

Geographical distribution of Neotropical Cichlid fishes (Teleostei : Cichlidae) in the Rio de la Plata (Paraná, Uruguay and Paraguay) basin

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Abstract

The purpose of this paper is to present an updated list of all known Neotropical Cichlids from the Rio de la Plata basin including their geographical distribution patterns. This study is based on the available up-to-date literature, field surveys and database represented in museum collections. In the course of time many species from the family Cichlidae have been reported from the Rio de la Plata basin. Most records have been confirmed, but some must be considered as ambiguous or erroneous. Till this days there is no cross-national study on this subject, but rather for certain regions or respectively reaches of some rivers, some genera or countries. This may be the first study which deals with a complete overview of all Cichlid species from the whole river basin. Altogether there are 75 valid species confirmed for the Rio de la Plata basin and some still undescribed species.

Furthermore we attempt to classify the whole basin in different ichthyogeographical subbasins.

Introduction

Cichlidae is one of the most species-rich fish family in freshwaters world-wide, with nowadays round about 1680 valid species and with estimates approaching at least a total of 2000 species (Fishbase; Eschmeyer; Farias 2000). The Neotropical cichlids (Cichlinae) are a monophyletic clade that is sister to the monophyletic African cichlid clade (Pseudocrenilabrinae) (Farias et al., 2000; López-Fernández 2010).

They can be externally recognized usually by a divided lateral line, one single nostril on each side of the head, 7-24 spines in the dorsal fin

and 2-12 spines in the anal fin (Kullander 2003; Riehl et al., 1994)

Cichlids have not only captured the attention of ecologists, behavioural and evolutionary scientists (Smith 2008; López-Fernández 2010). Because of their remarkable and interesting breeding behavior and often attractive colors, most cichlids are popular kept as ornamental fishes. (Kullander 2003; Riehl et al., 1994)

The geographical distribution includes freshwaters of Africa and Middle East (Pseudocrenilabrinae: with more than 1100 described valid species), southern India, Sri Lanka and Madagascar (Etroplinae and Ptychochrominae: total of round about 30 species) and the Americas (Cichlinae: with more than 540 species) (Kullander 2003; Eschmeyer) Their distribution range in South America is concentrated to the area east of the Andes and northwards of the Rio Negro (Patagonia).

A widely known evolutionary phenomenon in the Cichlidae is their rapid adaptation to diverse habitats and trophic niches (Piálek 2013). The geographical distribution of most species is often limited to a single river or even one or a few streams with a high level of endemism, reflecting drainage basin histories and ecological constraints (Kullander 2003).

With a drainage area of round about 3.100.000 km² the Rio de la Plata Basin is the second largest in South America and among the five largest in the world (Natale 2005). The La Plata Basin collects the watercourses from the south-east of Bolivia, a large part of Uruguay, the whole drainage of Paraguay, northeastern Argentina and an extensive part of southern Brazil, (Map on page 3). The main tributaries are the Rio Paraguay (Pilcomayo, Bermejo), Rio Paraná (Paranaíba, Paranapanema, Grande, Tiete, Iguazú, Salado) and Rio Uruguay (Canoas, Pelotas, Ibicuí, Negro).

Material and Methods

• Literature evaluation

The species list and their distribution ranges were developed on the basis of the references mentioned by the particular species overview in this work. For this purpose we used predominantly original surveys and database from museums (Fishbase und SpeciesLink). Compilations were widely disclaimed. As far as possible and available we concentrate our focus on actual literature not older than 15-20 years.

Most records have been confirmed, but some must be considered as ambiguous or erroneous. This records were treated in the following way:

- Records which are obviously wrong (due to clear missidentifications or synonymy of different names) which can be concretised without any further investigation or research, were adopted and assumed with the according correction. (e.g. Synonym of *Aequidens vittatus* or *A. paraguayensis* for *Bujurquina vittata*; older reports from *Cichlasoma portalegrense* in the lower Paraná and lower Uruguay as obvious missidentifications of *C. dimerus*).
- Reports which are based on obvious missidentifications, which can not be clearly defined without any further investigation or research of the material were ignored in this study. (e.g. reports of *Crenicichla niederleini* from the Paraná sup as presumably missidentifications with *C. haroldoi*, *C. jaguarensis*, *C. jupiaensis* or *C. sp. "Paraná Itaipú / Sete Quedas"*; reports of *Australoheros facetus* or *Astraloheros sp.* from the Iguazú basin before 2011 as possible missidentifications of *A. angiru* or *A. kaaygua*).
- Undefined or ambiguous records which are not based on missidentifications and which can be concretised without any further investigation or research of the original material were considered in this study and with appropriate or correspondent remark (e.g. *Laetacara cf. dorsigera* or *L. cf. araguaiae* in Paraná sup as *L. sp. "Paraná Superior"*; *Gymnogeophagus australis* as *G. sp. "Paraná Alto"* for reports from the Paraná alt).

The question marks on the distribution maps have different meanings:

- old records which need an actual confirmation (e.g. *Astronotus crassipinnis* for the Paraguay inf)

- doubtful reports which are a possible missidentification with an other valid or still undescribed species (e.g. *Australoheros facetus* in the endorheic basin)
- Reports on the basis of personal comments without any scientific publication or database from museums (e.g. *Geophagus cf. neambi* from the Paraná alto)
- contradictory data from publications or databases which could not be clarified (e.g. *Crenicichla niederleini*)

Ambiguous reports were only considered if there are at least two different and independent sources.

• Classification of the ichthyogeographical subbasins

There is no consistent naming and classification for the Rio de la Plata basin and its subbasins. Ebach et al. 2008 recognized this problem on international level and proposed an International Code of Area Nomenclature (ICAN), though this intention was criticized (e.g. Zaragüeta-Bagils et al. 2009) and finally never implemented. To discuss the possibilities and difficulties of the implementation is not the subject and intention of this work, but it is important to consider this problem.

For example there are different definitions of the Upper Paraná basin (Paraná Alto or Alto Paraná). Brazilian authors denominate usually the basin above the Itaipú dam as "Paraná alto", but Argentinian authors normally refer to the "Alto Paraná" upstream of its confluence with the Rio Paraguay. According to this there is a great likelihood of confusion and to avoid this problem we suggest a new classification (see Tab 2). This classification is based on the results of this work considering the natural barriers and the distribution patterns of the cichlid species.

To make matters worse, there are different names and spelling forms for the rivers. In this work we generally use the english or spanish name. In addition there is a danger of confusion between different rivers with similar names (e.g. Iguazú or Iguazu vs. Yguazú; Uruguay or Uruguai vs. Urugua-Í)

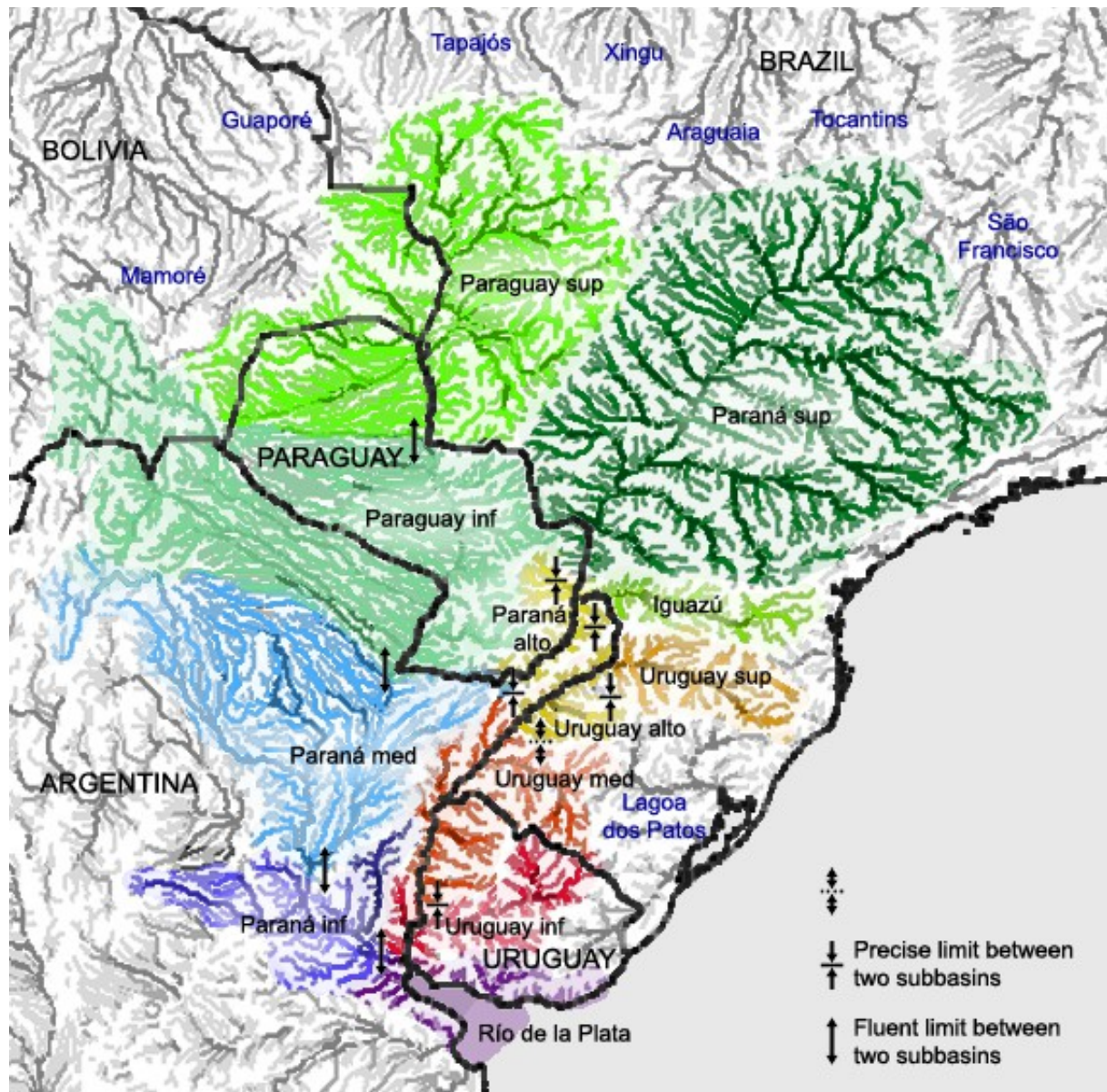


Fig. 1: The Rio de la Plata Basin and its subbasins.

Results

A total of 75 described cichlid species are nowadays known from the Rio de la Plata basin. 5 species are introduced to this basin. 59 species are endemic from the Rio de la Plata basin (ca. 78,6%) and

hereof 35 are endemic from one subbasin (50%). 6 species are mentioned by name, whichever are erroneously reported for the basin in different studies because of missidentifications or confusions.

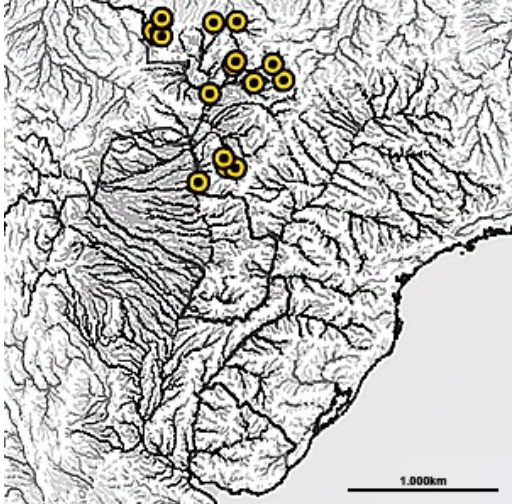

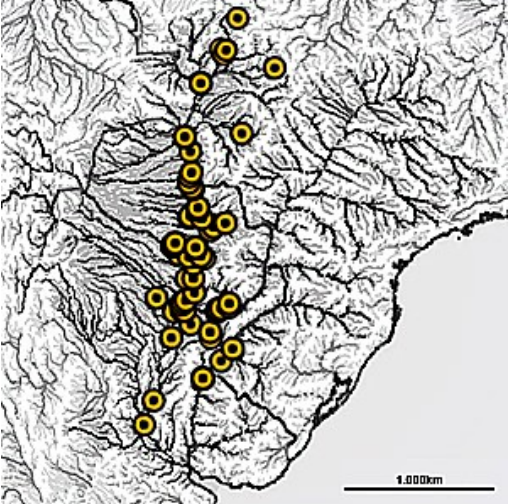
Species distribution overview and allocation in different subbasins

