CONSERVATION STATE OF SILURIFORMES FISHES FROM THE RAMSAR SITE JAAUKANIGAS (MIDDLE PARANA RIVER), ARGENTINA

ESTADO DE CONSERVACION DE PECES SILURIFORMES DEL SITIO RAMSAR JAAUKANIGAS (RIO PARANA MEDIO), ARGENTINA

Elly Cordiviola¹, Mirta Campana¹, Danilo Demonte², Daniel del Barco³ & Alicia Trógolo¹

¹Instituto Nacional de Limnología (INALI-CONICET-UNL), Ciudad Universitaria, Paraje El Pozo s/n° (3000) Santa Fe (Argentina); ²Universidad Autónoma de Entre Ríos (UADER), Paraná (E.R), ³Secretaría de Medio Ambiente, Ministerio de Aguas, Servicios Públicos y Medio Ambiente de la Provincia de Santa Fe.
E-mail: ellycordi@yahoo.com.

ABSTRACT

The Siluriformes conservation state was quantified by means of the SUMIN index, composed by the sum of 12 outstanding variables for the species survival and/or conservation. An arranged list of the thirty -three Siluriformes species from the Ramsar Site was obtained based on a gradient of conservation necessity. The species were defined as Vulnerable of Maximum Priority: *Pseudoplatystoma corruscans*, *P. f. fasciatum*, *Luciopimelodus pati* and *Hemisorubim platyrhinchos*; species Vulnerables of Special Attention: *Oxydoras kneri*, *Ageneiosus valenciennesi*, *Sorubim lima*, *Platydoras costatus*, *Pterodoras granulosus*, *Sturisoma robustum*, *Trachydoras paraguayensis* and *Ageneiosus brevifilis*. The remaining species, were qualified as Not Threatened: *Corydoras paleatus*, *Pimelodus ornatus*, *Loricariichthys anus*, *Pimelodus albicans*, *P. maculatus*, *Hypostomus commersoni*, *Loricariichthys platymetopon*, *Pimelodus brevis*, *Paraloricaria vetula*, *Parastegophilus maculatus*, *Trachelyopterus striatulus*, *T. cf. galeatus*, *Bergiaria westermanni*, *Pimelodella laticeps*, *Liposarcus anisitsi*, *Otocinclus vittatus*, *Loricaria simillima*, *Parapimelodus valenciennis*, *Pimelodella gracilis*, *Auchenipterus osteomystax* and *Hoplosternum littorale*.

KEYWORDS: Conservation index, ichthyofauna, South America.

RESUMEN

La conservación de Siluriformes se cuantificó mediante la aplicación del índice SUMIN, compuesto por la suma de 12 variables relevantes para su supervivencia y/o conservación. Se obtuvo un listado jerarquizado de treinta y tres especies de Siluriformes, de acuerdo a un gradiente de necesidad de conservación. Se determinaron como especies Vulnerables de Máxima Prioridad: *Pseudoplatystoma corruscans*, *P. f. fasciatum*, *Luciopimelodus pati*, y *Hemisorubim platyrhinchos*; especies Vulnerables de Especial Atención: *Oxydoras kneri*, *Ageneiosus valenciennesi*, *Sorubim lima*, *Platydoras costatus*, *Pterodoras granulosus*, *Sturisoma robustum*, *Trachydoras paraguayensis* y *Ageneiosus brevifilis*. Las especies restantes fueron calificadas como No Amenazadas: *Corydoras paleatus*, *Pimelodus ornatus*, *Loricariichthys anus*, *Pimelodus albicans*, *P. maculatus*, *Hypostomus commersoni*, *Loricariichthys platymetopon*, *Pimelodus brevis*, *Paraloricaria vetula*, *Parastegophilus maculatus*, *Trachelyopterus striatulus*, *T. cf. galeatus*, *Bergiaria westermanni*, *Pimelodella laticeps*, *Liposarcus anisitsi*, *Otocinclus vittatus*, *Loricaria simillima*, *Parapimelodus valenciennis*, *Pimelodella gracilis*, *Auchenipterus osteomystax* y *Hoplosternum littorale*.

PALABRAS CLAVE: Conservación de índice, ictiofauna, Sudamérica.

INTRODUCTION

Argentina is located inside the zoogeographical Neotropical Region, conformed by hydrographical systems such as Amazon, Orinoco and Paraná-Plata. It possesses all types of climate and physiographic conditions, leading to a wide environmental variety.

The Siluriformes order is the most diverse and widely distributed fish group of the ostariophysi. It comprises 34 families, 412 genera and more than 2405 species. Among them, 1440 species inhabit America, mostly in continental waters. The higher diversity occurs in the tropical and subtropical regions, especially in South America, Africa and South Eastern Asiatic rivers. Siluriformes fishes are appreciated as food as well as for their sportive value.

The Argentinean continental ichthyofauna is very well represented, 400 fish species, from which Siluriformes represent 37,5%, López (2001).

The Convention on Wetlands, signed in 1971 at Ramsar (Iran) is an intergovernmental treaty that provides the framework for national actions and international cooperation for the conservation and management of wetlands and their resources. There are presently 159 contracting parties to the convention, with 1847 wetland sites, totaling 181 million hectares, designated for inclusion in the Ramsar List of Wetlands of International Importance. Jaaukanigás was declared a Site (N° 1112) in 2001, and was the first Ramsar site in the Paraná River in Argentinean territory.

