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Full Length Research Paper

Diversity of parasites from Middle Paraná system freshwater fishes, Argentina

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Investigation into taxonomy at the local and regional level is essential. It is necessary to make an inventory of the local biodiversity to enhance the efforts of the region with respect to scientific research. Argentina is one of the most diverse countries in the world and little is known about the diversity of invertebrate species of ichthyoparasites of inland aquatic ecosystems. The Middle Paraná water system hosts a high diversity of fish and thus has as its correlate a diversity of parasites. The study aims to determine the extent of knowledge of the taxonomy of the Middle Paraná ichthyoparasite system. Publications, electronic databases and libraries were surveyed and specialists were consulted. The results obtained were grouped considering taxonomic placement of host and parasite, and locations of study sites of infection in the host body. A total of 50 species of fish hosts has been recognized, mostly Characiformes and Siluriformes (48 and 40%, respectively). The taxa studied were Monogenea (10%), Cestoda (24%), Digenea (27%), Nematoda (12%), Acanthocephala (3%) and Branchiura (11%); 91 metazoan parasites (at generic and/or specific level) were identified. Most of these relationships have been examined in fish of economic importance. The most common infected parts are the intestine and the gills.

Key words: Parasites, Middle Paraná River, Argentina, freshwater fishes, diversity, checklist.

INTRODUCTION

Articles and journals published by researchers in a given region are indicative of areas of interest and the scientific research efforts of every nation (Michán et al., 2008). The results will lead to development of the discipline, because it is first necessary to make an inventory of local biodiversity, which is based on the identification and description of new species (Mayr, 1969). The study of taxonomy practised in the region should consider its complex features, including its geographical, geological and biological highlights, the last of which is of interest for this paper (Mijac and Ryder, 2009). The Paraná River drains a continental-sized basin formed by several different, even contrasting, regions. Such regions cover areas with hundreds of thousands of square kilometres in extent (Iriondo and Paiva, 2007). The Paraná River is the second largest river in South America in terms of catchment area (1.51 x 10^6 km^2), the second longest (4400 km from the Headwaters of the Grande River in Brazil to the Rio de la Plata estuary), and the third in terms of discharge (about 470 km^3 of freshwater carried to the sea annually). Within this river hydrosystem, the segment of the Middle Paraná extends 700 km upstream from the Paraguay outlet (27°25´S to 58°31´W) to the tip of the delta upstream from Rosario city, Santa Fe Province, Argentina (32°13´S to 60°40´W). Along its main channel, the Middle Paraná has built a relatively wide fringing floodplain with a surface of about 20,000 km^2 (Drago, 2007). The middle section of the Paraná River shows a great richness of habitats, building up an environmental mosaic, due to its spatiotemporal

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Figure 1. Middle Paraná system (Argentina).

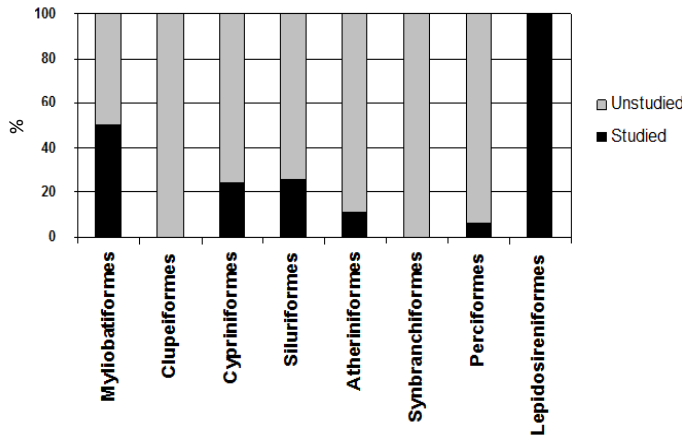

Figure 2. Fish hosts studied in relation to known species in the Middle Paraná system.

dynamics, inhabited by several fish species with different life strategies. Here, high fish diversity and productivity are observed (Bonetto, 1986). In the Middle Paraná River, there are 216 fish species belonging to nine orders and 35 families (Rossi et al., 2007). In this context, the water system of the Middle Paraná hosts a high diversity of fish and therefore has as its correlate a diversity of their parasites. The objectives of this study are to explore the current state of taxonomy studies of ichthyoparasites in the Middle Paraná System (Argentina) and introduce a list of recorded species, with data from the host, site of infection and location of collection, as well as analyse the value of these studies and their contribution to the knowledge of regional biodiversity.

MATERIALS AND METHODS

In this paper we reviewed printed and electronic literature concerning fish parasites in the Middle Paraná River (Figure 1), and prepared a checklist of parasites and hosts, as well as their geographical distribution, with the aim of providing a source of information for researchers. We also introduce the Neotropical fish species which have been the most studied in relation to their associated parasites, a hierarchy of identified parasite taxa and their implications for current knowledge of regional biodiversity.

RESULTS

In all the available area of the Middle Paraná system (Figure 1), studies were registered with identification of ichthyoparasites in 26 places, mainly in the Provinces of Santa Fe and Corrientes (ten in each case).

Fish that were studied represent approximately 23% of the ichthyofauna of the system (Rossi et al., 2007) and the level of progress in the knowledge of potential hosts of the parasitic fauna is incipient. Figure 2 shows hosts classified in taxonomic families. Among these, *Pimelodus albicans* (Valenciennes, 1840), *Pseudoplatystoma corruscans* (Spix and Agassiz, 1829) (Siluriformes) and *Salminus brasiliensis* Cuvier, 1816 (Characiformes) are the most studied species (Flores et al., 1992; Drago, 2007; De Chambrier and Gil de Pertierra, 2002).

