

ORIGINAL ARTICLE / ARTÍCULO ORIGINAL

SCIENTOMETRIC STUDY ON THE PARASITOLOGY OF FRESHWATER FISH IN BRAZIL

ESTUDIO CIENTOMÉTRICO EN PARASITOLÓGÍA DE PECES DE AGUA DULCE EN BRASIL

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Abstract

This study presents the current state of research of freshwater fishes' parasites in Brazil, exploring the watersheds requiring further studies. The articles used were obtained through searching the databases ISI and SciELO, as well as direct search in the Curricula Vitae of researchers in this area. The survey was conducted during the month of March 2012 and 685 articles were obtained. The most studied group was Monogenea. Taxonomy was the most common studied subject. The most reported river basin is the Amazon region and the region of Parana. The largest concentration of periodic articles was Memórias do Instituto Oswaldo Cruz. Most articles were published in journals with Qualis B1 and B2 and without impact factor. More than half of the articles were found in the Curriculum of researchers. It is believed that this information will contribute to the knowledge of the available literature on this subject, offering subsidies to agencies that support research in the country and identifying geographical sampling gaps. Moreover, it allows the design of future biogeographic and ecological studies in order to assist in understanding the patterns of biological diversity of several groups of parasites in Brazil.

Keywords: Brazil - database - journal - parasite - quails - region.

Resumen

Este estudio presenta la situación de la investigación de parásitos de peces de agua dulce en Brasil, indicando las cuencas hidrográficas y las áreas que requieren más estudios. Los artículos utilizados fueron obtenidos a través de búsquedas en las bases de datos ISI y SciELO, así como en el Curriculum Vitae de los investigadores en esta área. La búsqueda fue conducida durante el mes de Marzo 2012 y 685 artículos fueron obtenidos. El grupo más estudiado fue Monogenea y taxonomía fue el tema más estudiado. Con respecto a la cuenca del río más estudiados destacan la región amazónica y la región de Paraná. La mayor concentración de artículos fue en el periódico Memórias del Instituto Oswaldo Cruz. La mayoría de los artículos fueron publicados en revistas con Qualis B1 y B2 y sin factor de impacto. Más de la mitad de los artículos fueron encontrados en la hoja de vida de los investigadores. Creemos que esta información contribuirá al conocimiento de la literatura disponible sobre el tema, que ofrece subsidios a las agencias que apoyan la investigación en el país y a la identificación de brechas de muestreo geográficas. Además, permite el diseño de futuros estudios biogeográficos y ecológicos con el fin de ayudar en la comprensión de los patrones de diversidad biológica de varios grupos de parásitos en Brasil.

Palabras clave: base de datos - parásito - periódicos - qualis - región.

INTRODUCTION

Brazil has large spatial variability in water availability (Leal, 1998), with a land area exceeding 8,000,000 Km², with about 20% of global freshwater (Bizerril & Primo, 2001). The distribution of these resources in the country and throughout the year is not uniform, there are extremes of excess water in the Amazon and limitations of availability in the Northeast (Tucci *et al.*, 2001) and major climate changes in particular in the South (Marengo & Valverde, 2007).

In the Neotropical region there are recorded 4035 species of freshwater fish (Lévêque *et al.*, 2008), and the vast majority, 2587, occur in Brazilian rivers (Buckup *et al.*, 2007). However, only a small number of these fish species were necropsied in order to analyze the parasites in their various aspects (Eiras *et al.*, 2010). Species diversity of freshwater fish in Brazil together with the fact that each species is parasitized by an usually high number of parasites, shows that the diversity of parasite fauna of Brazil is very expressive (Eiras *et al.*, 2010). In recent years there has been an increase in production quality literature on the subject in the country, with descriptions of new species, key to the knowledge of biodiversity, but combined with more sophisticated analyzes, trying to explain the details of host-parasite relationships, and to characterize the pathologies and propose preventive measures to control these parasites.

Despite the difficulty in obtaining information about the first scientific research done in Brazil in relation to parasites of freshwater fish, no doubt about the importance of the expeditions made by the naturalist Johann Natterer collecting different groups of parasites in several Brazilian states. These shipments occurred between 1817 to 1835, and the specimens were first studied by Diesing (Diesing, 1851, 1856).