The knowledge of the conservation state of ichthyic fauna is scarce. There are few listings of fish species (Del Barco 1997; Cazenave & Bachetta 2001), with small reference to their conservation state. Several authors have classified the Argentinean ichthyic fauna, taking into account different fish groups and methodologies (Bertonatti & González 1993; Chebez 2009; Orlandini *et al.* 2001). Recently, Zayas & Cordiviola (2007) applied the numerical index SUMIN and defined the conservation state of the Characidae fishes from Santa Fe Province, Argentina.

Due to the little knowledge on the conservation state of fishes from the Paraná River, it was considered of interest to study this order. This information will be useful for a sustainable use of this Wetland of International importance.

The objective of this study is to quantify, with the

application the SUMIN index, the fish conservation state of the order Siluriformes in a Ramsar Site of the Middle Paraná River ("Jaaukanigás"), taking into account biological, ecological, ethological and distributional variables.

MATERIALS AND METHODS

STUDY AREA

The name "Jaaukanigás" means people of the water in "abipón" language, a reference to one of the local populations who lived there in the middle of the 18th century. It is located in Central Eastern Argentina (Fig. 1), at the northeastern extreme of the Santa Fe Province, in the General Obligado Department.

The geographical coordinates of the site are: 28° 00'N (the limit with Chaco Province), 29° 30'S, 58° 51'W (the limit is the Corrientes Province), 59° 46'W (its natural limit is the navigation channel of the Paraná River) and 29° 30 'S (coincident with the Malabrigo Stream). The area includes 492000 ha with an altitude of 43.8 m above sea level.

The Paraná is one of the largest and more diverse rivers in the world, the second in South America after the Amazon. An extensive complex of rivers, lagoons, pools, permanent freshwater marshes and seasonally inundated grasslands, interspersed with riparian woodlands and gallery forests, make this site one of paramount importance from the biodiversity and hydrological point of view in Argentina. The very rich aquatic life includes about 300 fish species of regional economic importance, as 50% of the population in the area lives of fishing. Sport fishing and ecotourism are important economic activities as well (Parma & Cordiviola 2004).

The climate of the site is classified as subtropical humid. The annual average temperature is 19.6 °C. The annual rainfall ranges between 1000 and 1300 mm, with an annual mean of 1285 mm.

Jaaukanigás belongs to a portion of the Middle Paraná River Basin. The river length in the area is 175 km, and this wetland covers 25 % of the total Middle Paraná River length. This is a characteristic wetland of the Paranaense, Chaqueña Oriental and Neotropical biogeography of the region. The Paraná River develops into an extensive and complex floodplain with a vast environmental heterogeneity and high productivity, favored and modulated by the alternation of floods and low water cycles.

Several lotic and lentic environments in the area

FIGURE 1. Location of the Ramsar Site Jaaukanigás (Middle Paraná River) in South America. Details of this site are shown on the right.

FIGURA 1. Ubicación del Sitio Ramsar Jaaukanigás (Río Paraná Medio). A la derecha detalle del Sitio.

FIGURE 2. Fish catch with seine in “Los Amores” Stream, Ramsar site Jaaukanigás (Middle Paraná River).

FIGURA 2. Captura de peces con red de arrastre en el arroyo Los Amores, sitio Ramsar Jaaukanigás (Río Paraná Medio).

(main channel, streams, lagoons, swamps, pools) constitute a set of interface aquatic-terrestrial associates (leaves with grasslands, tall grasslands, gallery forests and palm groves among others). These environments and communities represent one of the highest biodiversity areas not only in the Santa Fe Province but also in Argentina. There we can find 660 species of vertebrates, some of which are endangered species. Several biogeography regions converge in the area with their own typical flora and fauna elements. The southern limit of tropical flora and fauna population (Paranense and Amazonian) use the river as a corridor. The wetland area is an important spawning, developing, feeding and growing site for fish species; some of them using the river channel as a migratory route. Short transverse trophic migrations are registered from the river channel to the lagoons. This water bodies offer shelter and food for their early life stages (Sverlij 2001; Giraudo & Cordiviola 2002).

CONSERVATION INDEX (SUMIN)

Fish were caught in lotic and lentic environments from the Paraná River floodplain, where the most important artisanal fishing is done. Several trawls and trammel nets with several mesh size were used for catching fish in this study. The nets were put on at late afternoon and retrieved the next morning. Thirty-three Siluriformes species mentioned by Cordiviola *et al.* (2007) were studied. López *et al.* (2003) was followed for the systematic classification (Table I). The method proposed by Bello & Úbeda (1998), adapted from Reca *et al.* (1994), was applied considering the SUMIN index, an addition of 12 variables concerning the biology, ecology, ethology and distribution of each species.

The mean and standard deviation were calculated for the group of species under study. To evaluate the conservation state, the species were grouped as follow: the ones whose SUMIN value exceeds the mean plus a standard deviation are considered Vulnerable of Maximum Priority (VMP). Those that fall between the mean and the mean plus one standard deviation are considered Vulnerable requiring Special Attention (VSA). On the contrary, those whose index value is similar to the mean or lower are considered as Not Threatened (NT).

The applied variables are (according to Bello & Úbeda 1998; Zayas & Cordiviola 2007): 1) Continental distribution, 2) National distribution, 3) Amplitude in the habitat use, 4) Width in the vertical

space use, 5) Body size, 6) Reproductive potential, 7) Trophic width, 8) Abundance, 9) Taxonomic singularity, 10) Singularity, 11) Extractive actions and 12) Degree of Protection.