The identified specific variety is, until now, of 91 taxa, including all the metazoan groups, although only some of them are highlighted because they are the most representative ones, such as Digenea and Cestoda with more than 20 publications each. In other zoological groups, there are very few studies (for example, Myxozoa, Hirudinea and Mollusca) (Figure 3).

The most common infected areas in which parasites were identified are the intestine (39 parasite species) and the filaments of gills (16 species) (Figure 4).

A list of the registered parasites is shown in Table 1, including the host, the site of the infection, the registered places and references.

DISCUSSION

In the Northern Paraná (Brazil), 337 parasite species have been found in 72 host species of fishes (Takemoto et al., 2009). Our research gathered records of the Middle Paraná (Argentina) and revealed that knowledge is still

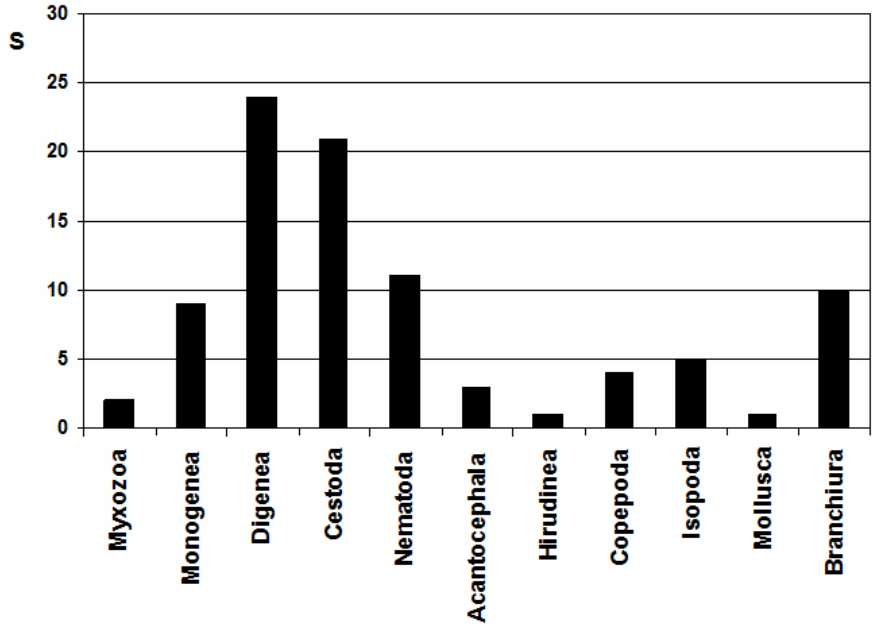

Figure 3. Parasites recorded in the Middle Paraná system.

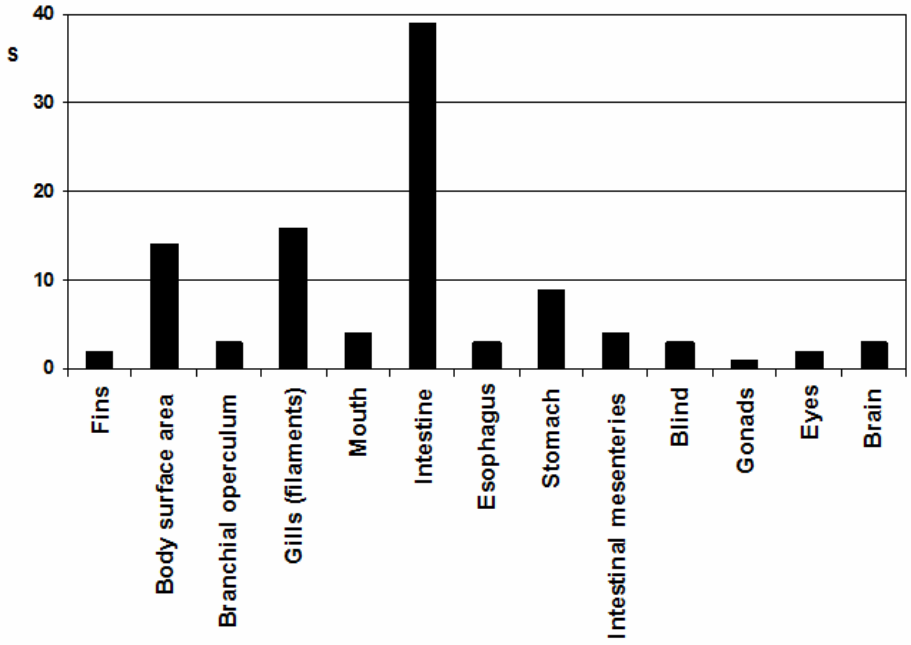

Figure 4. Species richness according to the site of infection/infestation reported in the Middle Paraná system (Argentina).

incipient due to the fact that only 104 parasites were found in 50 host species of fish, which constitute 23% of the ichthyofauna of the system. The species that are highlighted because of their amount of identified parasites are of commercial and sporting interest in the region: *P. albicans*, *P. corruscans* and *S. maxillosus.* This shows the orientation of previous studies that aimed at those species of high economic value, social and cultural recognition. However, more research is necessary on species of less social acknowledgment and high

Table 1. Checklist of ichthyoparasites in the middle Paraná system (Argentina).