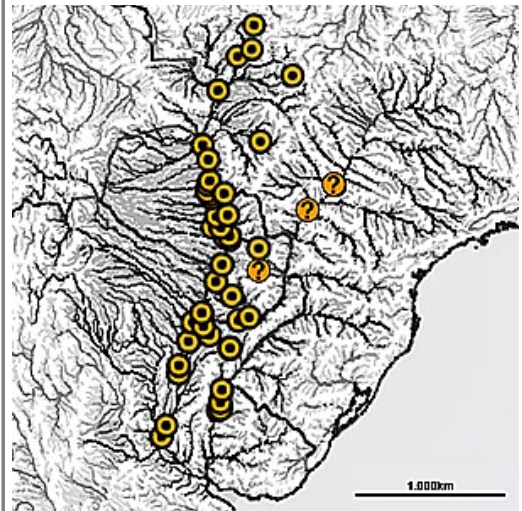
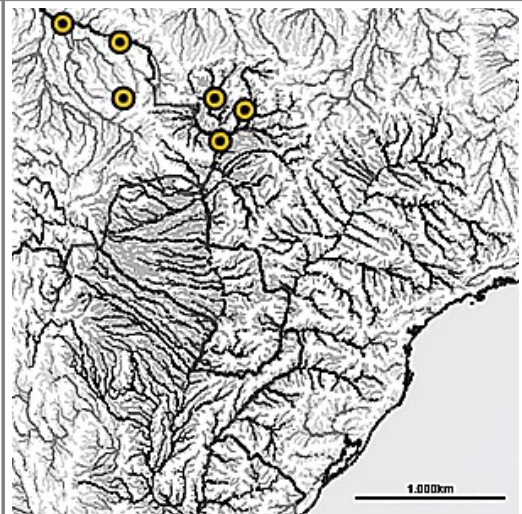
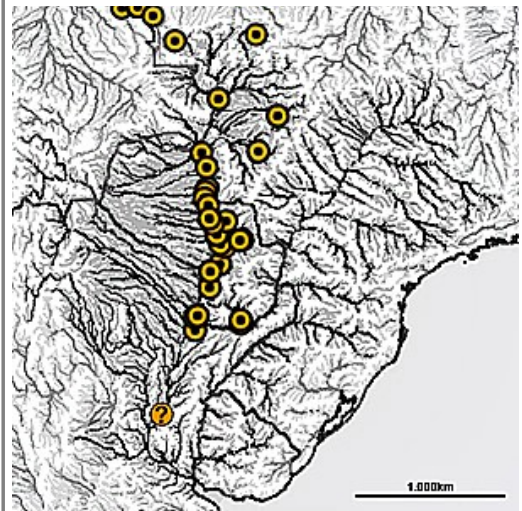
Species / Subbasin	Rio de la Plata basin	Paraná sup	Paraná alto	Paraguay sup	Paraguay inf	Paraná med	Paraná inf	Rio de la Plata estuary	Uruguay inf	Uruguay med	Uruguay alto	Uruguay sup	Sum
Total	75	6	21	17	13	13	8	10	15	18	13	14	
Endemic	35	4	15	1	1	1	0	0	1	1	5	6	
Allochthon	6	11	5	2	0	0	0	1	0	0	0	1	
<i>Crenicichla britskii</i>	1	1											1
<i>Crenicichla haroldoi</i>	1	1											1
<i>Crenicichla jaguarensis</i>	1	1											1
<i>Laetacara</i> sp „Paraná Superior“ *?	1	1*											1
<i>Cichlasoma paranaense</i>	1	1	1*?										1
<i>Coptodon cf rendalli</i> *	1	1*	1*										2
<i>Geophagus cf sveni</i> *	1	1*	1*?										1
<i>Oreochromis cf niloticus</i> *	1	1*	1*					1*?				1*	3
<i>Cichla kelberi</i> *	1	1*	1*	1*									3
<i>Geophagus brasiliensis</i>	1	1	1									1	4
<i>Cichla piquiti</i> *	1	1*		1*									2
<i>Crenicichla jupiaensis</i>	1	1				1							2
<i>Australoheros kaaygua</i>	1		1										1
<i>Crenicichla iguassuensis</i>	1		1										1
<i>Crenicichla tapii</i>	1		1										1
<i>Crenicichla tesay</i>	1		1										1
<i>Crenicichla tuca</i>	1		1										1
<i>Australoheros angiru</i>	1		1									1	2
<i>Australoheros tembe</i>	1		1										1
<i>Crenicichla yaha</i>	1		1										1
<i>Crenicichla ypo</i>	1		1										1
<i>Gymnogeophagus che</i>	1		1										1
<i>Australoheros guarani</i>	1		1										1
<i>Cichlasoma pusillum</i>	1		1										1
<i>Crenicichla gillmorlisi</i>	1		1										1
<i>Crenicichla hu</i>	1		1										1
<i>Crenicichla mandelburgeri</i>	1		1										1
<i>Gymnogeophagus setequeadas</i>	1	1*?	1										1
<i>Bujurquina vittata</i>	1		1	1	1	1							4
<i>Crenicichla lepidota</i>	1		1	1	1	1	1	1	1	1	1		10
<i>Crenicichla vittata</i>	1	1*?	1	1	1	1	1	1	1	1	1	1	10
<i>Aequidens plagiozonatus</i>	1			1	?								1
<i>Apistogramma inconspicua</i>	1			1									1
<i>Bujurquina oenolaemus</i>	1			1									1
<i>Satanoperca pappaterra</i>	1	1*		1									2
<i>Astronotus crassipinnis</i>	1	1*		1	?								2
<i>Chaetobranchopsis australis</i>	1			1	1								2
<i>Mesonauta festivus</i>	1			1	1								2
<i>Crenicichla semifasciata</i>	1	1*	1	1	1	1	1	1					7
<i>Cichlasoma dimerus</i>	1			1	1	1	1	1	1	1	?		7
<i>Gymnogeophagus balzanii</i>	1		?	1	1	1	1	1	?	1			6

<i>Apistogramma borellii</i>	1			1	1	1	?			1			4
<i>Apistogramma commbrae</i>	1			1	1	1	?			1			4
<i>Apistogramma trifasciata</i>	1			1	1	1	?						3
<i>Laetacara dorsigera</i>	1			1	1	1				1			4
<i>Gymnogeophagus caaguazuensis</i>	1		?		1								1
<i>Crenicichla taikyra</i>	1					1							1
<i>Australoheros facetus</i>	1	?	?			1	1	1	1	1	?		6
<i>Gymnogeophagus australis</i>	1		?			?	1	1	1	?	?		3
<i>Gymnogeophagus meridionalis</i>	1					?	1	1	1	1		?	4
<i>Gymnogeophagus terrapurpura</i>	1							1	1				2
<i>Crenicichla scottii</i>	1							1	1	1			3
<i>Gymnogeophagus mekinos</i>	1								1				1
<i>Australoheros scitulus</i>	1								1	1			2
<i>Crenicichla celidochilus</i>	1								1	1	1	1	4
<i>Crenicichla minuano</i>	1								1	1	1	1	4
<i>Crenicichla missioneira</i>	1								1	1	1	1	4
<i>Gymnogeophagus rhabdotus</i>	1								1	1		?	3
<i>Gymnogeophagus tiraparae</i>	1								1				2
<i>Gymnogeophagus pseudolabiatu</i>	1									1			1
<i>Australoheros minuano</i>	1									1	1		2
<i>Crenicichla tendybaguassu</i>	1									1	1	1	3
<i>Australoheros charrua</i>	1										1		1
<i>Australoheros ykeregua</i>	1										1		1
<i>Crenicichla gaucho</i>	1										1		1
<i>Gymnogeophagus constellatus</i>	1										1		1
<i>Gymnogeophagus missioneiro</i>	1										1		1
<i>Australoheros forquilha</i>	1											1	1
<i>Crenicichla empheres</i>	1											1	1
<i>Crenicichla hadrostigma</i>	1										1	1	2
<i>Crenicichla igara</i>	1											1	1
<i>Crenicichla jurubi</i>	1											1	1
<i>Crenicichla prenda</i>	1											1	1
<i>Gymnogeophagus lipokareno</i>	1										1	1	1
<i>Crenicichla niederleini</i>	1	?	?									?	?

Tab 1: Species distribution overview and allocation in different subbasins

Distribution details

<p><i>Aequidens plagiozonatus</i> Kullander, 1984 Synonym: none Distribution: Paraguay sup; // Guaporé; Countries: BOL; BRA; PAR; Comments: This species is known from the upper Paraguay with some reports from the Guaporé.</p> <p>References: Kullander 2003; Ottoni et al. 2008; Fernandes et al. 2010; Suárez et al. 2013; Frey-Dargas 2014; Polaz et al. 2014; Oliveira et al. 2015; Fishbase; SpeciesLink;</p>	 <p>A topographic map of the upper Paraguay basin showing the distribution of <i>Aequidens plagiozonatus</i>. The map features a network of rivers and tributaries. Yellow circles with black outlines mark the collection sites, which are clustered in the upper reaches of the basin. A scale bar in the bottom right corner indicates 1,000 km.</p>
<p><i>Aequidens</i> sp Synonym: none Distribution: Bermejo; Countries: ARG; Comments: Three specimens of a presumably undescribed <i>Aequidens</i> species are known from the Rio Bermejo;</p> <p>References: Miquelarena et al. 2012;</p>	 <p>A topographic map of the Rio Bermejo basin showing the distribution of an undescribed <i>Aequidens</i> species. The map displays the river network. A single yellow circle with a black outline marks the collection site. A scale bar in the bottom right corner indicates 1,000 km.</p>
<p><i>Aequidens tetramerus</i> (Heckel, 1840) <i>A tetramerus</i> is a species from the Amazonas with some erroneous reports from the Paraná basin; According to Kullander (1983) some authors considered <i>Cichlasoma dimerus</i> as a junior synonym from <i>A tetramerus</i> (e.g. Steindachner, 1875);</p>	
<p><i>Apistogramma borellii</i> (Regan, 1906) Synonym: <i>Heterogramma borellii</i>; <i>Heterogramma ritense</i>; <i>Heterogramma rondoni</i>; <i>Apistogramma aequipinnis</i>; <i>Apistogramma reitzigi</i>; Distribution: Paraguay sup / inf; Paraná med / inf; Uruguay med; Countries: ARG; BOL; BRA; PAR; URU; Comments: The distribution range of <i>A borellii</i> extends from the upper Paraguay to the lower Paraná and the middle Uruguay;</p> <p>References: Menni et al. 1992; Liotta 2005; Verissimo et al. 2005; Ottoni et al. 2008; Neiff et al. 2009; Fernandes et al. 2010; Iwaszkiw et al. 2010; Lanés et al. 2010; Zarucki et al. 2010; Miquelarena et al. 2012; Suárez et al. 2013; Brancolini et al. 2014; Montes et al. 2014; Polaz et al. 2014; Silva et al. 2014; Almirón et al. 2015; Fishbase; SpeciesLink;</p>	 <p>A topographic map showing the distribution of <i>Apistogramma borellii</i> across the upper Paraguay, lower Paraná, and middle Uruguay basins. The map shows a dense network of rivers. Numerous yellow circles with black outlines mark collection sites, distributed along the main river channels and their tributaries. A scale bar in the bottom right corner indicates 1,000 km.</p>

Apistogramma commbrae (Regan, 1906)**Synonym:** *Apistogramma corumbae***Distribution:** Paraguay sup / inf; Paraná med / inf; Uruguay med; // Paraná alto? / sup?;**Countries:** ARG; BOL; BRA; PAR; URU;**Comments:** This species is distributed from the upper Paraguay till lower Paraná and the middle Uruguay; One doubtful report from Río Güyrauguá, a Paraná alto tributary (Fishbase) need a confirmation; There are also some newer reports from the Paraná sup (Suarez et al. 2011; Costa-Pereira et al. 2012; SpeciesLink)**References:** Menni et al. 1992; Liotta 2005; Verissimo et al. 2005; Ottoni et al. 2008; Neiff et al. 2009; Iwaszkiw et al. 2010; Suárez et al. 2011; Costa-Pereira et al. 2012; Miquelarena et al. 2012; Suárez et al. 2013; Montes et al. 2014; Polaz et al. 2014; Silva et al. 2014; Almirón et al. 2015; Fishbase; SpeciesLink;***Apistogramma inconspicua*** Kullander, 1983**Synonym:** *none***Distribution:** Paraguay sup; // Guaporé;**Countries:** BOL; BRA;**Comments:** A *inconspicua* is known from a few localities in the upper Paraguay and Guaporé basin;**References:** Kullander 1983; Kullander 2003; Ottoni et al. 2008; Rojas et al. 2008; Fishbase; SpeciesLink;***Apistogramma trifasciata*** (Eigenmann & Kennedy, 1903)**Synonym:** *Biotodoma trifasciatus*; *Heterogramma trifasciatum maciliense*; *Apistogramma trifasciatum haraldschultzi***Distribution:** Paraguay sup / inf; Paraná med; // Paraná inf? // Guaporé;**Countries:** ARG; BOL; BRA; PAR;**Comments:** This species is distributed from the Guaporé till middle Paraná; There is also one outdated report from the lower Paraná (according to Liotta 2005 in Bonetto et al. 1970)**References:** Liotta 2005; Verissimo et al. 2005; Ottoni et al. 2008; Rojas et al. 2008; Iwaszkiw et al. 2010; Suárez et al. 2013; Polaz et al. 2014; Fishbase; SpeciesLink;***Apistogramma pleurotaenia*** (Regan, 1909)

According to Kullander (1982; 2003) this is a valid species, only known from females as type material (Kullander 1982). Regan (1909) mentioned „La Plata“ as type locality, but there are no newer records for this species;

Apistogramma taeniata (Günther, 1862)There are some erroneous reports for this species from the Rio Paraguay, but this should be considered as missidentification from *A. commbrae* specimens (Kullander 1982); Ringuelet (1967) considered *A. pleurotaenia* as a junior synonym from *A. taeniata*, according to this Liotta (2005) mentioned this species for the lower Paraná;

Astronotus crassipinnis (Heckel, 1840)

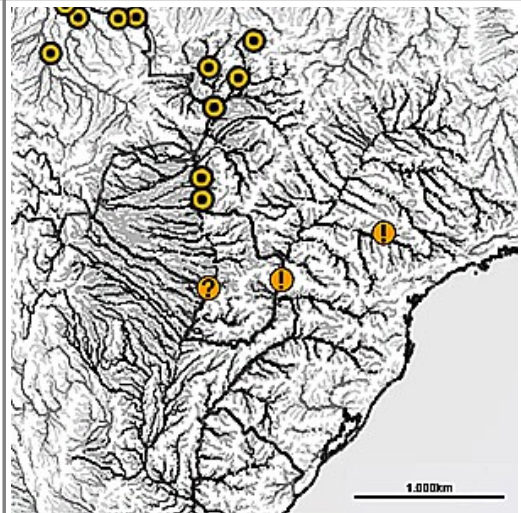
Synonym: *Acara crassipinnis*

Distribution: Paraguay sup; Paraná sup**; // Paraguay inf?; // Guaporé;

Countries: ARG?; BOL; BRA; PAR;

Comments: This species is known from the upper Paraguay and Guaporé; Some outdated reports for the lower Paraguay (Pozzi 1945; Ringuelett et al. 1967) require an actual confirmation; This species (and/or *A ocellatus*) has been introduced in the Paraná sup;

References: Lasso et al. 1999; Kullander 2003; Liotta 2005; Verissimo et al. 2005; Ribeiro Filho 2006; Brandao et al. 2007; Ottoni et al. 2008; Okada et al. 2012; Suárez et al. 2013; Polaz et al. 2014; Fishbase; SpeciesLink;



Astronotus ocellatus (Agassiz, 1831)

For a long time *A crassipinnis* was considered as a junior synonym from *A ocellatus*; Kullander (1986) revalidated *Astronotus crassipinnis* from synonymy with *A. ocellatus* and assigned records from the Paraguay and Paraná basin to *Astronotus crassipinnis* while restricting *A. ocellatus* to the Amazon drainage (1986, 2003); the allochthon specimens reported from Paraná sup could belong to *A ocellatus* and/or *A crassipinnis*;

Australoheros angiru Rican, Piálek, Almirón & Casciotta, 2011

Synonym: *Australoheros* sp. "*Jacutinga*"; '*Cichlasoma*' *facetum*; '*Cichlasoma*' sp. "*Iguaçu*"; *Australoheros kaaygua*;

Distribution: Iguazú; Uruguay sup; // Uruguay alto?