Variable 6 (Reproductive Potential), according to Bello & Úbeda (1998), is related to the species capacity to overcome the numeric decrease when the populations suffer perturbations. This was adapted to fishes from the Paraná River. The relative ovocyte size was defined as the relationship between the mature ovocyte size and the fish length at the first spawning, expressed by thousand (‰). For fishes with ovocytes of medium size, the following sequence must be followed: relative ovocyte size, fecundity, and ovocyte mean number in order to assign the variable (Table II).

Variable 12, Degree of Protection, comprised the following conservation units: Seven Argentinean National Parks and three Ramsar Sites located in the La Plata Basin in Argentinean Territory. The Provincial Laws 10967 (1992) and 12212 (2003) were also considered.

The obtained results were compared with other studies in Table IV. The information for each species considered was obtained from (Almirón *et al.* 2008; Araújo *et al.* 2000; Bonetto *et al.* 1970a and b; Britski *et al.* 1999; Casciotta *et al.* 2005; Cazenave & Bacchetta 2001; Chebez 2009; Cordiviola de Yuan 1980; Cordiviola *et al.* 1984; Cordiviola de Yuan & Oliveros 1979; Cordiviola de Yuan & Pignalberi 1985; De La Peña 1998; Del Barco 1997, 2000; Destefanis & Freyre 1972; Drago *et al.* 2003; Gómez *et al.* 1993, 1994; Haro & Bistoni 2007; Le Bail *et al.* 2000; Liotta 2005; Liotta *et al.* 1995, 1996; López *et al.* 2001, 2003, 2008; Marcucci *et al.* 2005; Menni 2004; Monasterio de Gonzo 2003; Montalto *et al.* 1999; Nakatami *et al.* 2001; Neves & Ruffino 1998; Oldani *et al.* 2003; Oliveros 1980; Orlandini *et al.* 2001; Pignalberi 1967; Pignalberi & Cordiviola de Yuan 1988; Reis *et al.* 2003; Ringuet *et al.* 1967, Ringuet 1975; Rossi *et al.* 2007; Rosso 2007; Salinas & Agudelo 2000; Sverlij *et al.* 1998; Suzuki *et al.* 2000; Vazzoler *et al.* 1997; Vazzoler, 1996, Winemiller 1989). The vulnerability and resilience values taken from Froese & Pauly (2009) are also included.

RESULTS

The species were ordered in decreasing order according to their SUMIN value, between 5 and 16

TABLE I. Siluriformes fish species registered in the Ramsar Site Jaaukanigás, Middle Paraná River (Cordiviola *et al.* 2007). The classification and taxonomic arrangement according to López *et al.* (2003).

TABLA I. Especies de peces Siluriformes registradas en el Sitio Ramsar Jaaukanigás, Río Paraná Medio (Cordiviola *et al.* 2007). Para su ordenamiento y actualización taxonómica se siguió a López *et al.* (2003).

SILURIFORMES

- Trichomycteridae
 - Stegophilinae
 - Parastegophilus maculatus* (Steindachner, 1879)
 - Callichthyidae
 - Corydoras paleatus* (Jenyns, 1842)
 - Hoplosternum littorale* (Hancock, 1828)
 - Loricariidae
 - Hypoptopomatinae
 - Otocinclus vittatus* Regan, 1904
 - Loricariinae
 - Loricaria simillima* Regan, 1904
 - Loricariichthys anus* (Valenciennes, 1836)
 - L. platymetopon* Isbrucker y Nijssen, 1979
 - Paraloricaria vetula* (Valenciennes, 1836)
 - Sturisoma robustum* (Regan, 1904)
 - Hypostominae
 - Hypostomus commersoni* Valenciennes, 1836
 - Liposarcus anisitsi* (Eigenmann y Kennedy, 1903)
 - Doradidae
 - Oxydoras kneri* Bleeker, 1862
 - Pterodoras costatus* (Linné, 1758)
 - P. granulatus* (Valenciennes, 1821)
 - Trachydoras paraguayensis* (Eigenmann y Ward, 1907)
 - Auchenipteridae
 - Auchenipterus osteomystax* Miranda Ribeiro, 1918
 - Trachelyopterus striatulus* (Steindachner, 1877)
 - T. cf. galeatus*
 - Ageneiosus brevifilis* Valenciennes, 1840
 - A. valenciennesi* Bleeker, 1864
 - Pimelodidae
 - Pimelodinae
 - Bergiaria westermanni* Reinhardt, 1874
 - Parapimelodus valenciennis* (Kröyer, 1874)
 - Pimelodus albicans* (Valenciennes, 1840)
 - P. brevis* Marini, Nichols y La Monte, 1933
 - P. maculatus* (Lacépède, 1803)
 - P. ornatus* Kner, 1857
 - Luciopimelodus pati* (Valenciennes, 1836)
 - Hemisorubim platyrhynchos* (Valenciennes, 1840)
 - Pseudoplatystoma corruscans* (Spix y Agassix, 1829)
 - P. f. fasciatum* (Linné, 1766)
 - Sorubim lima* (Bloch y Schneider, 1801)
 - Heptapterinae
 - Pimelodella gracilis* (Valenciennes, 1836)
 - P. laticeps* Eigenmann, 1917
-

TABLE II. Reproduction Potential Values estimated for Paraná River fish. * With parental care.

TABLA II. Valores de Potencial Reproductivo estimados para peces del río Paraná. * Con cuidados parentales.