Phylum Myxozoa (Grassé, 1970)
Class Myxosporea (Bütschli, 1881)
Order Myxobolidae (Gurley, 1891)
Suborder Platysporina (Kudo, 1919)
Family Myxobolidae (Thélohan, 1892)
***Henneguya* s Province (Thélohan, 1892)**
Hosts: *Hoplosternum littorale* (Hancock, 1828); *Serrasalmus* s Province (Lacepède, 1803)
Site of infection: gill filaments
Location: Salado River (SantoTomé City, Santa Fe Province); Paraná River (Corrientes Province)
Refs.: Flores Quintana et al. (1992) and Eiras et al. (2008)

Myxobolus paranensis (**Bonetto and Pignalberi, 1965)**
Host: *Salminus maxillosus (*Cuvier, 1816)
Site of infection: gonads (cystic masses)
Location: Rivers and streams near of Santa Fe City (Santa Fe Province)
Refs.: Bonetto and Pignalberi (1965)

Phylum Platyhelminthes (Gegenbaur, 1859)
Subphylum Neodermata (Ehlers, 1985; Cavalier-Smith, 1998)
Infraphylum Cercomeromorpha (Bychowsky, 1937; Cavalier-Smith, 1998)
Class Monogenea (Carus, 1863)
Subclass Monopisthocotylea (Odhner, 1912)
Order Monopisthocotylea (Odhner, 1912)
Family Dactylogyridae (Bychowsky, 1933)
***Amphocleithrum paraguayensis (*Price and Gonzalez, 1969)**
Host: *Pseudoplatystoma corruscans* (Spix and Agassiz, 1829)
Site of infection: gill filaments
Location: Paraná River (Corrientes Province)
Refs.: Suriano and Incorvaia (1995)

Demidospermus armostus **(Kritsky and Gutiérrez, 1998)**
Host: *Pimelodus albicans* (Valenciennes, 1840)
Site of infection: gill filaments
Location: Salado River (San Justo City, Santa Fe Province)
Refs.: Chemes et al. (2008)

Demidospermus bidiverticulatum **(Suriano and Incorvaia, 1995)**
Host: *Pimelodus albicans*
Site of infection: gill filaments
Location: Salado River (San Justo City, Santa Fe Province)
Refs.: Chemes et al. (2008)

Demidospermus idolus **(Kritsky and Gutiérrez, 1998)**
Host: *Pimelodus albicans*
Site of infection: gill filaments
Location: Salado River (San Justo City, Santa Fe Province)
Refs.: Chemes et al. (2008)

Demidospermus majusculus **(Kritsky and Gutiérrez, 1998)**
Host: *Pimelodus albicans*
Site of infection: gill filaments
Location: Salado River (San Justo City, Santa Fe Province)
Refs.: Chemes et al. (2008)

Table 1. Contd.

***Demidospermus* s Province (Suriano, 1983)**
Host: *Pimelodus albicans*
Site of infection: gill filaments
Location: Salado River (San Justo City, Santa Fe Province)
Refs.: Chemes et al. (2008)

***Unibarra paranoplatensis* (Suriano and Incorvaia, 1995)**
Hosts: *Pimelodus clarias maculatus* Lacepède, 1803; *Paulicea luetkeni* (Steindachner, 1877)
Site of infection: gill filaments
Location: Paraná River (Puerto Italia City, Corrientes Province; Corrientes Province; Entre Ríos Province)
Refs.: Suriano and Incorvaia (1995)

***Vancleaveus janauacaensis* (Kritsky et al., 1986)**
Host: *Pterodoras granulosus* (Valenciennes, 1821)
Site of infection: gill filaments
Location: Paraná River (Corrientes Province)
Refs.: Suriano and Incorvaia (1995)

Family Gyrodactylidae (Van Beneden and Hesse, 1863)
***Scleroductus yuncensi* (Jara and Cone, 1989)**
Host: *Pimelodus albicans*
Site of infection: gill filaments
Location: Salado River (San Justo City, Santa Fe Province)
Refs.: Chemes et al. (2008)

Monogenea n.n.
Host: *Aequidens portalegrensis* (Hensel, 1870)
Site of infection: gill filaments
Location: Riachuelo River Lagoons (Corrientes Province)
Refs.: Domitrovic (1998)

Class Cestoidea
Subclass Eucestoda (Southwell, 1930)
Order Proteocephalidea (Mola, 1928)
Family Proteocephalidae (La Rue, 1911)
***Ageneiella brevifilis* (de Chambrier and Vaucher, 1999)**
Host: *Ageneiosus inermis* (Linnaeus, 1766), *A. militaris* Valenciennes, 1835 (*)
Site of infection: intestine
Location: Colastiné River, Santa Fe Province
Refs.: Gil de Pertierra (2009)

***Gibsoniela meursaulti* (Woodland, 1935)**
Host: *Ageneiosus inermis*, *A. militaris* (*)
Site of infection: intestine
Location: Colastiné River, Santa Fe Province
Refs.: Gil de Pertierra (2009)

***Jauella glandicephala* (Rego and Pavanelli, 1985)**
Host: *Zungaro zungaro* (Humboldt, 1821)
Site of infection: intestine
Location: Paraná River (Italia Port, Corrientes City, Corrientes Province)
Refs.: Gil de Pertierra (2009)

Table 1. Contd.

***Luciaella ivanovae* (Gil de Pertierra, 2009)**
Host: *Ageneiosus inermis*
Site of infection: intestine
Location: Colastiné River, Santa Fe Province
Refs.: Gil de Pertierra (2009)

***Monticellia belavistensis* (Pavanelli et al., 1994)**
Host: *Pterodoras granulosus*
Site of infection: intestine
Location: Colastiné River (31°40´S - 60°46´W), Santa Fe Province
Refs.: Gil de Pertierra (2005)

***Monticellia magna* (Rego, et al., 1974)**
Hosts: *Pimelodus argenteus* Perugia, 1891; *P. maculatus*
Site of infection: intestine (anterior and middle parts)
Location: Colastiné River (31°40´S - 60°46´W), Santa Fe Province
Refs.: Gil de Pertierra (2004)