Countries: ARG?; BRA;

Comments: The distribution range of *A angiru* includes the Iguazú and the Uruguay sup; Some reports from the Uruguay alto require an actual confirmation.

References: Rican et al 2011; SpeciesLink;



Australoheros charrua Rican & Kullander, 2008

Synonym: *Australoheros* sp. "*Pirapo*";

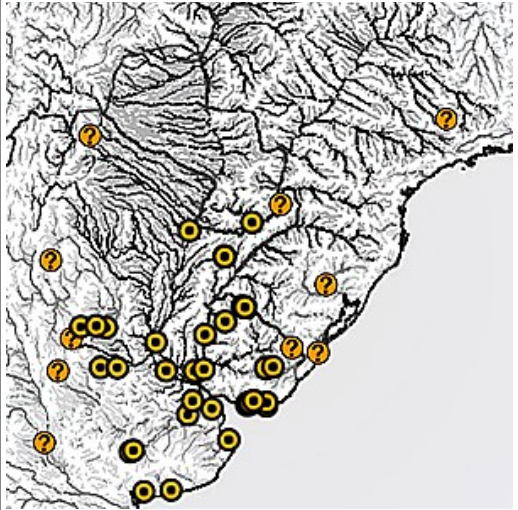
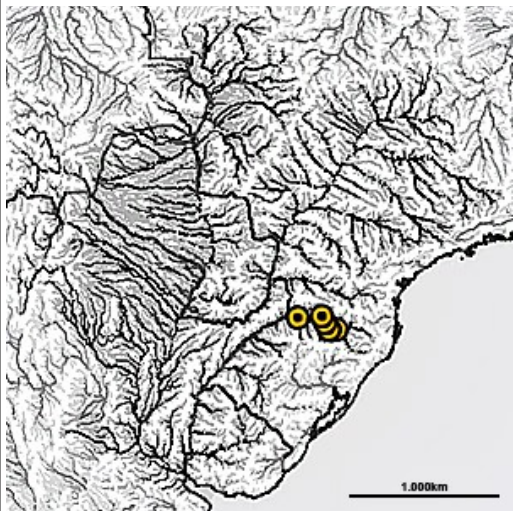
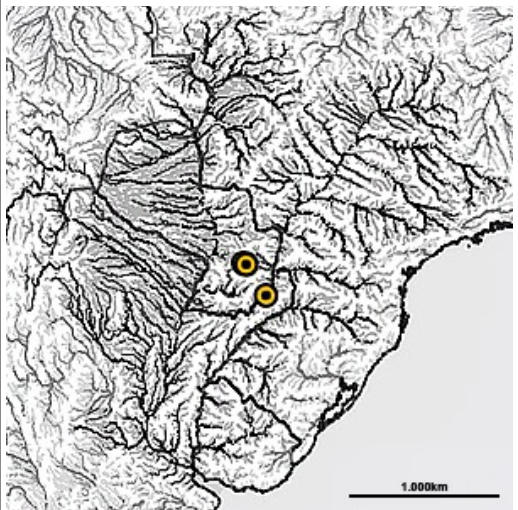
Distribution: Uruguay med;

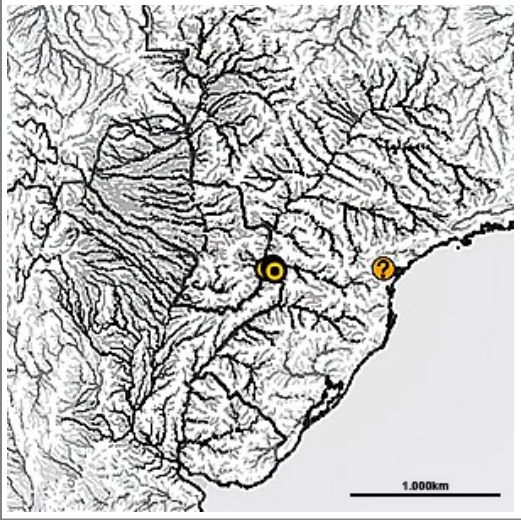
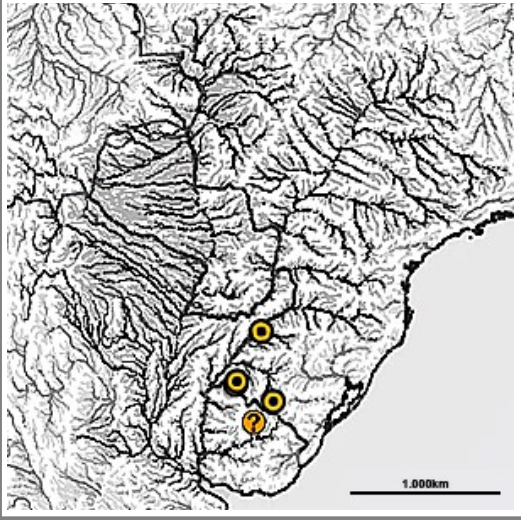
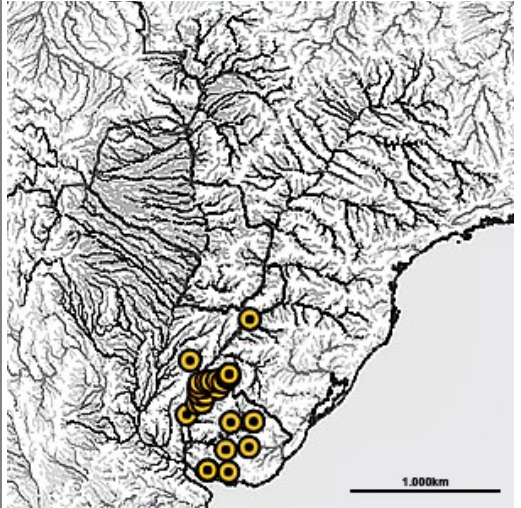
Countries: BRA;

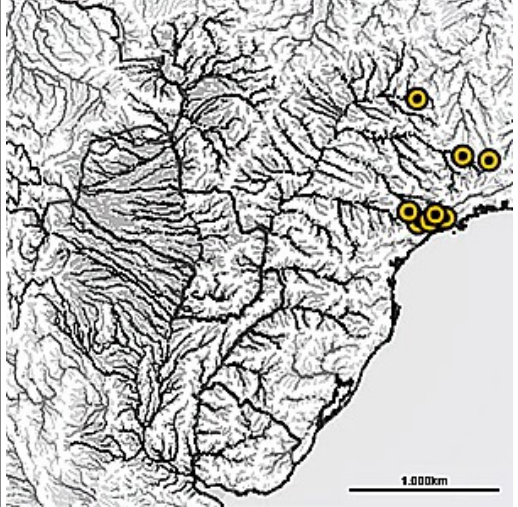


Comments: Only known from the type locality; Until now this species is not evaluated by the IUCN; but it would comply with their criteria for an endangered species in the Red List; In particular the realisation of the planned Garabi dam construction would negatively affect their distribution area;


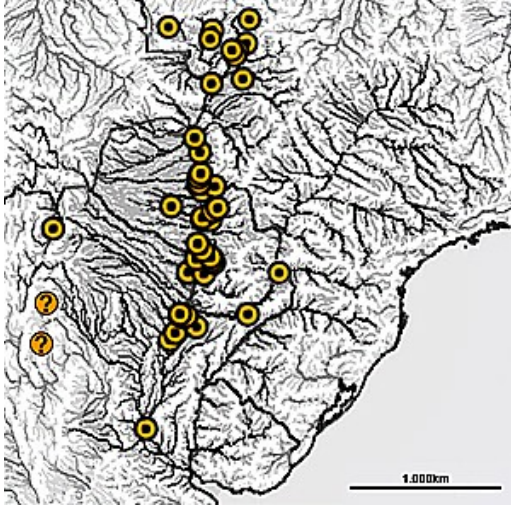

References: Rican & Kullander 2008; SpeciesLink;

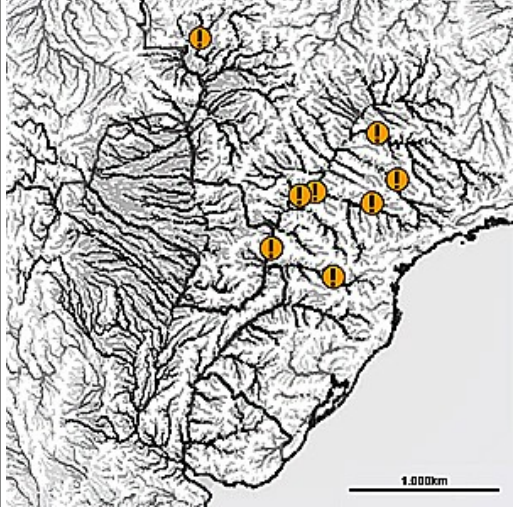
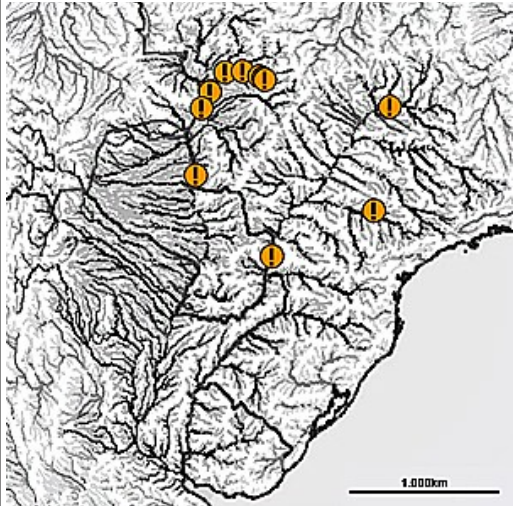
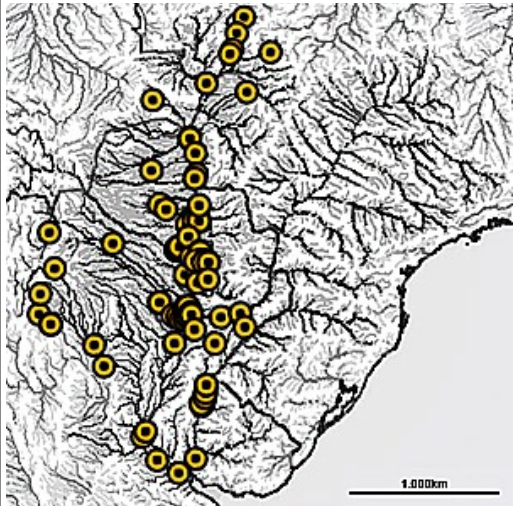


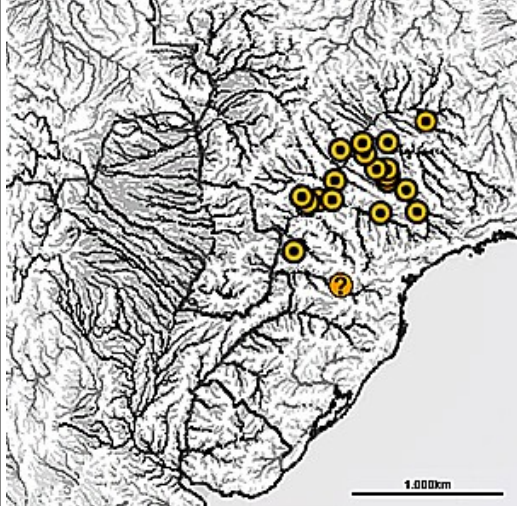

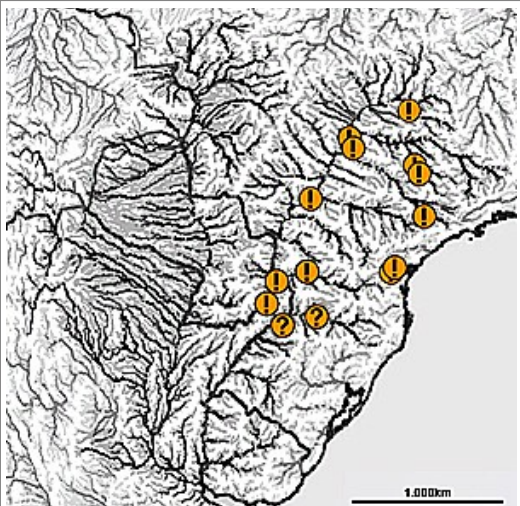
<p><i>Australoheros facetus</i> (Jenyns, 1842) Synonym: <i>Chromis facetus</i>; <i>Chromys oblonga</i>; <i>Heros autochthon</i>; <i>Heros jenynsii</i>; <i>Heros acaroides</i>; Distribution: Paraná med / inf; Rio de la Plata; Uruguay med / inf; // Bermejo?; Paraná sup? / alto?; // Endorheic basin east of the Andes; Atlantic tributaries Countries: ARG; BRA?; PAR?; URU; Comments: A facetus was a so-called "catch all species" inside the "catch all genus" Cichlasoma, until the revision from Rican & Kullander 2008; according to this, a critical examination of all localities mentioned in the older literature is nowadays necessary; one could consider as relative certain their distribution in the lower Paraná, Rio de la Plata, lower Uruguay and southern Atlantic Ocean tributaries; all other records should be considered as doubtful (A cf facetus); References: Miquelarena et al 1995; Ferriz, 1995/96; Liotta et al. 1996; Bistoni et al. 2002; Liotta 2005; Garcia et al. 2006; Calviño, 2007; Hued et al., 2007; Rican & Kullander, 2008; Mancini et al. 2009; Neiff et al. 2009; Solari et al. 2010; Bruno et al. 2011; Rican et al. 2011; Miquelarena et al. 2012; Cava et al., 2013; Montes et al 2014; Serra et al. 2014; Almirón et al. 2015; Fishbase; SpeciesLink;</p>	
<p><i>Australoheros forquilha</i> Rican & Kullander, 2008 Synonym: <i>Australoheros</i> sp. "Forquilha"; Distribution: Uruguay sup; Countries: BRA; Comments: Only known from the upper Uruguay; reports from the Uruguay alto (Rican & Kullander, 2008) where identified as A ykeregua (Rican et al. 2011); References: Rican & Kullander 2008; Amaral et al. 2010; Rican et al 2011; SpeciesLink;</p>	
<p><i>Australoheros guarani</i> Rican & Kullander, 2008 Synonym: <i>Australoheros</i> sp. "Paraguay"; Distribution: Paraná alto; Countries: PAR; Comments: Only known from the western tributaries (Monday and Tembey) from the Paraná alto; References: Rican & Kullander 2008;</p>	