Ovocites relative size (‰) of the first spawning length	0	1	2	3
Small (< 7 ‰)	>200,000	200,000 to 150,000	150,000 to 100,000	<100,000
Medium (from 7 to 18 ‰) External fecundity	100,000 to 50,000	50,000 to 25,000	25,000 to 10,000	<10,000
Internal fecundity	50,000 to 25,000	25,000 to 12,500	12,500 to 5,000	< 5,000
Large (>18 ‰)	> 10,000	10,000 to 5,000	5,000 to 500 *	< 500 *

TABLE III. SUMIN index in Ramsar Site Jaaukanigás Siluriformes fish. In each species are indicated the twelve variable values. 1: Continental Distribution; 2: National Distribution; 3: Amplitude in the Habitat Use, 4: Width in the Vertical Space Use, 5: Body Size, 6: Reproductive Potential 7: Trophic Amplitude, 8: Abundance, 9: Taxonomic Singularity, 10: Singularity, 11: Extractive Actions and 12: Protection Degree. Mean of SUMIN: 9 ± 3 .TABLA III. Índice SUMIN de peces Siluriformes del Sitio Ramsar Jaaukanigás. Se indican los valores de las 12 variables en cada especie. 1: Distribución Continental, 2: Distribución Nacional, 3: Amplitud en el Uso del Hábitat, 4: Amplitud en el Uso del Espacio Vertical, 5: Tamaño Corporal, 6: Potencial Reproductivo, 7: Amplitud Trófica, 8: Abundancia, 9: Singularidad Taxonómica, 10: Singularidad, 11: Acciones Extractivas y 12: Grado de Protección. Media del SUMIN: 9 ± 3 .

Species	1	2	3	4	5	6	7	8	9	10	11	12	SUMIN
<i>Pseudoplatystoma corruscans</i>	2	1	2	3	2	0	2	0	0	1	3	0	16
<i>Pseudoplatystoma f. fasciatum</i>	0	1	2	3	2	0	2	0	0	1	3	0	14
<i>Luciopimelodus pati</i>	2	1	1	1	2	0	2	0	1	1	2	0	13
<i>Hemisorubim platyrhynchos</i>	0	1	2	1	1	1	1	1	1	1	2	0	12
<i>Oxydoras kneri</i>	2	1	2	1	1	0	0	0	0	1	3	0	11
<i>Ageneiosus valenciennesi</i>	2	1	1	1	1	1	1	0	0	1	2	0	11
<i>Sorubim lima</i>	0	1	2	1	1	1	1	1	0	1	2	0	11
<i>Platydoras costatus</i>	0	1	2	1	0	3	0	0	0	0	2	1	10
<i>Pterodoras granulosus</i>	0	1	2	1	1	0	0	0	0	1	4	0	10
<i>Sturisoma robustum</i>	2	1	1	1	0	3	0	1	0	0	1	0	10
<i>Trachydoras paraguayensis</i>	2	1	2	1	0	2	0	1	0	0	0	1	10
<i>Ageneiosus brevifilis</i>	1	1	1	1	1	1	1	0	0	1	2	0	10
<i>Corydoras paleatus</i>	2	0	1	1	0	3	0	0	0	0	2	0	9
<i>Pimelodus ornatus</i>	0	1	1	1	1	2	0	1	0	0	1	1	9
<i>Loricariichthys anus</i>	2	1	1	1	1	2	0	0	0	1	0	0	9
<i>Pimelodus albicans</i>	2	1	1	1	1	0	0	0	0	1	2	0	9
<i>Pimelodus maculatus</i>	2	1	1	1	1	0	0	0	0	1	2	0	9
<i>Hypostomus commersoni</i>	2	1	1	1	1	2	0	0	0	1	0	0	9
<i>Loricariichthys platymetopon</i>	2	1	1	1	1	2	0	0	0	0	0	0	8
<i>Pimelodus brevis</i>	2	1	1	1	1	0	0	1	0	0	1	0	8
<i>Paraloricaria vetula</i>	2	1	1	1	1	0	0	0	0	1	1	0	8
<i>Parastegophilus maculatus</i>	2	1	0	1	0	2	2	0	0	0	0	0	8

Continuación TABLA III

<i>Trachelyopterus striatulus</i>	2	1	1	1	0	2	0	0	0	0	0	0	7
<i>Trachelyopterus cf. galeatus</i>	2	1	1	1	0	2	0	0	0	0	0	0	7
<i>Bergiaria westermanni</i>	2	1	0	1	0	2	0	1	0	0	0	0	7
<i>Pimelodella laticeps</i>	2	0	1	0	0	3	1	0	0	0	0	0	7
<i>Liposarcus anisitsi</i>	0	1	1	1	1	2	0	0	0	1	0	0	7
<i>Otocinclus vittatus</i>	0	1	0	1	0	2	1	0	0	0	1	0	6
<i>Loricaria simillima</i>	0	1	0	0	0	3	0	1	0	0	1	0	6
<i>Parapimelodus valenciennis</i>	2	0	1	1	0	2	0	0	0	0	0	0	6
<i>Pimelodella gracilis</i>	0	1	1	0	0	3	1	0	0	0	0	0	6
<i>Auchenipterus osteomystax</i>	0	1	1	1	0	1	1	0	0	0	0	0	5
<i>Hoplosternum littorale</i>	0	1	1	1	0	1	0	0	0	0	1	0	5

(Table III). The SUMIN mean for the Siluriformes considered was 9 ± 3 .

The Vulnerable Species of Maximum Priority (VMP) are: *Pseudoplatystoma corruscans*, *P. fasciatum*, *Luciopimelodus pati* and *Hemisorubim platyrhynchos*.