***Monticellia ventrei* (de Chambrier and Vaucher, 1999)**
Host: *Luciopimelodus pati* (Valenciennes, 1836)
Site of infection: intestine
Location: Paraná River (General Belgrano bridge, 27°27´S - 58°50´W, Chaco Province)
Refs.: Gil de Pertierra (2005)

***Spatulifer maringaensis* (Pavanelli and Rego, 1989)**
Host: *Sorubim lima* (Bloch and Schneider, 1801)
Site of infection: intestine
Location: Colastiné River and Coronda River, Santa Fe Province
Refs.: Arredondo and Gil de Pertierra (2008)

***Spatulifer rugosa* (Diesing, 1850)**
Host: *Pseudoplatystoma fasciatum* (Linnaeus, 1766)
Site of infection: intestine
Location: Colastiné River, Santa Fe Province
Refs.: Arredondo and Gil de Pertierra (2008)

***Travassiella avitellina* (Rego and Pavanelli, 1987)**
Host: *Paulicea luetkeni*
Site of infection: Middle and posterior part of intestine
Location: Middle Paraná River (Italia Port, Corrientes City, Corrientes Province)
Refs.: De Chambrier and Gil de Pertierra (2002)

***Peltidocotyle rugosa* (Diesing, 1850)**
Host: *Zungaro zungaro*
Site of infection: intestine
Location: Paraná River (Italia Port, Corrientes City, Corrientes Province)
Refs.: Gil de Pertierra (2009)

***Rudolphiella szidati* (Gil de Pertierra and de Chambrier, 2001)**
Host: *Luciopimelodus pati*
Site of infection: anterior intestine, middle portion rarely
Location: Paraná River (Italia Port, Corrientes City, Corrientes Province; General Belgrano bridge, 27°27´S - 58°50´W, Chaco Province)
Refs.: Gil de Pertierra and de Chambrier (2000)

Table 1. Contd.

***Nomimoscolex chubbi* (Pavanelli and Takemoto, 1995)**
Host: *Gymnotus carapo* (Linnaeus, 1758)
Site of infection: intestine
Location: Colastiné River (31°40´S - 60°46´W), Santa Fe Province
Refs.: Gil de Pertierra (2005)

***Nomimoscolex dechambrieri* (Gil de Pertierra, 2003)**
Host: *Gymnotus carapo*
Site of infection: blind gut
Location: Colastiné River (31°40´S - 60°46´W), Santa Fe Province
Refs.: Gil de Pertierra (2003)

***Nomimoscolex guillermoi* (Gil de Pertierra, 2003)**
Host: *Gymnotus carapo*
Site of infection: blind gut
Location: Colastiné River (31°40´S - 60°46´W), Santa Fe Province
Refs.: Gil de Pertierra (2003)

***Nomimoscolex lopesi* (Rego, 1989)**
Host: *Pseudoplatystoma fasciatum*
Site of infection: intestine
Location: Colastiné River (31°40´S - 60°46´W), Santa Fe Province
Refs.: Gil de Pertierra (2005)

Order Tetraphyllidea (Carus, 1863)
Family Onchobothriidae Braun, 1900
***Acanthobothrium ramiroi* (Ivanov, 2005)**
Host: *Potamotrygon motoro* (Müller and Henle, 1841)
Site of infection: spiral intestine
Location: Colastiné (31°40´S-60°46´W) and Coronda River (32°36´S-60°46´W), Santa Fe Province
Refs.: Ivanov (2005)

***Rhinebothrium paranaensis* (Menoret and Ivanov, 2009)**
Host: *Potamotrygon falkneri* (Castex and Maciel, 1963)
Site of infection: intestine
Location: Colastiné and Coronda River, Santa Fe Province
Refs.: Menoret and Ivanov (2009)

***Rhinebothroides campbelli* (Ivanov, 2004)**
Host: *Potamotrygon motoro*
Site of infection: intestine
Location: South River Colastiné (31°40´S - 60°46´W), Santa Fe Province
Refs.: Ivanov (2004)

***Rhinebothroides mclennanae* (Brooks and Amato, 1992)**
Host: *Potamotrygon motoro*
Site of infection: intestine
Location: Colastiné, Coronda and Reconquista River (Santa Fe Province)
Refs.: Ivanov (2004)

Table 1. Contd.

Order Trypanorhyncha (Diesing, 1863)
Superfamily Heteracanthoidea (Dollfus, 1942)
Family Eutetrarhynchidae (Guiart, 1927)
***Paroncomegas araya* (Campbell et al., 1999)**
Hosts: *Potamotrygon motoro*
Site of infection: intestine
Location: Reconquista Port (29°19´S - 59°42´W), Santa Fe Province
Refs.: Campbell et al. (1999)

Infraphylum Trematoda (Rudolphi, 1808; Cavalier-Smith, 1998)
Class Trematoda (Rudolphi, 1808)
Subclass Digenea (Carus, 1863)
Family Allocreadiidae (Stossich, 1903)
***Crepidostomum macrorchis* (Szidat, 1954)**
Hosts: *Ageneiosus brevifilis* (Linnaeus, 1766); *Auchenipterus nuchalis* (Spix and Agassiz, 1829)*; A. nigripinnis* (Boulenger, 1895)
Site of infection: Intestine
Location: Middle Paraná River (Corrientes City, Corrientes Province)
Refs.: Hamann (1988)

***Creptotrema creptotrema* (Travassos et al, 1928)**
Host: *Leporinus obtusidens* (Valenciennes, 1836)
Site of infection: foregut
Location: Middle Paraná River (Corrientes City, Corrientes Province)
Refs.: Hamann (1988)