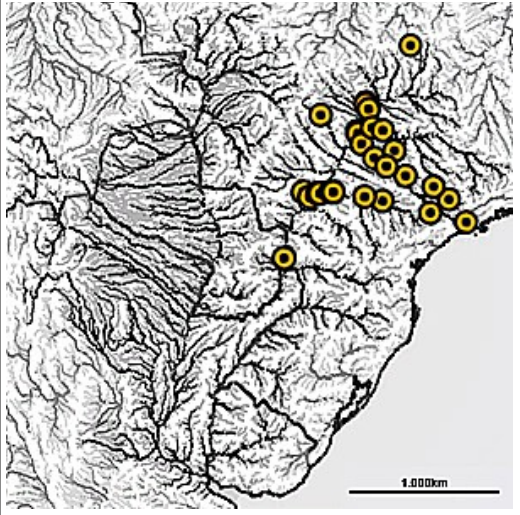
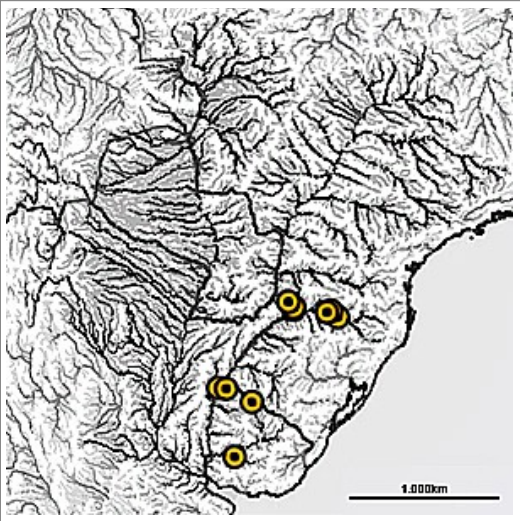

<p><i>Australoheros kaaygua</i> Casciotta, Almirón & Gómez, 2006 Synonym: <i>Australoheros</i> sp. "Jacutinga" Distribution: Iguazú; Countries: ARG; BRA; Comments: Only known from a few small tributaries of the Iguazú; There is one report for the upper Iguazú (Oliveira 2008), but this report could be a misidentification with <i>A. angiru</i>; References: Oliveira 2008; Rican & Kullander 2008; Rican et al 2011; SpeciesLink;</p>	
<p><i>Australoheros minuano</i> Rican & Kullander, 2008 Synonym: <i>Australoheros</i> sp. "Uruguai"; '<i>Cichlasoma</i>' sp. "Salto"; '<i>Cichlasoma</i>' sp. "Tacuarembó"; Distribution: Uruguay med; // Uruguay inf?; Countries: BRA; URU; Comments: A minuano is reported from a few eastern tributaries of the middle Uruguay; There is only one report from the lower Uruguay; References: Rican & Kullander 2008; SpeciesLink;</p>	
<p><i>Australoheros scitulus</i> (Rican & Kullander, 2003) Synonym: '<i>Cichlasoma</i>' <i>scitulum</i>; '<i>Cichlasoma</i>' sp. "Palmar"; Distribution: Rio de la Plata; Uruguay med / inf; Countries: ARG; BRA; URU; Comments: A scitulus is known from the Uruguay med / inf and from the sinistral Rio de la Plata tributaries; References: Rican & Kullander 2003; Rican et al 2011; Serra et al. 2014; Fishbase; SpeciesLink;</p>	



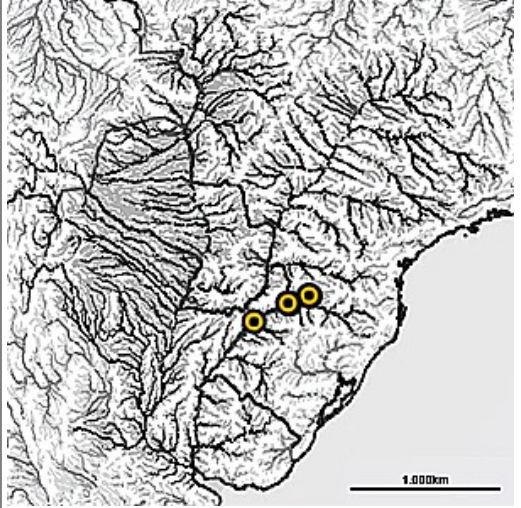
<p><i>Australoheros tavaresi</i> Ottoni, 2012 Synonym: <i>none</i> Distribution: Paraná sup; Countries: BRA; Comments: This species is only known from the upper Paraná basin; References: Ottoni 2012; SpeciesLink;</p>	
<p><i>Australoheros tembe</i> (Casciotta, Gómez & Toresani, 1995) Synonym: <i>Cichlasoma' tembe</i>; <i>Nandopsis tembe</i>; Distribution: Urugua-Í; Countries: ARG; Comments: Only known from the Urugua-Í basin; reports of this species for the Arroyo San Antonio (Iguazú) and Yabotí Mini (Uruguay) (Miquelarena 2012) require an accurate examination; Reports for the Yabotí Guazú (Uruguay) were identified as <i>A ykeregua</i> (Rican et al. 2011); References: Körber et al. 2005; Rican & Kullander 2008; Rican et al 2011; Miquelarena et al. 2012; Miquelarena et al. 2014;</p>	
<p><i>Australoheros ykeregua</i> Rican, Pialek, Almiron & Casciotta, 2011 Synonym: <i>Australoheros</i> sp. "<i>Forquilha</i>"; '<i>Cichlasoma' tembe</i>'; <i>Australoheros forquilha</i> Distribution: Uruguay alto; Countries: ARG; BRA?; Comments: Only known from the tributaries of the Uruguay alto; References: Rican et al 2011; SpeciesLink;</p>	
<p><i>Australoheros</i> sp There are some presumably undescribed <i>Australoheros</i> species known from the southeastern Rio Uruguay drainage (Řican et al. 2008); also the reports for <i>A. facetus</i> from the endorheic basin east of the Andes could be considered as presumably undescribed species;</p>	

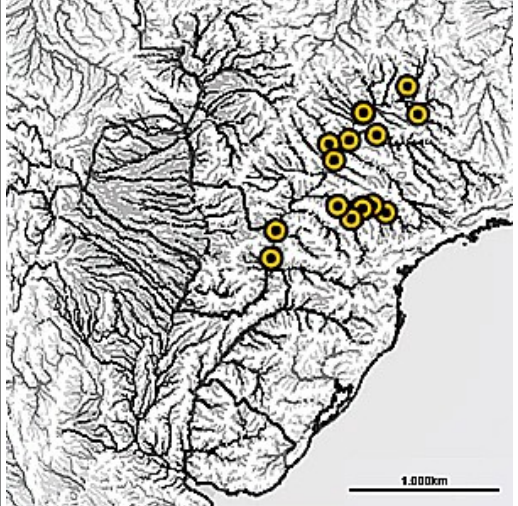


<p><i>Bujurquina oenolaemus</i> Kullander, 1987 Synonym: none Distribution: Paraguay sup; Countries: BOL; Comments: Only known from the type locality; Until now this species is not evaluated by the IUCN; but it would comply with their criteria for an endangered species in the Red List; References: Kullander 1987</p>	
<p><i>Bujurquina vittata</i> (Heckel, 1840) Synonym: <i>Acara vittatus</i>; <i>Cychlasoma vittatum</i>; <i>Acara vittata</i>; <i>Astronotus vittata</i>; <i>Aequidens paraguayensis</i>; <i>Aequidens vittatus</i>; <i>Acara paraguayensis</i>; <i>Bujurquina paraguayensis</i>; Distribution: Paraguay sup / inf; Paraná alto / med / inf; // Endorheic basin east of the Andes?; Guaporé; Countries: ARG; BOL; BRA; PAR; Comments: The distribution range of <i>B vittata</i> extends from the upper Paraguay to the lower Paraná; There are also some few reports from the Guaporé, two outdated report from the endorheic basin east of the Andes and one for the Paraná alto;</p> <p>References: Arratia et al. 1983; Miquelarena et al. 1990; Menni et al. 1992; Menni et al. 1998; Liotta 2005; Verissimo et al. 2005; Ottoni et al. 2008; Neiff et al. 2009; Fernandes et al 2010; Miquelarena et al. 2012; Suárez et al., 2013; Brancolini et al. 2014; Polaz et al. 2014; Silva et al. 2014; Almirón et al. 2015; Casciotta et al. 2016; Fishbase; SpeciesLink;</p>	
<p><i>Chaetobranchopsis australis</i> Eigenmann & Ward, 1907 Synonym: none Distribution: Paraguay sup / inf; Paraná med; // Paraná sup? // Guaporé Countries: ARG; BOL; BRA; PAR; Comments: The distribution range from this species includes the upper and lower Paraguay; There are also some few reports for the Guaporé; Suárez et al. (2011) mentioned <i>C australis</i> for the Paraná sup;</p> <p>References: Liotta 2005; Verissimo et al. 2005; Ottoni et al. 2008; Fernandes et al. 2010; Suárez et al. 2011; Suárez et al. 2013; Frey-Dargas 2014; Fishbase; SpeciesLink;</p>	


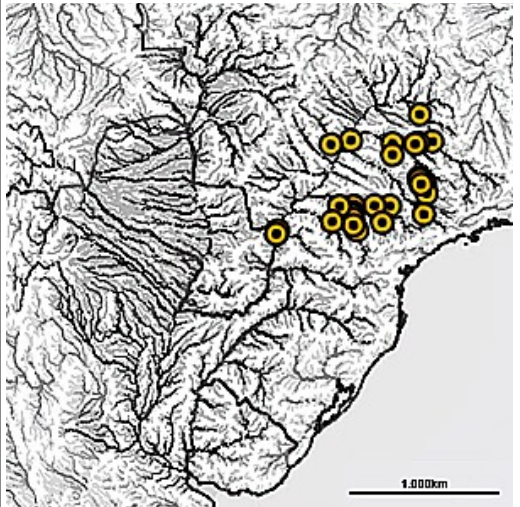
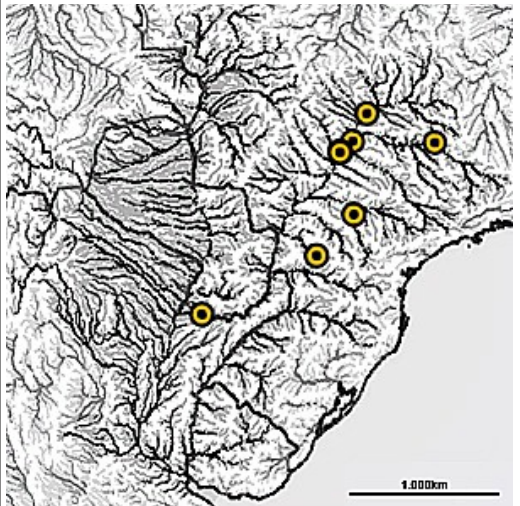
<p><i>Cichla kelberi</i> Kullander & Ferreira, 2006 Synonym: none Distribution: Paraná sup**; Paraguay sup**; Iguazú**; Countries: BRA; PAR?; Comments: This is an invasive species in the Paraguay sup and Paraná sup; There are also some records for the Iguazú; References: Oliveira et al. 2001; Castro et al. 2004; Brandao et al. 2007; Pelicice et al. 2009; Esguícero et al. 2011; Baumgartner et al. 2012; Okada et al. 2012; Ortega 2015; SpeciesLink;</p>	
<p><i>Cichla piquiti</i> Kullander & Ferreira, 2006 Synonym: none Distribution: Paraná sup**; Paraguay sup**; Countries: BRA; PAR?; Comments: Like <i>Cichla kelberi</i> is this an invasive piscivore species in the upper Paraguay and Paraná sup; References: Nascimento et al. 2001;Oliveira 2004; Brandao et al. 2007; Resende et al. 2008; Luiz et al. 2010; Okada et al. 2012; Suárez et al. 2013; SpeciesLink;</p>	
<p><i>Cichla monoculus</i> Agassiz, 1831 <i>Cichla ocellaris</i> Bloch & Schneider, 1801 <i>C. kelberi</i> was often misidentified as <i>Cichla ocellaris</i> or <i>Cichla monoculus</i>, two close congeners that are very similar in body shape and colouration.</p>	
<p><i>Cichlasoma dimerus</i> (Heckel, 1840) Synonym: <i>Acara dimerus</i>; <i>Acara marginatus</i>; <i>Cychlasoma dimerus</i>; <i>Heros centralis</i>; <i>Aequidens centralis</i>; <i>Heros centralis</i>; <i>Astronotus dimerus</i>; <i>Aequidens dimerus</i>; Distribution: Paraguay sup / inf; Paraná med / inf; Uruguay alto / med / inf; // Endorheic basin east of the Andes Countries: ARG; BOL; BRA; PAR; URU; Comments: This species has a wide distribution in nearly the whole basin, excluding only the upper Paraná and upper Uruguay; References: Kullander 1983; Menni et al. 1992; Liotta et al. 1996; Liotta 2005; Verissimo et al. 2005; Ottoni et al. 2008; Neiff et al. 2009; Fernandes et al 2010; Iwaszkiw et al. 2010; Nieva 2010; Miquelarena et al. 2012; Suárez et al., 2013; Brancolini et al. 2014; Frey-Dargas 2014; Montes et al 2014; Polaz et al. 2014; Serra et al. 2014; Almirón et al. 2015; Oliveira et al 2015; Fishbase; SpeciesLink;</p>	