The Vulnerable Species of Special Attention (VSA) are: *Oxydoras kneri*, *Ageneiosus valenciennesi*, *Sorubim lima*, *Platydoras costatus*, *Pterodoras granulosus*, *Sturisoma robustum*, *Trachydoras paraguayensis* and *Ageneiosus brevifilis*.

The Not Threatened species (NT) are: *Corydoras paleatus*, *Pimelodus ornatus*, *Loricariichthys anus*, *Pimelodus albicans*, *P. maculatus*, *Hypostomus commersoni*, *Loricariichthys platymetopon*, *Pimelodus brevis*, *Paraloricaria vetula*, *Parastegophilus maculatus*, *Trachelyopterus striatulus*, *T. cf. galeatus*, *Bergiaria westermanni*, *Pimelodella laticeps*, *Liposarcus anisitsi*, *Otocinclus vittatus*, *Loricaria simillima*, *Parapimelodus valenciennis*, *Pimelodella gracilis*, *Auchenipterus osteomystax*, and *Hoplosternum littorale*.

DISCUSSION

The data obtained from the Ramsar Site Jaaukanigás (SUMIN) were compared with those obtained by other authors applying different methodologies (Table IV).

Bertonatti & González (1993) and Chebez (2009) applied similar methodologies for obtaining the information. They used the classification proposed by the World Union for Conservation of Nature IUCN (1990). The first authors made a fish species list, giving categories of conservation, using a qualitative appreciation, and the state of each one.

Chebez (2009) underline the lack of information concerning the distribution of uncertain and rare species. However, in the present work it was possible to obtain these data for all the species considered. Concerning the vulnerability values, taken as a group, results obtained by Froese & Pauly (2009) showed a similar tendency to those obtained by SUMIN.

Within the species considered as Vulnerable of Maximum Priority, results obtained through the SUMIN index is noticeably coincident with the results obtained by the vulnerability value (Froese & Pauly, 2009): *Pseudoplatystoma corruscans*, and *Luciopimelodus pati*, very high and high, respectively, and *P. fasciatum* and *Hemisorubim platyrhynchos* with a similar state of conservation. The VSA species *Oxydoras kneri*, *Pterodoras granulosus*, *Sorubim lima*, *Platydoras costatus* and *Ageneiosus brevifilis* show a similar vulnerability.

The first group of six NT species, with an average value of SUMIN (9) showed a moderate vulnerability for Froese & Pauly (2009). The other species grouped within this category are coincident between methods in their low need for protection.

The results obtained on the Ramsar Site of International Care Jaaukanigás show the presence of twelve Siluriformes species that need special attention of conservation. Among them, the big "surubies" of the genus *Pseudoplatystoma* and the "armados" (*Pterodoras granulosus*, and *Oxydoras kneri*) are of commercial value.

As stated by Bello & Ubeda (1998), and Zayas & Cordiviola (2007), the SUMIN Index is a useful method for evaluating and adjusting knowledge on the conservation of fish resources.

TABLE IV. Comparison of the conservation state of Siluriformes fish from Ramsar Site Jaaukanigas obtained during this study with previous studies. 1: Bertonatti & González (1993); 2: Orlandini *et al.* (2001), 3: Vulnerability Froese & Pauly (2009), 4: Resilience Froese & Pauly (2009) and 5: Chebez (2009). U= Uncertain; IK= Insufficiently Known; S= Strange; CT= Commercially Threatened; VMP= Vulnerable of Maximum Priority; VSA = Vulnerable of Special Attention; NT= No Threatened; w/d=without data; Me = Medium; Mo = Moderate; L = Low; VH =Very High, H =High.

TABLA IV. Comparación del estado de conservación de los peces Siluriformes del Sitio Ramsar Jaaukanigás obtenidos en el presente trabajo con estudios previos. 1: Bertonatti & González (1993); 2: Orlandini *et al.* (2001), 3: Vulnerabilidad Froese & Pauly (2009), 4: Resiliencia Froese & Pauly (2009) y 5: Chebez (2009). U= Indeterminada; IK= Insuficientemente Conocida; S= Rara; CT= Comercialmente Amenazada; VMP= Vulnerable de Máxima Prioridad; VSA= Vulnerable que merece Especial Atención; NT= No Amenazada; w/d= sin datos. Me= Media, Mo= Moderada, L= Baja, VH= Muy Alta, H=Alta.