***Creptotrematina dispar* (Freitas, 1941)**
Host: *Triportheus paranensis* (Günther, 1874)
Site of infection: foregut
Location: Middle Paraná River (Corrientes City, Corrientes Province)
Refs.: Hamann (1988)

***Creptotrematina dissimilis* (Freitas, 1941)**
Host: *Astyanax bimaculatus* (Linnaeus, 1758)
Site of infection: small intestine
Location: Paraná River (Corrientes City, Corrientes Province)
Refs.: Hamann (1983)

Family Angiodityidae (Looss, 1902)
***Curumai curumai* (Travassos, 1961)**
Host: *Colossoma mitrei* (Berg, 1895)
Site of infection: intestine
Location: Middle Paraná River (Corrientes City, Corrientes Province)
Refs.: Hamann (1982a)

Family Bucephalidae (Poche, 1907)
***Prosorhynchoides cambapuntaensis* (Lunaschi, 2004)**
Host: *Salminus brasiliensis* (Cuvier, 1816)
Site of infection: intestine
Location: Paraná River (Corrientes Province)
Refs.: Lunaschi (2004)

Table 1. Contd.

***Rhipidocotyle santanaensis* (Lunaschi, 2004)**
Host: *Acestrorhynchus pantaneiro* (Menezes, 1992)
Site of infection: caeca
Location: Paraná River (Santa Ana City, Corrientes Province)
Refs.: Lunaschi (2004)

Family Cladorchiidae (Fischoeder, 1901)
***Dadaytrema oxycephala* (Diesing, 1836)**
Hosts: *Colossoma mitrei; Pterodoras granulosus*
Site of infection: intestine
Location: Middle Paraná River (Corrientes City, Corrientes Province); Paraná and Paraguay River (in area of confluence, Corrientes Province)
Refs.: Hamann (1982a, b)

***Travassosinia dilatata* Daday, 1907**
Hosts: *Colossoma mitrei; Pterodoras granulosus*
Site of infection: intestine
Location: Middle Paraná River (Corrientes City, Corrientes Province); Paraná and Paraguay River (in area of confluence, Corrientes City, Corrientes Province)
Refs.: Hamann (1982a, b)

Family Diplostomidae Poirier, 1886
***Diplostomulum gymnoti* (Szidat, 1969)** metacercariae
Host: *Gymnotus carapo*
Site of infection: brain (metacercariae cysts)
Location: Salta the Old Lagoon (Resistencia City, Chaco Province)
Refs.: Szidat (1969)

***Neodiplostomulum gymnoti* (Szidat, 1969)** metacercariae
Host: *Gymnotus carapo*
Sites of infection: peritoneum and adipose tissue of the visceral cavity (metacercariae cysts)
Location: Salta the Old Lagoon (Resistencia City, Chaco Province)
Refs.: Szidat (1969)

***Sphinclerodiplostomum musculosum* (Dubois, 1936)**
Host: *Hoplias malabaricus* (Bloch, 1794)
Site of infection: orbits (metacercariae cysts)
Location: Salta the Old Lagoon (Resistencia City, Chaco Province); Chaco Province
Refs.: Szidat (1969), Lunaschi and Drago (2006)

Family Fellodistomidae (Nicoll, 1913)
***Kalipharynx piramboae* (Boeger and Thatcher, 1983)**
Host: *Lepidosiren paradoxa* (Fitzinger, 1837)
Site of infection: intestine
Location: ¿? (Chaco Province)
Refs.: Lunaschi (1994)

Family Halipegidae (Poche, 1926)
***Genarchella genarchella* (Travassos, 1928)**
Hosts: *Ageneiosus brevifilis; Auchenipterus nigripinnis; Leporinus obtusidens; Luciopimelodus pati; Oligosarcus jenynsii* (Günther, 1864); *Paulicea luetkeni; Pimelodus albicans; P. clarias; Pseudoplatystoma corruscans; P. fasciatum; Salminus brasiliensis; Sorubim lima*
Sites of infection: esophagus and stomach
Location: Middle Paraná RIVER (Italia Port, Corrientes City, Corrientes Province)

Table 1. Contd.

Refs.: Hamann (1986a

***Genarchella parva* (Travassos et al., 1928)**
Hosts: *Auchenipterus nigripinnis; A. nuchalis; Luciopimelodus pati; Pimelodus albicans; P. clarias; P. ornatus* (Kner, 1858*); Pimelodella gracilis* (Valenciennes, 1836)*; P. howesi* (Fowler, 1940)*; Pseudoplatystoma corruscans*
Sites of infection: esophagus and stomach
Location: Middle Paraná River (Italia Port, Corrientes City, Corrientes Province)
Refs.: Hamann (1989)

***Genarchella szidati* (Yamaguti, 1971)**
Hosts: *Jenynsia lineata* (Jenyns, 1842)*; Salminus brasiliensis; Triportheus paranensis*
Site of infection: stomach
Location: Middle Paraná River (Italia Port, Corrientes City, Corrientes Province)
Refs.: Hamann (1989)

Family Haploporidae (Nicoll, 1914)
***Chalcinotrema salobrensis* (Freitas, 1947)**
Host: *Colossoma mitrei*
Site of infection: small intestine
Location: Paraná River (Corrientes City, Corrientes Province)
Refs.: Hamann (1983)

***Saccocoelioides elongatus* (Szidat, 1954)**
Host: *Prochilodus lineatus* (Valenciennes, 1836)
Site of infection: small intestine
Location: Paraná and Paraguay River (in area of confluence, Corrientes Province)
Refs.: Hamann (1982c)

***Saccocoelioides szidati* (Travassos et al., 1969)**
Host: *Leporinus obtusidens*
Site of infection: intestine
Location: Paraná River (Corrientes City, Corrientes Province)
Refs.: Hamann (1983)