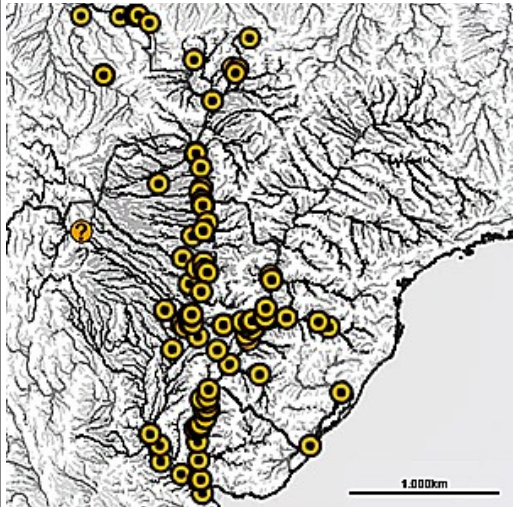

<p><i>Cichlasoma paranaense</i> Kullander, 1983 Synonym: none Distribution: Paraná sup; // Iguazú**? Countries: BRA; PAR?; Comments: Known from the Paraná sup; According to Baumgartner (2012) this species has an invasive distribution in the Iguazú; References: Kullander 1983 b; Oliveira et al. 2001; Castro et al. 2003; Casatti 2004; Castro et al. 2004; Casatti et al. 2006; Brandao et al. 2007; Suarez 2008; Casatti et al. 2009; Esguícero et al. 2011; Pazian 2011; Baumgartner et al. 2012; Sampaio et al. 2012; Pereira 2014; Fishbase; SpeciesLink;</p>	
<p><i>Cichlasoma pusillum</i> Kullander, 1983 Synonym: none Distribution: Paraná alto; Countries: PAR; Comments: Only known from the type locality and nearby area; Until now this species is not evaluated by the IUCN; but it would comply with their criteria for an endangered species in the Red List; It has a small distribution area and their habitat is subject to a great alteration (urbanisation and dam construction); References: Kullander 1983 b; Kullander & Lucena 2013</p>	
<p><i>Coptodon cf rendalli</i> (Boulenger, 1897) Synonym: <i>Chromis rendalli</i>; <i>Tilapia rendalli</i>; <i>Tilapia sexfasciata</i>; <i>Tilapia latifrons</i>; <i>Tilapia christyi</i>; <i>Tilapia sykesii</i>; <i>Tilapia kirkhami</i>; <i>Tilapia druryi</i>; <i>Tilapia mackeani</i>; <i>Tilapia swierstrae</i>; <i>Tilapia gefuensis</i>; <i>Tilapia zillii</i>; <i>Tilapia melanopleura</i>; <i>Tilapia lata</i>; Distribution: Paraná sup** / alto**; Iguazú**; // Uruguay sup*** / alto***? Countries: ARG; BRA; PAR?; Comments: This is an invasive species from central Africa, normally mentioned as <i>Tilapia rendalli</i>; In the early fifties <i>Coptodon rendalli</i> was introduced in several Brazilian reservoirs (Zaganini et al. 2012; Biagioni et al. 2013) There are populations in the upper Paraná sup and Iguazú and maybe also in the upper Uruguay. It is questionable if their are really <i>C. rendalli</i> or one of the numerous similar species. According to SpeciesLink some museum material was identified as <i>Tilapia melanopleura</i>, <i>Tilapia zillii</i> or simply as <i>Tilapia</i> sp. References: Castro 2003; Ingenito 2004; Körber et al 2005; Baumgartner et al 2006; Casatti et al 2006; Oliveira 2008; Casatti et al 2009; Oliveira et al 2009; Villares Junior 2011; Sampaio et al. 2012; Zaganini et al. 2012; Biagioni et al. 2013; Takahashi 2013; Casciotta et al. 2016; SpeciesLink;</p>	

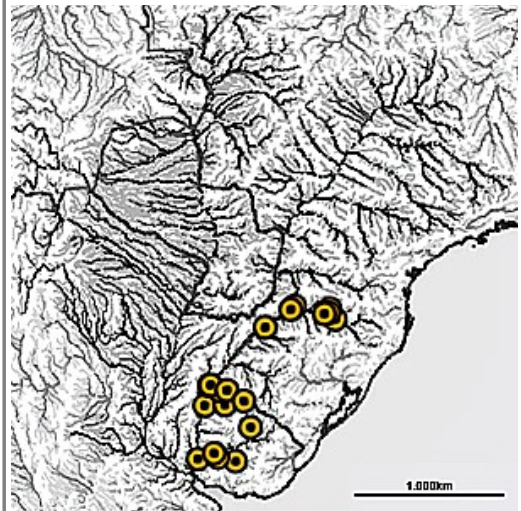
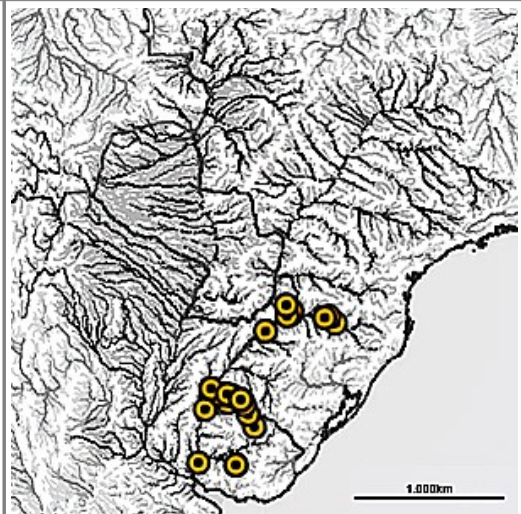
<p><i>Crenicichla britskii</i> Kullander, 1982 Synonym: none Distribution: Paraná sup; Countries: BRA; PAR?; Comments: This species has a wide distribution in the Paraná sup basin; References: Hahn et al. 1998; Casatti et al. 2001; Oliveira et al. 2001; Castro et al. 2003; Casatti 2004; Castro et al. 2004; Casatti et al. 2006; Brandao et al. 2007; Suarez 2008; Casatti et al. 2009; Esguícero et al. 2011; Pazian 2011; Varella 2011; Villares Junior 2011; Mello Cioneck et al. 2012; SpeciesLink;</p>	
<p><i>Crenicichla celidochilus</i> Casciotta, 1987 Synonym: none Distribution: Uruguay sup / alto / med / inf; Countries: ARG; BRA; URU; Comments: Wide distribution in the whole Uruguay basin; References: Casciotta 1987; Oliveira Nuner 2009; Meurer 2010; Burress 2011; Silva 2011; Araya et al. 2012; Miquelarena et al. 2012; Miquelarena et al. 2014; Nascimento e Silva 2014; Serra et al. 2014; SpeciesLink;</p>	
<p><i>Crenicichla empheres</i> Lucena, 2007 Synonym: none Distribution: Uruguay sup; Countries: BRA; Comments: Endemic species from the upper Uruguay; References: Lucena 2007; SpeciesLink;</p>	

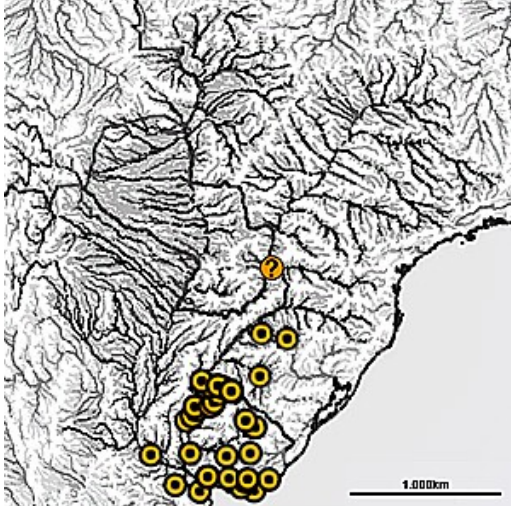
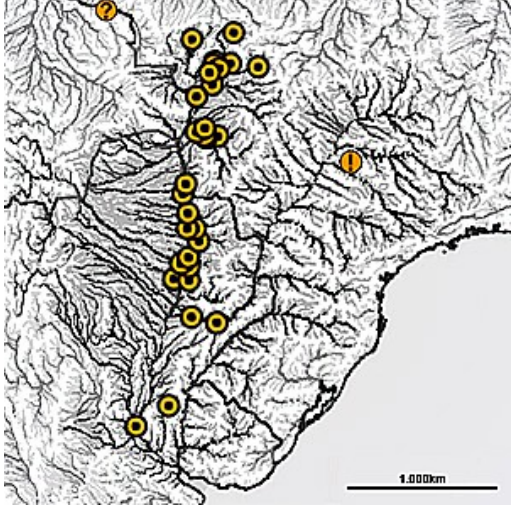

<p><i>Crenicichla gaucha</i> Lucena & Kullander, 1992 Synonym: <i>none</i> Distribution: Uruguay alto; Countries: ARG; BRA; Comments: Only known from the Uruguay alto; the realisation of the planned Garabi dam construction would negatively affect their distribution area; References: Körber 2005; Miquelarena et al. 2012; Fishbase; SpeciesLink</p>	
<p><i>Crenicichla gillmorlisi</i> Kullander & Lucena, 2013 Synonym: <i>none</i> Distribution: Paraná alto; Countries: PAR; Comments: Endemic species from the Rio Acaray; References: Kullander 2013</p>	
<p><i>Crenicichla hadrostigma</i> Lucena, 2007 Synonym: <i>none</i> Distribution: Uruguay sup / alto; Countries: ARG; BRA; Comments: This species is known from the upper Uruguay References: Lucena 2007; Piálek et al. 2010; SpeciesLink;</p>	


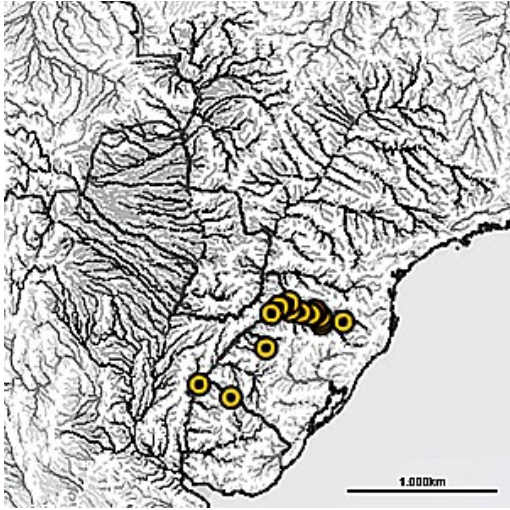

<p><i>Crenicichla haroldoi</i> Luengo & Britski, 1974 Synonym: <i>none</i> Distribution: Paraná sup; Countries: BRA; PAR?; Comments: Known from the Paraná sup;</p> <p>References: Hahn et al. 1998; Castro et al. 2004; Brandao et al. 2007; Varella 2011; SpeciesLink;</p>	
<p><i>Crenicichla hu</i> Piálek, Rican, Casiotta & Almiron, 2010 Synonym: <i>none</i> Distribution: Paraná alto; Countries: ARG; Comments: Only known from the type locality in the Rio Piray-Miní;</p> <p>References: Piálek et al. 2010; Varella 2011</p>	
<p><i>Crenicichla igara</i> Lucena & Kullander, 1992 Synonym: <i>none</i> Distribution: Uruguay sup; Countries: BRA; Comments: Only known from the upper Uruguay;</p> <p>References: Oliveira Nuner 2009; Amaral et al. 2010; Meurer 2010; Nascimento e Silva 2014; SpeciesLink;</p>	


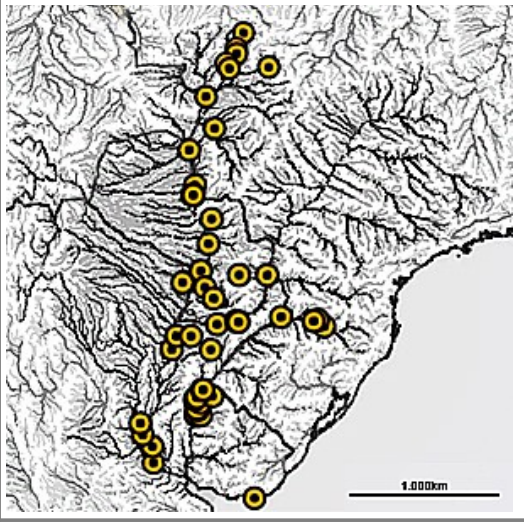

<p><i>Crenicichla iguassuensis</i> Haseman, 1911 Synonym: <i>none</i> Distribution: Paraná alto; Countries: ARG; BRA; Comments: Endemic from the Rio Iguazú</p> <p>References: Baumgartner et al. 2006; Varella 2011; Casciotta et al. 2016; Fishbase; SpeciesLink;</p>	
<p><i>Crenicichla jaguarensis</i> Haseman, 1911 Synonym: <i>none</i> Distribution: Paraná sup; Countries: BRA; PAR?; Comments: Known from the Paraná sup</p> <p>References: Brandao et al. 2007; Oliveira et al. 2009; Varella 2011; SpeciesLink;</p>	
<p><i>Crenicichla jupiaensis</i> Britski & Luengo, 1968 Synonym: <i>none</i> Distribution: Paraná sup / med Countries: ARG; BRA; PAR?; Comments: This species is known from the Paraná sup with one report for the Paraná med;</p> <p>References: Varella 2011; SpeciesLink;</p>	


