macrurus	-	46	-	-	-	-	-	-	-	-	-	-	Bertollo *et al.* (1980)
PERCIFORMES													
CICHLIDAE													
Acarichthys heckeli	-	48	6M-SM+42ST-T	-	-	-	-	-	-	-	-	-	Thompson (1979)
Apistograma agassizi	20	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
A. agassizi	-	46	24M-SM+22ST-T	-	-	-	-	-	-	-	-	-	Thompson (1979)
Apistograma ortmanni	19	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
A. ortmanni	-	46	24M-SM+22ST-T	-	-	-	-	-	-	-	-	-	Thompson (1979)
A. pertensis [18]	24	-	-	-	-	-	-	-	-	-	-	-	Post (1965)
Astronotus ocellatus	24	48	12M-SM+36ST-A	2	1	M-SM	p	INTERST.	-	-	-	-	Feldberg & Bertollo (1985ab)
Cichla temensis	-	48	48ST-T	-	-	-	-	-	-	-	-	-	Thompson (1979)
Cichla sp.	-	48	48ST-T	-	-	-	-	-	-	-	-	-	Venere (1988)
Crenicichla strigata	-	48	6M-SM+42ST-T	-	-	-	-	-	-	-	-	-	Thompson (1979)
C. lucius	-	48	-	-	-	-	-	-	-	-	-	-	Thompson (1979)
Dicrossus filamentosus [19]	-	46	12M-SM+34ST-T	-	-	-	-	-	-	-	-	-	Thompsom (1979)
D. maculata [20]	23	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
Geophagus altifrons [21]	24	48	4M-SM+44ST-A	2	1	M-SM	p	INTERST.	-	-	-	-	Feldberg & Bertollo (1985ab)
Guinacara sp.	-	48	4M-SM+44ST-A	2	1	M-SM	p	INTERST.	-	X	-	-	Feldberg *et al.* (1990)
Heros severus [22]	24	-	-	-	-	-	-	-	-	-	-	-	Post (1965)
H. severus	24	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
H. severus	-	48	4M-SM+44ST-T	-	-	-	-	-	-	-	-	-	Thompson (1979)
Hypselacara coryphaenoides [23]	-	48	6M-SM+42ST-T	-	-	-	-	-	-	-	-	-	Thompson (1979)
Laetacara curviceps [24]	19	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
Pterophyllum eimekei	24	-	-	-	-	-	-	-	-	-	-	-	Post (1965)
P. scalare	24	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)
P. scalare	-	48	4M-SM+44ST-T	-	-	-	-	-	-	-	-	-	Thompson (1979)
Satanoperca jurupari [25]	-	48	-	-	-	-	-	-	-	-	-	-	Moreira F° *et al.* (1980a)
Symphysodon aequifasciatus [26]	-	60	44M+16A	-	-	-	-	-	-	-	-	-	Ohno & Atkin (1966)
S. aequifasciatus	30	-	-	-	-	-	-	-	-	-	-	-	Scheel (1973)

TABLE I (6)

S. aequifasciatus	-	60	58M-SM+2ST-T	-	-	-	-	-	-	-	-	-	Thompson (1979)
Uaru amphiacanthoides	-	46	8M-SM+38ST-T	-	-	-	-	-	-	-	-	-	Thompson (1979)
LEPIDOSIRENIFORMES													
LEPIDOSIRENIDAE													
Lepidosiren paradoxa	-	38	38M	-	-	-	-	-	-	-	-	-	Ohno & Atkin (1966)
L. paradoxa	-	38	38M-SM-ST	-	-	-	-	-	-	-	-	-	Oliveira *et al.* (1988a)

1 = Cheirodon axelrodi
2 = Hyphessobrycon simulans
3 = Poptella orbicularis
4 = Bryconella palifrons
5 = Hemigrammus gracilis
6 = Hemigrammus stictus
7 = Hyphessobrycon erythrostigma
8 = Poecilobrycon eques
9 = P. harrisoni
10 = P. unifasciatus
11 = Piaractus nigripinnis
12 = Metynnis hypsauchen
13 = Utiaritichthys sp
14 = Brochis coeruleus
15 = Corydoras aneus
16 = Corydoras schultzies
17 = Dianema urostriata
18 = Apistograma pertense
19 = Crenicara filamentosa
20 = Crenicara maculatus
21 = Geophagus surinamensis
22 = Cichlasoma severum
23 = Cichlasoma coryphaenoides
24 = Aequidens curviceps
25 = Geophagus jurupari
26 = Symphysodon aequifasciata