Family Proterodiplostomidae (Dubois, 1936)
Subfamily Proterodiplostominae (Dubois, 1936)
***Herpetodiplostomulum gymnoti* (Szidat, 1969)** metacercariae
Host: *Gymnotus carapo*
Site of infection: skin, particularly of the head (with metacercariae cysts)
Location: Salta the Old Lagoon (Resistencia City, Chaco Province)
Refs.: Szidat (1969)

Family Strigeidae (Railliet, 1919)
***Cystodiplostomulum gymnoti* (Szidat, 1969)** metacercariae
Host: *Gymnotus carapo*
Site of infection: body musculature (metacercariae cysts)
Location: Salta the Old Lagoon (Resistencia City, Chaco Province)
Refs.: Szidat (1969)

***Tetracotyloides gymnoti* (Szidat, 1969)** metacercariae
Host: *Gymnotus carapo*
Sites of infection: brain, vitreous and orbits (metacercariae free)
Location: Salta the Old Lagoon (Resistencia City, Chaco Province)
Refs.: Szidat (1969)

Table 1. Contd.

***Tylodelphylus jenynsiae* (Szidat, 1969)** metacercariae
Host: *Jenynsia lineata*
Site of infection: visceral cavity (metacercariae)
Location: Salta the Old Lagoon (Resistencia City, Chaco Province)
Refs.: Szidat (1969)

***Tylodelphylus* s Province1 (Szidat, 1969)** metacercariae
Host: *Hoplias malabaricus*
Site of infection: brain (metacercariae cysts)
Location: Salta the Old Lagoon (Resistencia City, Chaco Province)
Refs.: Szidat (1969)

Digenea n.n.
Host: *Aequidens portalegrensis*
Site of infection: gills (cysts)
Location: Riachuelo River Lagoon (Corrientes City, Corrientes Province)
Refs.: Domitrovic (1998)

Superphylum Aschelminthes
Phylum Nematoda (Rudolphi, 1808; Lankester, 1877)
Class Adenophorea (Linstow, 1905)
Order Enoplida (Filipjev, 1929)
Superfamily Dioctophymatoidea (Railliet, 1916)
Family Dioctophymatidae (Railliet, 1915)
***Eustrongylides* s Province (Jägerskiöld, 1909)**
Host: *Serrasalmus spilopleura* (Kner, 1858)
Site of infection: visceral cavity (encysted larvae)
Location: Riachuelo River Lagoon (27°20´S - 57°30´W), Corrientes Province
Refs.: Ramallo and Torres (1995)

Class Secernentea (Linstow, 1905)
Order Ascaridida (Skrjabin et Schulz, 1940)
Superfamily Ascaridoidea (Railliet et Henry, 1915)
Family Anisakidae (Railliet et Henry, 1912)
Subfamily Anisakinae (Railliet et Henry, 1912)
***Contracaecum* s Province (Larvae and Henry, 1912)**
Host: *Serrasalmus spilopleura*
Site of infection: intestinal mesenteries
Location: Riachuelo River Lagoon (27°20´S - 57°30´W), Corrientes Province
Refs.: Ramallo and Torres (1995), Hamann (1999a)

Subfamily Goeziinae (Travassos, 1919)
***Goezia spinulosa* Diesing, 1839**
Host: *Pseudoplatystoma corruscans*
Site of infection: stomach
Location: Paraná River (in area of confluence, Corrientes Province)
Refs.: Hamann (1984)

Superfamily Cosmocercoidea (Railliet, 1916)
Family Atractidae Railliet, 1917
***Klossinemella iheringi* (Travassos et al., 1928)**
Host: *Pterodoras granulosus*
Site of infection: intestine

Table 1. Contd.

Location: Paraná River (in area of confluence, Corrientes Province)
Refs.: Hamann (1982b, 1995: 6)

***Rondonia rondoni* (Travassos, 1920)**
Hosts: *Colossoma mitrei; Pterodoras granulosus*
Site of infection: intestine
Location: Paraná River (in area of confluence, Corrientes Province); Corrientes Province
Refs.: Hamann (1982a, b, 1995, 1996)

Family Kathlaniidae (Lane, 1914)
***Spectatus spectatus* (Travassos, 1923)**
Hosts: *Colossoma mitrei; Pterodoras granulosus*
Site of infection: intestine
Location: Paraná River (in area of confluence, Corrientes Province); Corrientes Province
Refs.: Travassos (1923), Travassos et al. (1939) and Hamann (1982a, b)

Superfamily Seuratoidea (Hall, 1916)
Family Cucullanidae (Cobbold, 1864)
***Cucullanus paulicea* (Vaz and Pereira, 1934)**
Host: *Paulicea luetkeni*
Site of infection: Small and large intestine
Location: Paraná River (in area of confluence, Corrientes Province)
Refs.: Hamann (1984)

***Cucullanus pinnai* (Travassos et al., 1928)**
Hosts: *Luciopimelodus pati; Pimelodus albicans; P. clarias; Pseudoplatystoma corruscans*
Site of infection: intestine
Location: Middle Paraná River (Corrientes City, Corrientes Province)
Refs.: Hamann (1985)

Order Spirurida (Chitwood, 1933)
Superfamily Camallanoidea (Railliet et Henry, 1915)
Family Camallanidae (Railliet et Henry, 1915)
Subfamily Procamallaninae (Yeh, 1960)
***Procamallanus (Spirocamallanus) inopinatus* (Travassos et al., 1928)**
Hosts: *Brycon orbygnianus* (Valenciennes, 1850); *Ephyppicharax orbicularis paraguayensis* (Valenciennes, 1850); *Leporinus maculatus* (Müller and Troschel, 1844)*; L. obtusidens; Luciopimelodus pati; Pseudoplatystoma corruscans; Serrasalmus marginatus* Valenciennes, 1836*; S. nattereri* (Kner, 1858); *S. spilopleura*
Sites of infection: anterior intestine and pyloric caeca, intestine
Location: Perez and Totora Lagoon, Riachuelo basin; Riachuelo River Lagoon (27°20´S - 57°30´W), Corrientes Province
Refs.: Hamann (1982a, 1986b, 1995, 1996, 1999b)