<p><i>Crenicichla jurubi</i> Lucena & Kullander, 1992 Synonym: none Distribution: Uruguay sup; Countries: BRA; Comments: Only known from the Uruguay sup;</p> <p>References: Oliveira Nuner 2009; Amaral et al. 2010; Meurer 2010; Nascimento e Silva 2014; SpeciesLink;</p>	
<p><i>Crenicichla lepidota</i> Heckel, 1840 Synonym: <i>Crenicichla edithae</i>, Ploeg, 1991; Distribution: Paraguay sup / inf; Paraná alto / med / inf; Rio de la Plata; Uruguay sup / alto / med / inf; // Iguazú**?; // Guaporé; Lagoa dos Patos; Countries: ARG; BOL; BRA; PAR; URU; Comments: This species has a wide distribution in nearly the whole basin, excluding only the Paraná sup; According to some references (Piálek et al. 2015, Casciotta et al. 2016;) it is also habiting the Iguazú;</p> <p>References: Menni et al. 1992; Liotta et al. 1996; Lasso et al., 1999; Körber 2005; Verissimo et al. 2005; Garcia et al, 2006; Ottoni et al. 2008; Flores, 2009; Neiff et al. 2009; Fernandes et al 2010; Iwaszkiw et al. 2010; Meurer, 2010; Piálek et al., 2010; Varella, 2011; Araya et al. 2012; Campagnolo, 2012; Llompert et al, 2012; Miquelarena et al. 2012; Kullander & Lucena, 2013; Suárez et al., 2013; Witt et al, 2013; Brancolini et al. 2014; Montes et al 2014; Nascimento e Silva, 2014; Polaz et al. 2014; Serra et al. 2014; Silva et al. 2014; Almirón et al. 2015; Piálek et al. 2015; Casciotta et al. 2016; Fishbase; SpeciesLink;</p>	
<p><i>Crenicichla mandelburgeri</i> Kullander, 2009 Synonym: none Distribution: Paraná alto; Countries: ARG; PAR; Comments: This species is known from the Paraná alto;</p> <p>References: Kullander 2009; Varella 2011</p>	

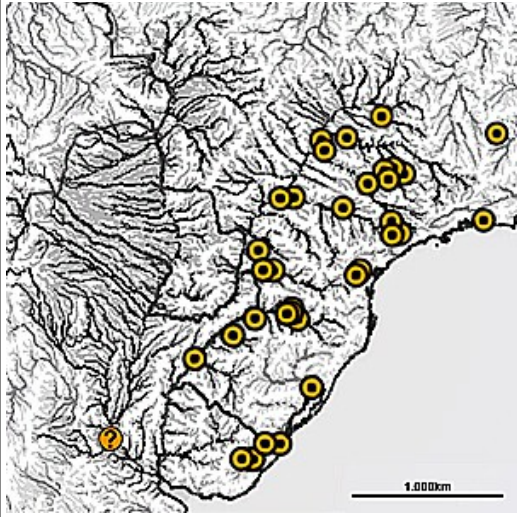
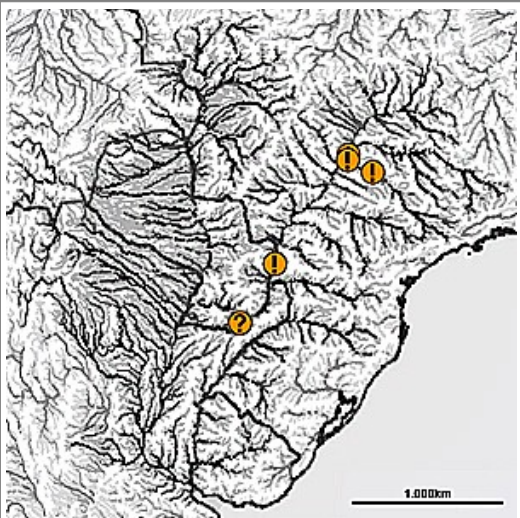

Crenicichla minuano Lucena & Kullander, 1992**Synonym:** *none***Distribution:** Uruguay sup / alto / med / inf;**Countries:** ARG; BRA; URU;**Comments:** Known from the whole Uruguay basin**References:** Kullander 2003; Oliveira Nuner 2009; Amaral et al. 2010; Meurer 2010; Zarucki et al. 2010; Burress 2011; Silva 2011; Araya et al. 2012; Nascimento e Silva 2014; Serra et al. 2014; Fishbase; SpeciesLink;***Crenicichla missioneira*** Lucena & Kullander, 1992**Synonym:** *none***Distribution:** Uruguay sup / alto / med / inf;**Countries:** ARG; BRA; URU;**Comments:** Known from the whole Uruguay basin**References:** Kullander 2003; Körber 2005; Oliveira Nuner 2009; Meurer 2010; Zarucki et al. 2010; Burress 2011; Silva 2011; Araya et al. 2012; Miquelarena et al. 2012; Nascimento e Silva 2014; Serra et al. 2014; Fishbase; SpeciesLink;***Crenicichla niederleinii*** (Holmberg, 1891)**Synonym:** *Acharnes niederleinii* Holmberg, 1891; *Crenicichla niederleini*; *Crenicichla niederlini***Distribution:** presumably Uruguay sup; // Paraná alto? / sup?**Countries:** ARG; BRA?;**Comments:** *C. niederleinii* is nowadays an unresolved mystery; The original description is based on one single specimen and this specimen could be considered as lost; As type locality Holmberg mentioned the Rio Pequiri; Most authors consider it as a species from the Paraná alto, but according to Varella 2011 it should be a species from the Uruguay sup (Río Pepirí Guazú);**References:** Holmberg, 1891; Kullander, 1981; Varella, 2011; Kullander 2013;***Crenicichla prenda*** Lucena & Kullander, 1992**Synonym:** *none***Distribution:** Uruguay sup;**Countries:** BRA;**Comments:** Only known from the Uruguay sup;**References:** Kullander 2003; SpeciesLink;

<p><i>Crenicichla scottii</i> (Eingenmann, 1907) Synonym: <i>none</i> Distribution: Paraná inf; Rio de la Plata; Uruguay med / inf; Countries: ARG; BRA; URU; Comments: <i>C scottii</i> is known from the Paraná inf to the lower Uruguay; There is one doubtful report from the Paraná alto (Iguazú); References: Lucena et al. 1992; Liotta et al. 1996; Burress 2011; Miquelarena et al. 2012; Serra et al. 2014; Fishbase; SpeciesLink;</p>	
<p><i>Crenicichla semifasciata</i> Heckel, 1840 Synonym: <i>Acharnes chacoensis</i>; <i>Cichla chacoensis</i>; <i>Boggiana ocellata</i> Perugia, 1897; <i>Batrachops ocellatus</i>; <i>Crenicichla simoni</i>; Distribution: Paraguay sup / inf; Paraná sup** / med / inf; // Guaporé? Countries: ARG; BOL; BRA; PAR; Comments: The distribution range of <i>C semifasciata</i> extends from the upper Paraguay to the lower Paraná, with one report from the Guaporé and from the Paraná sup; References: Menni et al. 1992; Verissimo et al. 2005; Ottoni et al. 2008; Rojas et al., 2008; Piálek et al., 2010; Varella, 2011; Miquelarena et al. 2012; Suárez et al., 2013; Brancolini et al. 2014; Polaz et al. 2014; Almirón et al. 2015; Oliveira et al 2015; Roa-Fuentes et al, 2015; Fishbase; SpeciesLink;</p>	
<p><i>Crenicichla taikyra</i> Casciotta, Almirón, Aichino, Gómez, Piálek & Rican, 2013 Synonym: <i>none</i> Distribution: Paraná med; Countries: ARG; PAR?; Comments: Only known from the Paraná med References: Casciotta et al. 2013</p>	

<p><i>Crenicichla tapii</i> Piálek, Dragová, Casciotta, Almirón & Řičan, 2015 Synonym: <i>Crenicichla aff. yaha 'Iguazú 1'</i> Distribution: Iguazú Countries: ARG; BRA; Comments: Endemic from the lower Iguazú</p> <p>References: Piálek et al. 2015</p>	
<p><i>Crenicichla tendybaguassu</i> Lucena & Kullander, 1992 Synonym: none Distribution: Uruguay sup / alto / med; Countries: ARG; BRA; URU; Comments: This species is known from the Uruguay sup , alto and med;</p> <p>References: Oliveira Nuner 2009; Meurer 2010; Burress 2011; Serra et al. 2011; Miquelarena et al. 2012; Nascimento e Silva 2014; SpeciesLink;</p>	
<p><i>Crenicichla tesay</i> Casciotta & Almirón, 2008 Synonym: none Distribution: Iguazú; Countries: ARG; BRA; Comments: Endemic species from the Iguazú</p> <p>References: Casciotta et al. 2008; Piálek et al. 2015; SpeciesLink;</p>	

<p><i>Crenicichla tuca</i> Piálek, Dragová, Casciotta, Almirón & Říčan, 2015 Synonym: <i>Crenicichla</i> sp. 'Iguazú biglips 2' Distribution: Iguazú; Countries: ARG; BRA; Comments: Endemic from the lower Iguazú</p> <p>References: Piálek et al. 2015</p>	
<p><i>Crenicichla vittata</i> Heckel, 1840 Synonym: none Distribution: Paraguay sup / inf; Paraná alto / med / inf; Rio de la Plata; Uruguay sup / alto / med / inf; Countries: ARG; BOL; BRA; PAR; URU; Comments: This species has a wide distribution in nearly the whole basin, excluding only the Paraná sup;</p> <p>References: Menni et al. 1992; Liotta et al. 1996; Verissimo et al. 2005; Ottoni et al. 2008; Oliveira Nuner 2009; Iwaszkiw et al. 2010; Meurer, 2010; Burress 2011; Silva 2011; Varella, 2011; Araya et al. 2012; Miquelarena et al. 2012; Suárez et al., 2013; Montes et al 2014; Nascimento e Silva, 2014; Polaz et al. 2014; Silva et al. 2014; Almirón et al. 2015; Oliveira et al 2015; Fishbase; SpeciesLink;</p>	
<p><i>Crenicichla yaha</i> Casciotta, Almirón & Gómez, 2006 Synonym: none Distribution: Uruguay-Í; Countries: ARG; Comments: This species is only known from the Urugua-Í. Reported specimens from the lower Iguazú were identified as <i>C. tesay</i> (Piálek et al. 2015) <i>Crenicichla yaha</i> is not evaluated by the IUCN red list of threatened species, but their type locality is flooded and destroyed by the artificial lake formed by the hydroelectric dam. It seems to be a rare species.</p> <p>References: Casciotta et al. 2006; Varella 2011; Piálek et al. 2015; Říčan et al. 2017; SpeciesLink;</p>	

<p><i>Crenicichla ypo</i> Casciotta, Almirón, Piálek, Gómez & Rícan, 2010 Synonym: none Distribution: Urugua-í; Countries: ARG; Comments: This species is endemic from the Urugua-í</p> <p>References: Casciotta et al. 2010</p>	
<p><i>Crenicichla aff mucuryana</i> There is one report from Varella 2011 for a species tentatively identified as C aff mucuryana from a tributary of the Paranaíba.</p>	
<p><i>Crenicichla sp "Alto Paraguai / Juruena"</i> Synonym: none Distribution: Paraguay sup; // Tapajós Countries: BRA; Comments: Varella 2011 mentioned this undescribed species for the upper Paraguai and upper Tapajos basin;</p> <p>References: Varella, 2011</p>	
<p><i>Crenicichla sp "Paraná Itaipú / Sete Quedas"</i> Synonym: <i>Crenicichla sp Paraná</i> Distribution: Paraná sup / alto; Countries: BRA; PAR; Comments: According to Varella 2011 and Kullander 2013 there is an undescribed <i>Crenicichla</i> species in the upper Paraná between Itaipú and Sete Quedas. Kullander 1981 made a tentative identification from this species as <i>Crenicichla niederleinii</i>. This study follows the recommendation from Varella 2011 and agree with him that <i>C niederleinii</i> is a species from the Rio Uruguay basin. Varella 2011 and Kullander 2013 mentioned this species as <i>Crenicichla sp "Paraná"</i>, but this name was also used by Piálek et al 2012 as provisional working name for an undescribed species from the middle Paraná (now described as <i>Crenicichla taikyra</i>). That's why we recommend to use the provisional working name C sp "Paraná Itaipú / Sete Quedas".</p> <p>References: Kullander, 1981; Varella, 2011; Kullander 2013;</p>	
<p><i>Crenicichla sp "Paranaíba"</i> Synonym: none Distribution: Paraná sup; Countries: BRA; Comments: This undescribed species is only known from the Paranaíba, a tributary of the Paraná sup</p> <p>References: Varella, 2011</p>	
<p><i>Crenicichla sp</i> Piálek et al. 2012 mentioned some still undescribed specimens of <i>Crenicichla</i> from the Paraná alto; C. sp. Urugua-í Line (Urugua-í) C. sp. Piray- Guazú (Piray-Guazú) C. sp. Piray-Guazú Line (Piray-Guazú) C. sp. Chapa (Yabebirí)</p>	