In 1913, a leading researcher at the Instituto Oswaldo Cruz (Manguinhos) in the state of Rio de Janeiro, Lauro Travassos began his studies with the fauna of parasites of vertebrates, including fish. Over the years described several

genera and species of parasites, becoming internationally known as the "Father of the Brazilian Helminthology". Among these publications, there is a landmark of Brazilian parasitology, helminth fauna of freshwater fish in Brazil, published in 1928 by Travassos, Artigas and Pereira in the Archives of the Biological Institute.

Necessary to mention the contributions of leading researchers in the study of these parasites Boeger, W. A.; Chubb, J. C.; Cohen, S. C.; Crane, J. W.; Eiras, J. C.; Fernandes, B. M. M.; Freitas, T.; Gibson, D. I.; Kohn, A.; Kritsky, D. C.; Luque, J. L.; Machado Filho, D. A.; Mizelle, J. D.; Molnár, K.; Moravec, F.; Pinto, R. M.; Rego, A. A.; Santos, C. P.; Tavares, L. E. R.; Thatcher, V. E.; Travassos, J. F. L.; Vicente, J. J.; Woodland, W. N. F (Woodland, 1934; Machado Filho, 1947; Mizelle *et al.*, 1968; Travassos *et al.*, 1969; Kristky *et al.*, 1986; Thatcher, 1991; Kohn & Cohen, 1998; Moravec, 1998; Rego *et al.*, 1999; Vicente & Pinto, 1999; Eiras *et al.*, 2005; Kohn *et al.*, 2007; Luque & Tavares, 2007; Santos *et al.*, 2008). Besides the authors cited above, should also be noted the significant recent contributions of some researchers: Adriano, E. A.; Amato, J. F. E.; Azevedo, C.; Brooks, D.; Brazil Sato, M. C.; Cecarelli, P. S.; Chambrier, A.; Chubb, J. C.; Lizama, M. de los Angeles, Malta, J. C. O.; Marques, F. P. L.; Martins, M. L.; Sholz, T.; Varella, A. M. B. among others.

According to Tague-Sutcliffe (1992) scientometrics is the study of the quantitative aspects of science as a discipline or economic activity. It is applied in the development of science policy and involves quantitative studies of scientific activities, including the publication. With the increase of available literature, this new tool has been widely used to try to understand real direction of the studies in several areas of scientific knowledge (Kopp *et al.*, 2007).

This research presents the state-of-the-art of parasites of freshwater fish in Brazil, indicating the basins and areas requiring further ecological studies, coupled with the effort of actions aimed at increasing knowledge of parasite biodiversity.

It is expected that the northeast region has the lowest number of articles, as the number of researchers is reduced. This information will contribute to the knowledge of the available literature on this topic, and provide subsidies for research funding agencies in the country. This will also allow the design of future ecological and biogeographical studies, in order to assist in the understanding of patterns of biological diversity of the various groups of parasites.

MATERIALS AND METHODS

The articles used in this study were obtained mainly from the databases of the ISI (Institute for Scientific Information; www.isiknowledge.com) and SciELO (Scientific Electronic Library Online; www.scielo.org) during the month of March 2012.

The key words used in the search for articles made reference to parasites of freshwater fish in Brazil, having been used the following terms in both English and in Portuguese: fish* parasit* Brazil*; for searches following substituted the word Brazil by the name of every river basin in Brazil (Amazon, Tocantins-Araguaia, North-East Atlantic West, San Francisco, Paraná, Paraguay, Parnaíba, Uruguay, Eastern Northeast Atlantic, Eastern Atlantic, Southeast Atlantic, total = 11) classified by the National Water Agency-ANA. Then replaces "parasitoid" prefixes by 13 groups of parasites (Amoebae, Flagellate, Apicomplexa, Ciliophora, Myxozoa, Monogenea, Digenea, Cestoda, Nematoda, Acanthocephala, Hirudinea, Crustacea, Mollusca) according to Eiras *et al.* (2010). This search was done in "Topic" field of the ISI and SciELO database. After research in databases, the survey was conducted to Curriculum vitae of researchers in this area, and consider the references to checklists of major groups.