Species		1	2	3	4	5
<i>Pseudoplatystoma corruscans</i>	VMP	w/d	w/d	VH	L	U
<i>Pseudoplatystoma. fasciatum</i>	VMP	IK	w/d	Mo	Me	w/d
<i>Luciopimelodus pati</i>	VMP	w/d	w/d	H	Me	w/d
<i>Hemisorubim platyrhynchos</i>	VMP	IK	w/d	Mo	Me	U
<i>Oxydoras kneri</i>	VSA	w/d	w/d	Mo-H	Me	w/d
<i>Ageneiosus valenciennesi</i>	VSA	IK	w/d	L	Me	U
<i>Sorubim lima</i>	VSA	w/d	w/d	Mo	Me	U
<i>Platydoras costatus</i>	VSA	S	w/d	L-Mo	H	w/d
<i>Pterodoras granulosus</i>	VSA	w/d	w/d	Mo-H	Me	w/d
<i>Sturisoma robustum</i>	VSA	w/d	w/d	L	w/d	S
<i>Trachydoras paraguayensis</i>	VSA	S	w/d	L	H	U
<i>Ageneiosus brevifilis</i>	VSA	IK	w/d	L-Mo	Me	w/d
<i>Corydoras paleatus</i>	NT	CT	NT	L	Me	w/d
<i>Pimelodus ornatus</i>	NT	IK	w/d	Mo	Me	w/d
<i>Loricariichthys anus</i>	NT	w/d	w/d	Mo	w/d	w/d
<i>Pimelodus albicans</i>	NT	w/d	VSA	Mo	Me	w/d
<i>Pimelodus maculatus</i>	NT	w/d	w/d	Mo	Me	w/d
<i>Hypostomus commersoni</i>	NT	S	NT	L-Mo	w/d	U
<i>Loricariichthys platymetopon</i>	NT	w/d	w/d	L	w/d	w/d
<i>Pimelodus brevis</i>	NT	IK	w/d	L	H	S
<i>Paraloricaria vetula</i>	NT	w/d	w/d	Mo	w/d	w/d
<i>Parastegophilus maculatus</i>	NT	w/d	w/d	L	w/d	U
<i>Trachelyopterus striatulus</i>	NT	IK	w/d	L	w/d	U
<i>Trachelyopterus cf. galeatus</i>	NT	IK	w/d	L	w/d	w/d
<i>Bergiaria westermanni</i>	NT	w/d	w/d	L	H	w/d
<i>Pimelodella laticeps</i>	NT	w/d	NT	L	w/d	w/d
<i>Liposarcus anisitsi</i>	NT	w/d	w/d	L	w/d	w/d
<i>Otocinclus vittatus</i>	NT	w/d	w/d	L	w/d	U
<i>Loricaria simillima</i>	NT	w/d	w/d	L	w/d	w/d
<i>Parapimelodus valenciennis</i>	NT	w/d	w/d	L	H	w/d
<i>Pimelodella gracilis</i>	NT	w/d	w/d	L	w/d	w/d
<i>Auchenipterus osteomystax</i>	NT	IK	w/d	L	w/d	w/d
<i>Hoplosternum littorale</i>	NT	w/d	w/d	L	Me	U

REFERENCES

- ALMIRÓN, A., J. CASCIOTTA, L. CIOTEK, & P. GEORGIS. 2008. Guía de los Peces del Parque Nacional Pre-Delta. APN. 215 pp.
- ARAÚJO, F.G., S. DUARTE, R. S. GOLDBERG & I. FICHBERG. 2000. Ciclo reproductivo de *Parauchenypterus striatulus* (Pisces – Auchenipteridae) na Represa de Ribeirão das Lages – RJ. Arquivo brasileiro de medicina veterinária e zootecnia. 52 (3), 12 pp.
- BELLO, M.T. & C.A UBEDA. 1998. Estado de conservación de los peces de agua dulce de la Patagonia Argentina. Aplicación de una metodología objetiva. Gayana Zoológica 62 (1): 45-60.
- BERTONATTI, C. & F. GONZÁLEZ. 1993. Lista de vertebrados argentinos en peligro de extinción. Boletín Técnico Fundación Vida Silvestre Argentina. 8: 1-39.
- BONETTO, A.A., E. CORDIVIOLA DE YUAN & C. PIGNALBERI. 1970a. Nuevos datos sobre poblaciones de peces en ambientes leníticos permanentes del Paraná medio. Physis. 30 (80): 141-154.
- BONETTO, A.A., C. PIGNALBERI, E. CORDIVIOLA DE YUAN & O. OLIVEROS. 1970b. Nuevos aportes al conocimiento de las poblaciones ícticas en cuencas temporarias del valle de inundación del Paraná medio. Acta Zoologica Lilloana 27: 135-153.
- BRITSKI, H.A., K.Z. DE S. DE SILIMON & B.S. LOPES. 1999. Peixes do Pantanal. Manual de identificação. Empresa Brasileira de Pesquisa Agropecuária. Serviço de Produção de Informação (Brasil) 184 pp.
- CASCIOTTA, J., A. ALMIRÓN Y J. BECHARA. 2005. Peces del Ibero. Hábitat y Diversidad. La Plata. 244pp.
- CAZENAVE, J. & C. BACCHETTA. 2001. Catálogo de peces argentinos de agua dulce del Museo Provincial de Ciencias Naturales “Florentino Ameghino”. Comunicación Provincial del Museo de Ciencias Naturales “Florentino Ameghino”. 18 pp.
- CHEBEZ, J.C. 2009. Otros que se van. Especies argentinas en peligro. Editorial Albatros, Buenos Aires. 604 pp.