***Procamallanus (Spirocamallanus) rarus* (Travassos et al., 1928**
Host: *Pimelodus albicans*
Sites of infection: Small and large intestine
Location: Paraná River (in area of confluence), Corrientes Province
Refs.: Hamann (1984)

Superfamily Habronematoidea Chitwood et Wehr, 1932
Family Cystidicolidae Skrjabin, 1946
***Spinitectus asperus* (Travassos et al., 1928)**
Host: *Prochilodus lineatus*
Site of infection: cardiac stomach
Location: Paraná River (in area of confluence, Corrientes Province)

Table 1. Contd.

Refs.: Hamann (1982c)

Superphylum Gnathifera
Phylum Acanthocephala (Kohlreuther, 1771)
Class Palaeacantocephala (Meyer, 1931)
Order Echinorhynchida (Southwell and Macfie, 1925)
Family Cavisomidae (Meyer, 1932)
***Paracavisoma impudica* (Diesing, 1851) syn. *Echinorhynchus impudicus* (Diesing, 1851)**
Host: *Oxydoras kneri* (Bleeker, 1862)
Site of infection: Intestine
Location: Paraná River (in area of confluence), Corrientes Province
Refs.: Kritscher (1957), Hamann (1982b)

Family Echinorhynchidae (Cobbold, 1876)
***Echinorhynchus jucundus* (Travassos, 1923)**
Host: *Colossoma mitrei*
Site of infection: intestine
Location: Middle Paraná River (Corrientes City, Corrientes Province)
Refs.: Hamann (1982a)

Class Eoacanthocephala (Van Cleave, 1936
Order Neoechinorhynchida (Southwell and Macfie, 1925)
Family Neoechinorhynchidae (Ward, 1917)
***Gracilisentis variabilis* (Diesing, 1856) Syn. *Neoechinorhynchus variabilis* (Diesing, 1856)**
Host: *Prochilodus lineatus*
Site of infection: small intestine
Location: Paraná River (in area of confluence), Corrientes province
Refs.: Nickol and Thatcher (1971) and Hamann (1982c)

Superphylum Eutrochozoa
Phylum Annelida (Lamarck, 1809)
Class Clitellata (Lamarck, 1818)
Subclass Euhirudinea (Lukin, 1956)
Order Rhynchobdellida (Blanchard, 1894)
Family Piscicolidae (Johnston, 1865)
Subfamily Platybdellinae (Epshtein, 1970)
***Mizobdella platensis* (Cordero, 1933)**
Host: *Hoplias malabaricus*
Site of infection: fins
Location: Rivers near Entre Ríos and Santa Fe Province
Refs.: Cordero (1933), Lopretto (1995)

Phylum Mollusca (Linnaeus, 1758; Cuvier, 1795)
Mollusca n.n.
Host: *Aequidens portalegrensis*
Site of infection: gills (glochids)
Location: Riachuelo River Lagoon (Corrientes Province)
Refs.: Domitrovic (1998)

Superphylum Panarthropoda
Phylum Arthropoda (Latreille, 1829)
Superclass Crustacea (Pennant, 1777)
Class Maxillopoda (Dahl, 1956)

Table 1. Contd.

Subclass Copepoda (Milne-Edwards, 1840)
Order Cyclopoida (Burmeister, 1834)
Family Lernaeidae (Cobbold, 1879)
***Lernaea argentinensis* (Paggi, 1972)**
Host: *Pseudoplatystoma corruscans; P. fasciatum*
Site of infection: branchial chamber edges and inside of operculum
Location: Colastiné, Coronda and Salado River, Santa Fe province; Paraná River, Paraná City, Entre Ríos Province
Refs.: Paggi (1972)

***Taurocherus tarangophilus* (Paggi, 1976)**
Host: *Hoplias malabaricus*
Site of infection: outer surface of operculum
Location: Posta Old Lagoon island (Santa Fe province)
Refs.: Paggi (1976b)

Family Ergasilidae (von Nordmann, 1832)
***Therodamas fluviatilis* (Paggi, 1976)**
Hosts: *Apareiodon affinis* (Steindachner, 1879)*; Cheirodon piaba* (Lütken, 1875)*; Thoracocharax stellatus* (Kner, 1858)*; Leporinus* s Province Juvenil Agassiz in Spix and Agassiz (1829)
Sites of infection: body surface area, floor of mouth, opercula
Location: Salado River (Santo Tomé City, Santa Fe Province)
Refs.: Paggi (1976a)

Ergasilidae n.n.
Host: *Aequidens portalegrensis*
Site of infection: gill filaments
Location: Riachuelo River Lagoon, Corrientes Province
Refs.: Domitrovic (1998)

Subclase Branchiura (Thorell, 1864)
Orden Arguloida (Yamaguti, 1963)
Familia Argulidae (Leach, 1819)
***Argulus nattereri* (Heller, 1913)**
Hosts: *Pimelodus albicans; Pseudoplatystoma corruscans; P. fasciatum*
Site of infection: body surface
Location: Ysoró stream (Cuatro Bocas City, Corrientes Province); Paraná River (Entre Ríos Province)
Refs.: Barzanti (1976)

***Argulus paranensis* (Ringuelet, 1943)**
Host: *Salminus brasiliensis*
Site of infection: body surface
Location: Las Conchas stream (Paraná City, Entre Ríos Province)
Refs.: Ringuelet (1948)

***Argulus pestifer* (Ringuelet, 1948)**
Host: *Pseudoplatystoma corruscans*
Site of infection: body surface
Location: Ysoró stream (Cuatro Bocas City, Corrientes Province)
Refs.: Ringuelet (1948) and Barzanti (1976)

Table 1. Contd.