<p>“Geophagus” brasiliensis (Quoy & Gaimard, 1824) Synonym: <i>Chromis brasiliensis</i>; <i>Chromys unimaculata</i>; <i>Acara gymnopoma</i>; <i>Acara minuta</i>; <i>Geophagus tuberosus</i>; <i>Geophagus offersi</i>; Distribution: Paraná sup; Iguazú; Uruguay sup / alto / med; // Paraná med? / inf?; // Atlantic tributaries Countries: ARG; BRA; PAR?; URU; Comments: This species is known from the Paraná sup, Iguazú and Uruguay sup, with some few reports from the eastern Uruguay alto / med tributaries; In the older literature it is mentioned for the lower Paraná, but this references should be considered as missidentifications or doubtful reports;</p> <p>References: Pozzi 1945; Ringuélet et al. 1967; Castro et al. 2003; Castro et al. 2004; Casatti 2004; Ingenito 2004; Liotta 2005; Silva Cas-semiro 2005; Baumgartner et al 2006; Casatti et al 2006; Garcia et al, 2006; Brandao et al. 2007; Oliveira 2008; Casatti et al 2009; Oliveira et al 2009; Oliveira Nuner 2009; Amaral et al 2010; Meurer, 2010; Es-guícero et al 2011; Silva 2011; Villares Junior 2011; Cetra et al. 2012; Sampaio et al. 2012; Schork 2012; Takahashi 2013; Witt et al, 2013; Nascimento e Silva, 2014; Pereira 2014; Casciotta et al. 2016; Fish-base; SpeciesLink;</p>	
<p>Geophagus cf sveni Synonym: none Distribution: Paraná sup** / alto**? Countries: ARG?; BRA; PAR?; Comments: This is an invasive species in the Paraná sup and there are some reports from Paraná alto; Normally mentioned as Geophagus cf proximus or Geophagus cf altifrons; But according to newer studies it could be G sveni from the upper Tocantins and Araguaiae (Silva et al. 2015);</p> <p>References: Moretto et al. 2008; Oliveira Penha Zica et al. 2010; Okada et al 2012; Zago et al. 2012; Silva et al. 2015; SpeciesLink;</p>	
<p>Gymnogeophagus australis (Eigenmann, 1907) Synonym: none Distribution: Paraná inf; Rio de la Plata; Uruguay inf; // Paraná med? / alto?; Uruguay med? / alto? Countries: ARG; URU; Comments: For our opinion G australis needs an actual overview; One could consider as relative certain their distribution in the lower Paraná, Rio de la Plate and lower Uruguay; all other records for the basin should be considered as doubtful or possible missidentifications;</p> <p>References: Gosse 1976; Reis et al. 1988; Haro et al 1998; Bistoni et al. 2002; Flores, 2009; Neiff et al. 2009; Miquelarena et al. 2012; Mala-barba et al. 2015; Fishbase; SpeciesLink</p>	

Gymnogeophagus balzanii (Perugia, 1891)

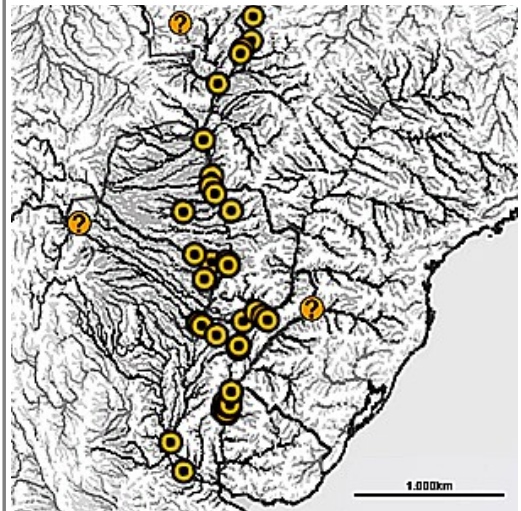
Synonym: *Geophagus duodecimspinosus*; *Gymnogeophagus cyanopterus*;

Distribution: Paraguay sup / inf; Paraná med / inf; Uruguay med; // Uruguay alto?; upper Bermejo?; // Guaporé?

Countries: ARG; BOL?; BRA; PAR; URU;

Comments: *G. balzanii* is known from the upper and lower Paraguay, the lower Paraná and the middle Uruguay; There are some few reports from the Uruguay alto, upper Bermejo and from the Guaporé;

References: Reis et al., 1988; Menni et al. 1992; Liotta et al. 1996; Liotta 2005; Verissimo et al. 2005; Ottoni et al. 2008; Flores, 2009; Neiff et al. 2009; Fernandes et al 2010; Iwaszkiw et al. 2010; Araya et al. 2012; Miquelarena et al. 2012; Suárez et al., 2013; Brancolini et al. 2014; Montes et al 2014; Polaz et al. 2014; Almirón et al. 2015; Fish-base; SpeciesLink;



Gymnogeophagus caaguazuensis Staeck, 2006

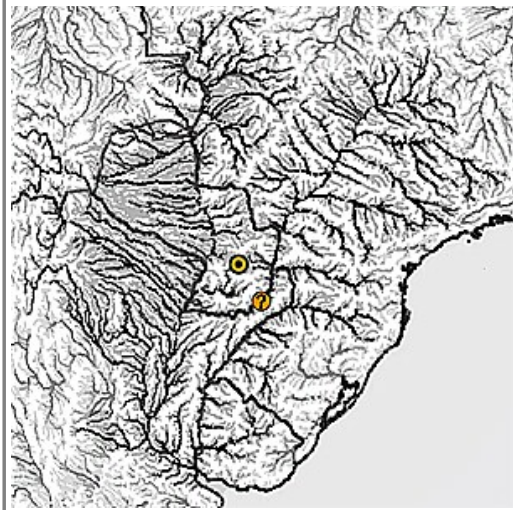
Synonym: none

Distribution: Paraguay inf;

Countries: PAR;

Comments: Only known from the Rio Tebicuary; but some undefined *G. sp* reports from the Paraná alto and medio look very similar to this species;

References: Staeck 2006



Gymnogeophagus che Casciotta, Gómez & Toresani, 2000

Synonym: none

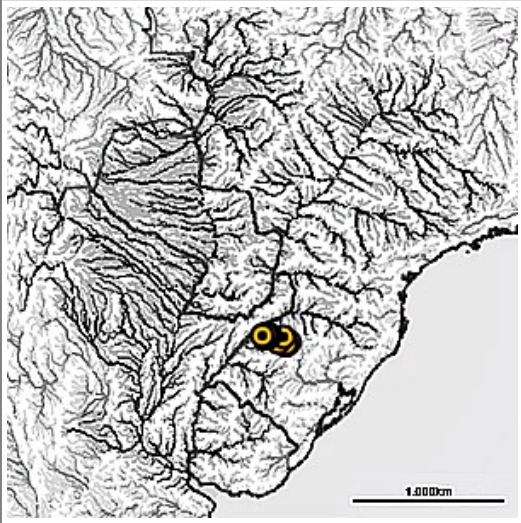

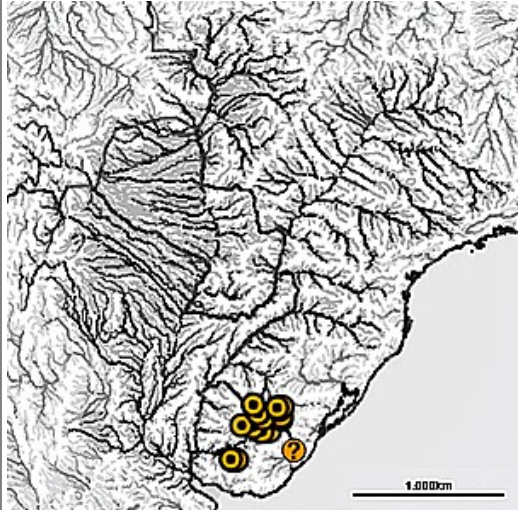
Distribution: Paraná alto;

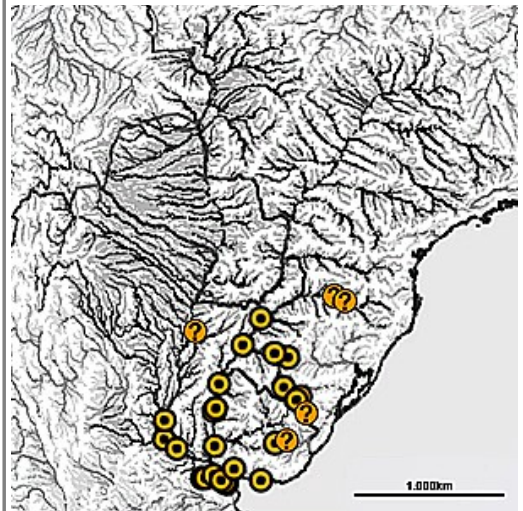
Countries: ARG;

Comments: Endemic species from the Uruguáí

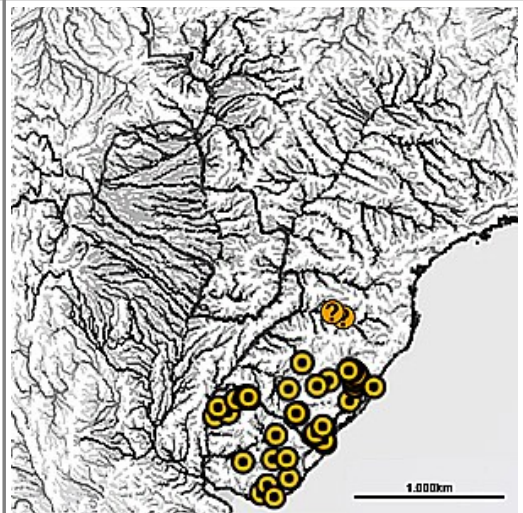
References: Miquelarena et al. 2012; Miquelarena et al. 2014;



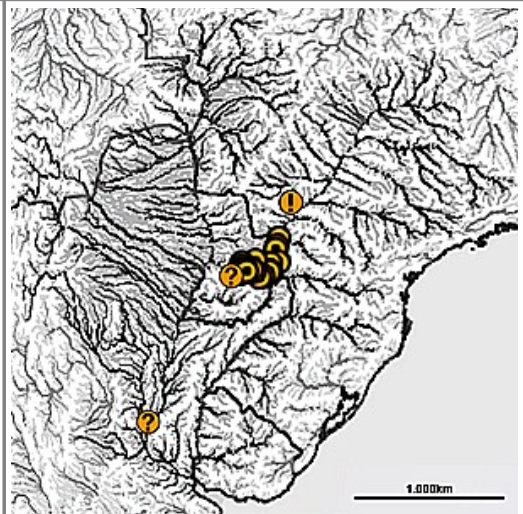
<p><i>Gymnogeophagus constellatus</i> Malabarba, Malabarba & Reis, 2015 Synonym: none Distribution: Uruguay alto; Countries: BRA; Comments: Endemic from the Rio Ijuí</p> <p>References: Malabarba et al. 2015</p>	
<p><i>Gymnogeophagus gymnogenys</i> (Hensel, 1870) G. gymnogenys was a so-called "catch all species" for the G. gymnogenys clade, until the publication from Malabarba, Malabarba & Reis 2015; According to this, a critical examination of all localities mentioned in the older literature is nowadays necessary; One could consider as relative certain their distribution in the Lagoa Merim and Lagoa dos Patos tributaries; all records for the Paraná and Uruguay basin should be considered as doubtful or possible misidentifications;</p>	
<p><i>Gymnogeophagus lipokarenos</i> Malabarba, Malabarba & Reis, 2015 Synonym: none Distribution: Uruguay sup / alto; Countries: ARG; BRA Comments: Only known from the Uruguay sup and alto;</p> <p>References: Wimberger et al. 1998; Malabarba et al. 2015; Casciotta et al. 2017</p>	
<p><i>Gymnogeophagus mekinos</i> Malabarba, Malabarba & Reis, 2015 Synonym: none Distribution: Uruguay inf; // Lagoa dos Patos? Countries: BRA; URU; Comments: Endemic from the Rio Negro, but possibly also in the Lagoa dos Patos drainage;</p> <p>References: Wimberger et al. 1998; Pereyra et al. 2008; Malabarba et al. 2015</p>	

Gymnogeophagus meridionalis Reis & Malabarba, 1988**Synonym:** *none***Distribution:** Paraná inf; Rio de la Plata; Uruguay med / inf; // Paraná med?; Uruguay sup? // Lagoa dos Patos?**Countries:** ARG; BRA; URU;**Comments:** This species is known from the Paraná inf, Rio de la Plata and the lower Uruguay; There are also some doubtful reports from the Paraná med, Uruguay sup and Lagoa dos Patos;**References:** Reis et al 1988; Liotta et al. 1996; Silva 2011; Llompart et al, 2012; Miquelarena et al. 2012; Miquelarena et al. 2014; Nascimento e Silva, 2014; Serra et al. 2014; Almirón et al. 2015; Fishbase; SpeciesLink;***Gymnogeophagus missioneiro*** Malabarba, Malabarba & Reis, 2015**Synonym:** *none***Distribution:** Uruguay alto;**Countries:** BRA;**Comments:** Endemic from the Rio Piratini**References:** Wimberger et al. 1998; Malabarba et al. 2015***Gymnogeophagus pseudolabiatu*** Malabarba, Malabarba & Reis, 2015**Synonym:** *none***Distribution:** Uruguay med;**Countries:** BRA; URU;**Comments:** Endemic from the Rio Quaraf**References:** Wimberger et al. 1998; Pereyra et al. 2008; Malabarba et al. 2015

Gymnogeophagus rhabdotus (Hensel, 1870)
Synonym: *Geophagus brachyurus*; *Geophagus camurus*
Distribution: Uruguay med / inf; // Uruguay sup? // Lagoa dos Patos;
Countries: BRA; URU;
Comments: This species is known from the eastern tributaries of the lower Uruguay and the Lagoa dos Patos drainage; There are also some doubtfull reports from the Uruguay sup;
References: Reis et al. 1988; Garcia et al, 2006; Meurer, 2010; Witt et al, 2013; Nascimento e Silva, 2014; Fishbase; SpeciesLink;



Gymnogeophagus setequeadas Reis, 1992
Synonym: none
Distribution: Paraná sup / alto;
Countries: ARG?; BRA; PAR;
Comments: This species is known from the upper Paraná, there is also one doubtfull report from a lower Paraguay tributary (Tebicuary-Mi) and from the lower Paraná; Their occurrence in the Paraná sup is invasive after the clousure of the Itaipú dam;
References: Reis et al 1992; Almirón et al. 2015; Fishbase; Species-Link;