- CORDIVIOLA DE YUAN, E. 1980. Campaña limnológica “Keratella I” en el río Paraná Medio: Taxocenosis de peces de ambientes leníticos. Ecología. 4: 103-113.
- CORDIVIOLA DE YUAN, E., & O.B. OLIVEROS. 1979. Campaña “Keratella I” a lo largo del río Paraná medio I. Peces de ambientes leníticos. Acta Zoológica Lilloana. 35: 629-642.
- CORDIVIOLA DE YUAN, E. & C. PIGNALBERI. 1985. Fish populations in the Paraná River: Lenitic environments of Diamante and San Pedro areas (Argentine Republic). Hydrobiologia 127: 213-218.
- CORDIVIOLA DE YUAN, E., N. OLDANI, O. OLIVEROS & C. PIGNALBERI DE HASSAN. 1984. Aspectos limnológicos de ambientes próximos de Santa Fe (Paraná Medio): poblaciones de peces ligadas a la vegetación. Neotrópica 30 (84): 127-139.
- CORDIVIOLA, E.A., D. DEL BARCO, M. CAMPANA. 2006. Los peces del Sitio Ramsar “Jaukanigás”, río Paraná, Santa Fe, Argentina. Un inventario preliminar. FABICIB. 10: 69-76.
- CORDIVIOLA, E., D. DEL BARCO, M. CAMPANA & A. TROGOLO. 2007. Los peces del Sitio Ramsar “Jaukanigás”, río Paraná medio, Santa Fe, Argentina. Nuevos datos. FABICIB. 11: 41-50.
- DE LA PEÑA, M. 1998. Guía de peces, anfibios, reptiles y mamíferos del Litoral Argentino. Fundación Hábitat & Desarrollo (Argentina), 367pp.
- DEL BARCO, D.M. 1997. Anexo I Lista de peces de la provincia de Santa Fe 97-106. En: Rozzati J.C. & E. Mosso (eds) Sistema provincial de áreas naturales protegidas de Santa Fe. Gobierno de la Provincia de Santa Fe, Administración de Parques Nacionales, Edición de la Asociación Cooperadora de la Estación Zoológica Experimental de Santa Fe, Argentina, 174 pp.
- DEL BARCO, D.M. 2000. Seminario Internacional de Pesca Continental. Desarrollo sustentable de los recursos pesqueros en aguas continentales. Consejo Federal de Inversiones (CFI, Argentina), 13 pp.
- DESTEFANIS, S. & L. FREYRE. 1972. Relaciones tróficas de los peces de la Laguna de Chascomús con un intento de referenciación ecológica y tratamiento bioestadística del espectro trófico. Acta Zoológica Lilloana. 29: 17-33.
- DRAGO, E.C., I.E. DE DRAGO, O.B. OLIVEROS & A.R. PAIRA. 2003. Aquatic habitats, fish and invertebrate assemblages of the Middle Paraná River. Amazoniana 17 (3/4): 291-341.
- FREYRE, L.R. & J. IWASZKIW. 1982. Importancia de la distribución espacial de ovocitos en ovarios de peces para determinación de fecundidad. Limnobiología 2 (5): 305-310.
- FROESE, R. & D. PAULY (Eds.). 2009. Fish Base. World Wild Web Electronic Publication. <http://www.fishbase.org/> Version 07/07/09.
- GIRAUDO, A. & E. CORDIVIOLA. 2002. Jaukanigás, un nuevo Sitio Ramsar en la Argentina. Naturaleza y Conservación 10: 34 - 35.
- GÓMEZ, S. E.; CASSARA, H. & S. BORDONE. 1993/94. Producción y comercialización de los peces ornamentales en la República Argentina. Revista de Ictiología 2/3 (1 / 2): 13-20.
- HARO, J. G. & M. BISTONI. 2007. Peces de Córdoba. Univ. Nacional de Córdoba. 246p.
- LE BAIL, P.Y., P. KEITH & P. PLANQUETTE. 2000. Atlas des poissons d’eau douce de Guyane (tome 2, fascicule II). Publications scientifiques du Muséum National d’Histoire Naturelle, Paris: 307 pp.
- LEY PROVINCIAL DE SANTA FE N° 12.212. Cámara de Senadores de la Provincia de Santa Fe (Argentina). 20 noviembre 2003.
- LEY PROVINCIAL DE SANTA FE N° 10.967. Cámara de Diputados Provincia de Santa Fe (Argentina). 10 diciembre 1992.
- LIOTTA, J. 2005. Distribución geográfica de los peces de aguas continentales de la República Argentina. ProBiot. Serie Documentos N°3. 701 pp.