***Argulus salminei* (Kroyer, 1863)**
Hosts: *Pimelodus albicans; PROVINCE clarias; Pseudopimelodus zungaro* (Humboldt, 1821)*; Salminus brasiliensis*
Site of infection: body surface
Location: Paraná River; Gualeguaychú River (Entre Ríos Province)
Refs.: Ringuelet (1948), Barzanti (1976)

***Argulus cf. violaceus* (Thomsen, 1925)**
Host: *Serrasalmus spilopleura*
Site of infection: body surface
Location: Riachuelo River Lagoon (27°20´S - 57°30´W), Corrientes Province
Refs.: Hamann (1995/6)

***Dipteropeltis hirundo* (Calman, 1912)**
Host: *Salminus brasiliensis*
Site of infection: body surface
Location: Las Conchas stream (Paraná City, Entre Ríos Province)
Refs.: Ringuelet (1948)

***Dolops cf. bidentata* (Bouvier, 1899)**
Host: *Serrasalmus spilopleura*
Site of infection: body surface
Location: Riachuelo River Lagoon (27°20´S - 57°30´W), Corrientes Province
Refs.: Hamann (1995/6)

***Dolops cf. Carvalhoi* (Lemos de Castro, 1949)**
Host: *Serrasalmus spilopleura*
Site of infection: body surface
Location: Riachuelo River Lagoon (27°20´S - 57°30´W), Corrientes Province
Refs.: Hamann (1995, 1996)

***Dolops longicauda* (Heller, 1857)**
Hosts: *Potamotrygon s Province* (Garman, 1877)*; Pseudoplatystoma corruscans; P. fasciatum; Salminus brasiliensis*
Site of infection: body surface
Location: Mamachepa stream (31°43'S - 60°47' W), Paraná, Colastiné and San Javier River (Santa Fe Province); Las Conchas stream and Paraná River (Paraná City, Entre Ríos Province); Ysoró stream (Cuatro Bocas City) and Paraná River (Bella Vista City), Corrientes Province
Refs.: Ringuelet (1948), Barzanti (1976)

***Dolops striata* (Bouvier, 1899)**
Host: *Hoplias malabaricus*
Site of infection: body surface
Location: Guadalupe Lagoon and Coronda River (Santa Fe Province)
Refs.: Barzanti (1976)

Class Malacostraca (Latreille, 1802)
Subclass Eumalacostraca (Groben, 1892)
Superorder Peracarida (Calman, 1904)
Order Isopoda (Latreille, 1817)
Suborder Flabellifera (Sars, 1882)
Family Cymothoidae (Leach, 1818)

Table 1. Contd.

***Braga fluviatilis (*Richardson, 1911)**
Host: *Serrasalmus spilopleura*
Sites of infection: body surface tegument, fins and cavities
Location: Riachuelo River Lagoon (27°20´S - 57°30´W); Ramada Paso and Aeroclub Lagoon, Riachuelo River, Corrientes Province
Refs.: Hamann (1995, 1996, 1997, 1998)
***Isonebula maculatus* (Taberner, 1977)**
Host: *Metynnis maculatus* (Kner, 1860)
Sites of infection: body surface and oral cavity
Location: Esteros del Riachuelo and Itatí Crossing (Corrientes Province)
Refs.: Taberner (1977, 1979, 1982)
***Paracymothoa oliverosae* Grassini, 1992**
Host: *Holoshestes pequira* (Steindachner, 1882)
Site of infection: oral cavity
Location: El Tigre Lagoon, Middle Paraná River (31°41´S - 60°42´W), Santa Fe Province
Refs.: Grassini (1992)
***Paracymothoa parva* (Taberner, 1976)**
Host: *Hyphessobrycon callistus* (Boulenger, 1900)
Site of infection: oral cavity
Location: Itatí Crossing (Corrientes Province)
Refs.: Taberner (1976)
Isopoda n.n. (Audouin and Savigny, 1825)
Host: *Aequidens portalegrensis*
Site of infection: gills filaments
Location: Riachuelo River Lagoon (Corrientes Province)
Refs.: Domitrovic (1998)
(*) In the original paper only reports that these species were caught in the Paraná River System. They are included here because they are typical of the Middle Paraná.

ecological value due to their different roles in the trophic chains, their migratory dynamics in the alluvial valley and interactions that they are part of.

The cestode ichthyoparasites constitute one of the most studied taxa of the region. These contributions were mainly made by fish of the order Siluriformes. However, little is known about the rest of the ichthyc families. The Digenea constitute the most studied group, and this is of direct or indirect relevance for health reasons because they often include in their life cycles the infections of ground vertebrates (birds, mammals) which are consumed by human beings. Efforts will be required to gather information about them to determine which ones are the zoonotic species. This reason also applies to the Nematoda, which have been even less studied.

The places where the species were caught are also not enough to represent the environmental diversity of the Middle Paraná and its valley. Further research is needed on permanent lagoons, affluent streams and secondary branches of the system.

To understand the role of the community of parasites in an ecosystem, previous knowledge of the species that compose it is required. Conducting further studies using taxonomic and systematic approaches is the key to understanding how biotic and abiotic factors affect species, since there is no way to understand the effects on a population without knowing the species (Takemoto et al., 2009).

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