Gymnogeophagus terrapurpura Loureiro, Zarucki, Malabarba & González-Bergonzoni, 2016
Synonym: none
Distribution: Uruguay inf; Rio de la Plata;
Countries: ARG; URU;
Comments: A new species described from the Uruguay inf. and Rio de la Plata tributaries.
References: Loureiro et al 2016; García et al 2017



Gymnogeophagus tiraparae González, Loureiro & Oviedo, 2009

Synonym: none

Distribution: Uruguay inf; // Lagoa dos Patos

Countries: BRA; URU;

Comments: This species is only known from the Rio Negro (Uruguay inf) and Lagoa Merim drainage;

References: González-Bergonzoni et al. 2009; Serra et al. 2014



Laetacara dorsigera (Heckel, 1840)

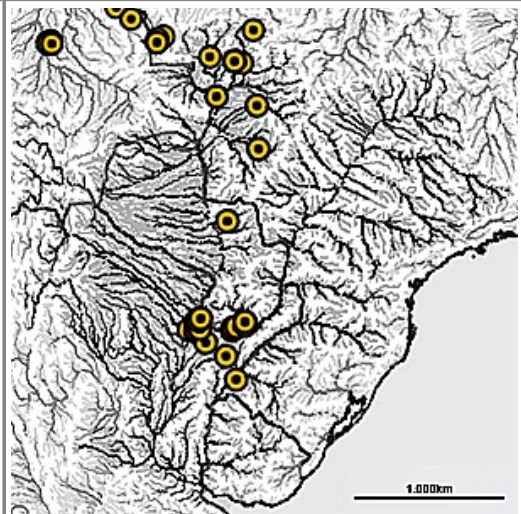
Synonym: *Acara dorsiger*; *Cychlasoma dorsigerum*; *Aequidens dorsigera*; *Aequidens dorsiger*; *Astronotus dorsigera*; *Aequidens dorsigerus*; *Parvacara dorsigera*; *Nannacara dorsigera*;

Distribution: Paraguay sup / inf; Paraná med; Uruguay med; // Guaporé;

Countries: ARG; BOL; BRA; PAR;

Comments: *L. dorsigera* is known from the Guaporé till middle Paraná and from the middle Uruguay;

References: Verissimo et al. 2005; Ottoni et al. 2008; Rojas et al. 2008; Neiff et al. 2009; Ottoni et al. 2009; Fernandes et al. 2010; Iwaszkiw et al. 2010; Lanés et al. 2010; Frey-Dargas 2014; Montes et al. 2014; Polaz et al. 2014; Fishbase;



***Laetacara* sp. “Paraná Superior”**

An unclear *Laetacara* species could be found in the Paraná sup.; The pictures shown by Graça, W. & Pavanelli, C.S.; 2007 and Teresa, F.B. & Gonçalves-de-Freitas, E. 2011 are very similar to *L. araguaiae* from the Tocantins and Araguaia basin; But the meristic data mentioned by Graça, W. & Pavanelli, C.S., 2007 don't accord to the data mentioned in the original description for this species by Ottoni & Costa, 2009

References: Oliveira et al. 2001; Martins-Santos et al. 2005; Casatti et al. 2006; Graça et al. 2007; Teresa 2007; Casatti et al. 2009; Oliveira et al. 2009; Ottoni et al. 2009; Takemoto et al. 2009; Souza Filho et al. 2010; Teresa et al. 2011; Takahashi et al. 2013;

Mesonauta festivus (Heckel, 1840)

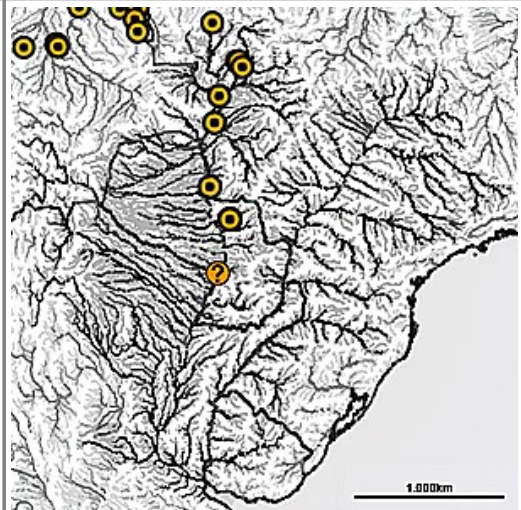
Synonym: *Heros festivus*; *Acara (Heros) festiva*; *Astronotus (Mesonauta) festivus*; *Cichlaurus festivus*; *Cichlosoma festivum*; *Mesonauta festiva*;

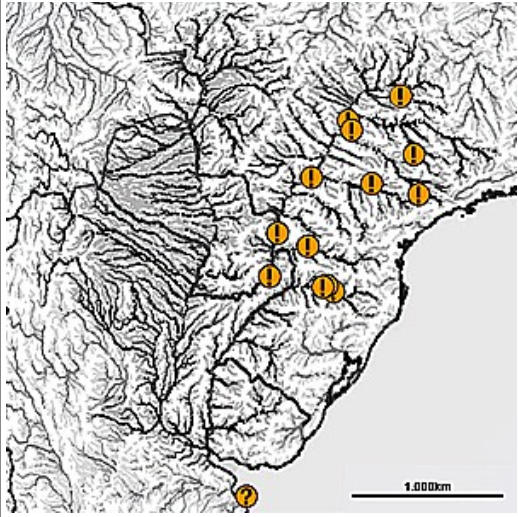
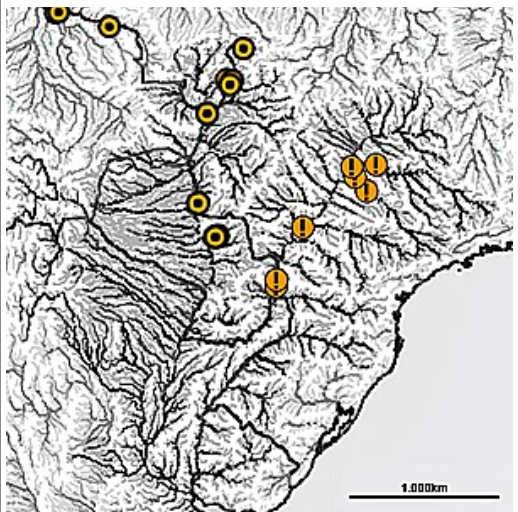
Distribution: Paraguay sup / inf; // Guaporé; Mamoré; Madeira; lower Tapajos

Countries: ARG?; BOL; BRA; PAR;

Comments: This species is known from the whole Paraguay basin and from the Guaporé and other southern tributaries of the Amazonas;

References: Kullander 1991; Lasso et al. 1999; Liotta 2005; Ottoni et al. 2008; Rojas et al. 2008; Suárez et al. 2013; Polaz et al. 2014; Silva et al. 2014; Fishbase; SpeciesLink;



<p><i>Oreochromis cf niloticus</i> (Linnaeus, 1758) Synonym: <i>Chromis guentheri</i>; <i>Tilapia calciati</i>; <i>Tilapia crassispina</i>; <i>Tilapia dolloi</i>; <i>Tilapia inducta</i>; <i>Tilapia regani</i> Distribution: Paraná sup** / alto**; Iguazú**; Uruguay sup**; // Rdl-Plata**? Countries: ARG; BRA; PAR?; Comments: This is an invasive species from central Africa with a wide distribution in the Paraná sup, Uruguay sup and Iguazú. There is also one report from the Río de la Plata and from the Paraná alto. It is commonly used in aquaculture ponds from which they sometimes escape into the wild. In addition to <i>O. niloticus</i> there are three other species from the genus <i>Oreochromis</i> (<i>O. mossambicus</i>, <i>O. aureus</i> und <i>O. hornorum</i>) and some hybrids widespread in aquaculture ponds. Consequently it is very difficult or impossible to identify the exact species belonging to the populations. References: Castro 2003; Körber et al 2005; Baumgartner et al 2006; Casatti et al 2006; Brandao et al. 2007; Casatti et al 2009; Oliveira et al 2009; Meurer, 2010; García et al., 2011; Silva 2011; Villares Junior 2011; Okada et al 2012; Sampaio et al. 2012; Schork 2012; Nascimento e Silva, 2014; Pereira 2014; Casciotta et al. 2016; SpeciesLink;</p>	
<p><i>Satanoperca pappaterra</i> (Heckel, 1840) Synonym: <i>Geophagus pappaterra</i> Distribution: Paraguay sup / inf; Paraná sup**; // Guaporé; Countries: BOL; BRA; PAR; Comments: This species occur in the Paraguay drainage and upper Guaporé; It is an invasive species in the upper Paraná; References: Hahn et al. 1998; Oliveira et al. 2001; Castro et al. 2004; Verissimo et al. 2005; Casatti et al. 2006; Ottoni et al. 2008; Rojas et al. 2008; Casatti et al. 2009; Fernandes et al. 2010; Pazian 2011; Okada et al. 2012; Suárez et al. 2013; Polaz et al. 2014; Silva et al. 2014; Fishbase; SpeciesLink;</p>	

Discussion

Most mentioned species are endemic from the Río de la Plata basin. The greatest distribution range is reported for *Crenicichla lepidota*, *Crenicichla vittata* und *Cichlasoma dimerus* which occur in nearly the whole basin. Round about 50 % of the known species are endemic from one subbasin or one single locality. In particular *Australoheros charrua*, *Bujurquina oenolaemus*, *Cichlasoma pusillum*, *Crenicichla gillmorlisi*, *Crenicichla hu*, *Crenicichla prenda*, *Crenicichla yaha*, *Gymnogeophagus caaguazuensis* and *Gymnogeophagus missioneiro*. This species are only known from the type locality and the immediate vicinity thereof. Even though this species are not evaluated by the IUCN, but they seem to be extremely rare and they would comply with their criteria for an vulnerable or endangered species in the Red List. On the other side there are some allochthon species which have a negative influence on the native fauna. Especially in the reservoirs from the Paraná superior. In particular *Cichla kelberi*

and *Cichla piquiti* in the Paraguay superior and Paraná superior are known to cause disastrous consequences for the native fauna (Pelicice et al. 2009; Luiz, 2010).

As a result of there fast adaptive radiation, there territorial behavior and there strong preference for particular habitats, the distribution patterns of cichlids are well suited to define ichthyological regions. Notably obvious is this in the relatively well studied cichlids from the Rift Lakes in East Africa (Lake Tanganjika and Lake Malawi). In this lakes the sandy sectors form effective distribution barriers between the rocky regions and respectively great is the species diversity and the grade of endemism in comparison to the species of other families in this lakes (Poll, 1986; Konings, 1999; Konings, 2003)

Herewith we try to define the ichthyological subbasins from the Río de la Plata basin according to the distribution patterns of the

species reflecting their habitat and climate preferences. Partially there are precise limitations between the subbasins (for example geological barriers) and other boundaries are fluent (for example caused by the average climate change). As a final remark it is important to mention that the ichthyological fauna from the Paraguay sup

(bras. Pantanal), Paraná sup and eastern Uruguay inf is relatively well documented and surveyed. The restant subbasins are rather sparsely surveyed and some areas are a blank area on the map (for example the middle Pilcomayo and Bermejo, the lower Paraguay and the Paraná medio).

Ichthyogeographic Zones	Upper boundary	Lower boundary	
Paraguay sup	Water divide	Porto Murtinho	Paraguay
Paraguay inf	Porto Murtinho	Corrientes / entry of the Paraguay in the Paraná	
Paraná sup	Water divide	Sete Quedas or Guaíra Falls / Itaipú	Upper Paraná
Iguazú	Water divide	Cataratas del Iguazú	
Paraná alto	Sete Quedas or Guaíra Falls / Itaipú	embouchure/ entry of the Paraná in the Yacyretá dammed lake	
Paraná med	embouchure/ entry of the Paraná in the Yacyretá dammed lake	Santa Fé	Lower Paraná
Paraná inf	Santa Fé	Tigre	
Uruguay sup	Water divide	Moconá / Yucumã	Upper Uruguay
Uruguay alto	Moconá / Yucumã	Garabi	
Uruguay med	Garabi	Salto Grande	Lower Uruguay
Uruguay inf	Salto Grande	Martín Garcia o Timoteo Domínguez Island	
Rio de la Plata	Tigre / Martín Garcia o Timoteo Domínguez Island	Atlantic Ocean	

Tab 2: Proposed ichthyogeographical subbasins in the Rio de la Plata basin

Sorensen Index (Czekanowski) $I = 2c/(a+b)$											
	Paraná sup	Paraná alto	Paraguay alto	Paraguay inf	Paraná med	Paraná inf	Rio de la Plata	Uruguay inf	Uruguay med	Uruguay alto	Uruguay sup
Shared species between subbasins											
Paraná sup	6	0,074	0	0	0,11	0	0	0	0	0	0,1
Paraná alto	1	21	0,21	0,24	0,24	0,21	0,19	0,11	0,103	0,12	0,17
Paraguay alto	0	4	17	0,8	0,67	0,4	0,37	0,19	0,4	0,13	0,06
Paraguay inf	0	4	12	13	0,77	0,48	0,43	0,21	0,452	0,15	0,07
Paraná med	1	4	10	10	13	0,57	0,52	0,29	0,516	0,15	0,07
Paraná inf	0	3	5	5	6	8	0,89	0,52	0,462	0,19	0,09
Rio de la Plata	0	3	5	5	6	8	10	0,64	0,5	0,17	0,08
Uruguay inf	0	2	3	3	4	6	8	15	0,667	0,36	0,28
Uruguay med	0	2	7	7	8	6	7	11	18	0,45	0,31
Uruguay alto	0	2	2	2	2	2	2	5	7	13	0,44
Uruguay sup	1	3	1	1	1	1	1	4	5	6	14

Tab 3: Comparison of subbasins (Soerensen Index)

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