- LIOTTA, J., B. GIACOSA & M. WAGNER. 1995/96. Lista comentada de la ictiofauna del delta del río. Revista de Ictiología 4 (1-2): 23-32.
- LÓPEZ, H., C. BAIGUN, J. IWASKIW, R. DELFINO & O. PADIN. 2001. La cuenca del Salado: uso y posibilidades de sus recursos pesqueros. Ed. Univ. La Plata. La Plata, Argentina. 60 pp.
- LÓPEZ, H.L., A.M. MIQUELARENA & R. MENNI. 2003. Lista comentada de los peces continentales de la Argentina. ProBiota Serie Técnica y Didáctica 5, 86pp.
- LÓPEZ, H.L.; R. C. MENNI, M. DONATO & A. M. MIQUELARENA. 2008. Biogeographical revision of Argentina (Andean and Neotropical Regions): an analysis using freshwater fishes. Journal of Biogeography 35(9):1564-1579.
- MARCUCCI, K.M., M.L. ORSI & O. A. SHIBATTA. 2005. Abundancia e aspectos reproductivos de *Loricariichthys platymetopon* (Siluriformes, Loricariidae) em quatro trechos da represa Capivara, medio Rio Paranapanema. Iheringia, Serie Zoologia 95(2):197-203.
- MENNI, R.C. 2004. Peces y Ambientes en la Argentina Continental. Monografías del Museo Argentino de Ciencias Naturales N°5. 316 pp.
- MONASTERIO DE GONZO, G. 2003. Peces de los Ríos Bermejo, Juramento y Cuencas Endorreicas de la Provincia de Salta. Museo Ciencias Naturales y Consejo Investigación Universidad Nacional Salta. 243 pp.
- MONTALTO, L., O.B. OLIVEROS, I. EZCURRA DE DRAGO & L.D. DEMONTE. 1999. Peces del río Paraná Medio predadores de una especie invasora: *Limnoperna fortunei* (Bivalvia, Mytilidae). FABICIB 3: 85-101.
- NAKATAMI, K., A.A. AGOSTINHO, G. BAUMGARTNER, A. BIALETZKI, P.V. SÁNCHEZ, M.C. MAKRAKIS & C.S. PAVANELLI. 2001. Ovos e larvas de peixes de agua doce. Desenvolvimento e manual de identificação. Editora da Universidade Estadual de Maringá (Brasil). 378 pp.
- NEVES, A.M.B. & M.L. RUFFINO. 1998. Reproductive aspects of *Liposarcus pardalis* (Pisces, Siluriformes, Loricariidae) (Castelnau, 1855) in the Amazons. Boletim do Museo para Emilio Goeldi. Serie Zoologia 14(1): 77-94.
- OLDANI, N., C. BAIGUN, J. PETEAN, N. CALAMARI & L. ESPÍNOLA. 2003. Características y evaluación preliminar de la pesquería artesanal del Río San Javier (tramo medio del valle aluvial del río Paraná). Sante Fé. Argentina. En: Pesquerías continentales en America Latina. UNL101:114.
- OLIVEROS, O.B. 1980. Campaña limnológica "Keratella I" en el río Paraná Medio: aspectos tróficos de los peces de ambientes leníticos. Ecología 4: 115-126.
- ORLANDINI, S. L., L. AUN & R. MARTORI. 2001. Estado de conservación de la ictiofauna de las sierras pampeanas de la provincia de Córdoba, Argentina. Boletín Sociedad Biológica de Concepción 72: 91-103.
- PARMA, M. J. & E. CORDIVIOLA. 2004. Diversidad de peces en un tramo del río Paraná medio (Jaukanigás, Sitio Ramsar, Santa Fe, Argentina). En: Temas de biodiversidad del Litoral fluvial Argentino. (Coord.: F.G. Aceñolaza). Insugeo, San Miguel de Tucumán, Misceláneas 12: 265-270.
- PIGNALBERI, C. 1967. Observaciones sobre gónadas de algunas especies de peces del Paraná Medio. Acta Zoológica Lilloana 23: 163-172.
- PIGNALBERI, C. & E. CORDIVIOLA DE YUAN. 1988. Fish Populations in the Paraguay River waters of the Formosa area, Argentina. Studies on Neotropical Fauna and Environment 23 (3): 165-175.
- RECA, A., C. UBEDA & D. GRIGERA. 1994. Conservación de la fauna de tetrápodos. I. Un índice para su evaluación. Mastozoología Neotropical 1(1): 17-28.
- REIS, R.E., S.O. KULLANDER & C. J. FERRARIS. 2003. The check list of the freshwater fishes of South and Central America. Editorial de la Pontificia Universidad Católica de Rio Grande do Sul, 729 pp.
- RINGUELET, R.A. 1975. Zoogeografía y ecología de los peces de aguas continentales de la Argentina y consideraciones sobre las áreas ictiológicas de América del Sur. Ecosur 2(3): 1-122.
- RINGUELET, R.A., ARAMBURU, R.H. & A. ALONSO DE ARAMBURU. 1967. Los peces argentinos de agua dulce. Comisión Investigaciones Científicas Provincia Buenos Aires, La Plata, 602 pp.
- ROSSI, L., E. CORDIVIOLA & M.J. PARMA. 2007. Fishes. Part IV. 12. Vertebrate animal life. In The Middle Paraná River: Limnology of a Subtropical Wetland. Springer-Verlag. 305-325.
- ROSSO, J.J. 2007. Peces Pampeanos, guía y ecología. Literature of Latin America (LOLA). 221pp.
- SALINAS, C. & E. AGUDELO. 2000. Peces de importancia económica en la Cuenca Amazónica Colombiana. SINCHI: Instituto Amazónico de Investigaciones Científicas. Ministerio del Medio Ambiente. Santa Fe de Bogotá, Colombia. 140 pp.
- SVERLIJ, S.B., H.L. LÓPEZ, R.L. DELFINO SCKENKE & A. ESPINACH ROS. 1998. Peces del Río Uruguay. Comisión Administradora Río Uruguay. 89 pp.
- SVERLIJ, S.B. 2001. Draft Management Plan of "Jaukanigas" Wetland Parana River, Argentina. Wetland Advisory and Training Centre. The Netherlands 1-41.
- SUZUKI, H.I., A.A. AGOSTINHO & K.O. WINEMILLER. 2000. Relationship between oocyte morphology and reproductive strategy in loricariid catfishes of the Paraná River, Brazil. Journal of Fish Biology. 57: 971 - 807.
- UICN. 1990. World Conservation Monitoring Centre (comp.). UICN Red List of Threatened Animal. Cambridge. UK, 192 pp.
- VAZZOLER, A. 1996. Biología da reprodução de peixes teleósteos: Teoria e prática. Editora da Universidade Estadual de Maringá (Brasil), 169 pp.
- VAZZOLER, A.E., A.A. AGOSTINHO & N. SEGATTI HAHN. 1997. A Planície de inundação do alto Rio Parana:

- Aspectos físicos, biológicos e socioeconômicos. Editora da Universidade Estadual de Maringá (Brasil), 460 pp.
- WINEMILLER & O. KIRA. 1989. Patterns of variation in life history among South American fishes in seasonal environments. *Oecologia* 81: 225-241.
- ZAYAS, M. & E. CORDIVIOLA. 2007. The conservation state of Characidae Fish (Pisces: Characiformes) in an area of the Plata Basin, Argentina. *Gayana* 71 (2):178-186.

Recibido: 07.08.09
Aceptado: 01.10.09