Of the articles analyzed, data were obtained for the year of publication, a group of parasites, subject matter, river basin, journal, impact factor

(year 2012) and database. Then we investigated the Qualis in which the journals were published the articles analyzed (year 2012). The Qualis is a set of procedures used by CAPES (Brazilian Coordination of Improvement of Higher Education Personnel), linked to the Ministry of Education – MEC and CNPq (National Council for Scientific and Technological Development) affect the Ministry of Science, Technology and Innovation - MCTI, in order to assess the quality of articles, from the analysis of the quality of scientific journals. This survey was conducted using the application WebQualis, which frames the journals in different fields of knowledge in strata indicative of quality - A1, the highest standard, followed by A2, B1, B2, B3, B4, B5, C - with zero weight. For this work, the area of Capes was consulted on Biodiversity.

The articles were analyzed from 1856, the first record of the matter, until 2012, the year in which the survey was conducted.

RESULTS

The results here obtained show that the number of articles published in the area of freshwater fishes' parasites is growing significantly in Brazil, especially from the 80s, and recorded until 2012 a total of 685 articles (Fig. 1). The most studied group of parasitic was Monogenea, together Fauna (articles involving more than one parasite group) (35%), followed by Crustacea with 15% (Fig. 2).

The issue that stood out in the articles was taxonomy involving descriptions of new species and taxonomic revisions (61%), followed by ecology (15%), occurrence records (13%) and other issues with about 10% of the total (Fig. 3). For regions most studied watersheds include the Amazon region with 212 (31%) articles and the region of Parana with 182 (27%) (Fig. 4).

Of the total number of articles found in this study, 115 are published in the journal Memórias do Instituto Oswaldo Cruz, coming, then the journals Brazilian Journal of Biology (54)

(former Brazilian Journal of Biology), *Acta Amazon* (47) and *Acta Scientiarum* (44) (former UNIMAR). In Other includes journals that had less than 10 published articles (Fig. 5).

As shown in Figure 6, the majority of articles were published in journals with Qualis B1 and B2, representing over 50% of total production, and 20% of the publications can be found in journals of high scientific level (A2) (Fig. 6).

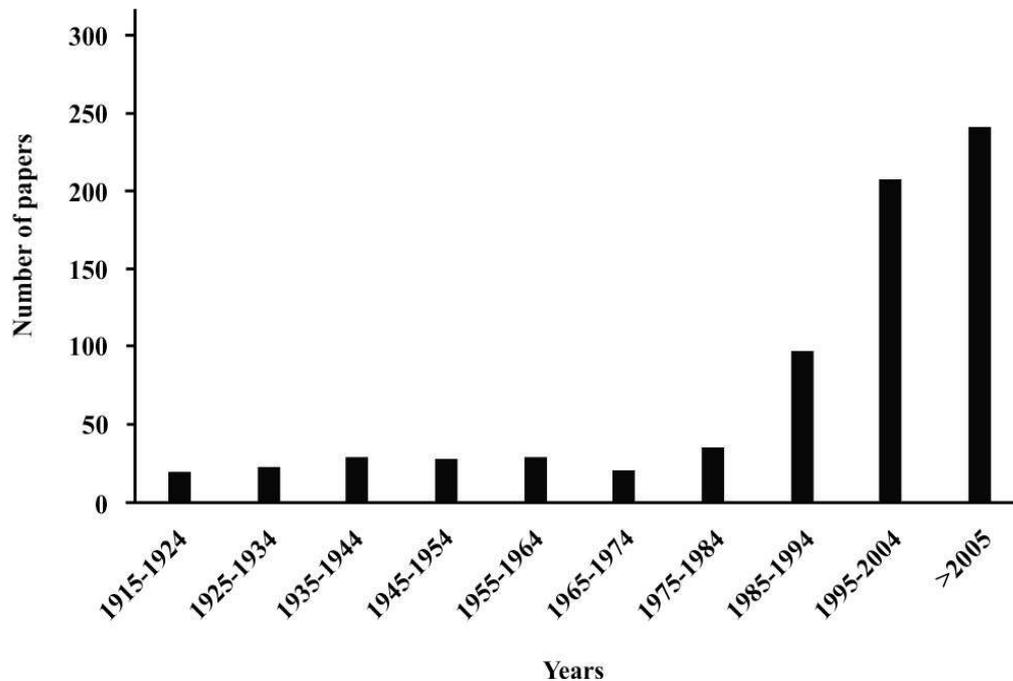


Figure 1. Studies in parasitology of freshwater fish in Brazil, from 1915 to 2012. The reference of Diesing (1856) was not used because it was the only item recorded until 1915.

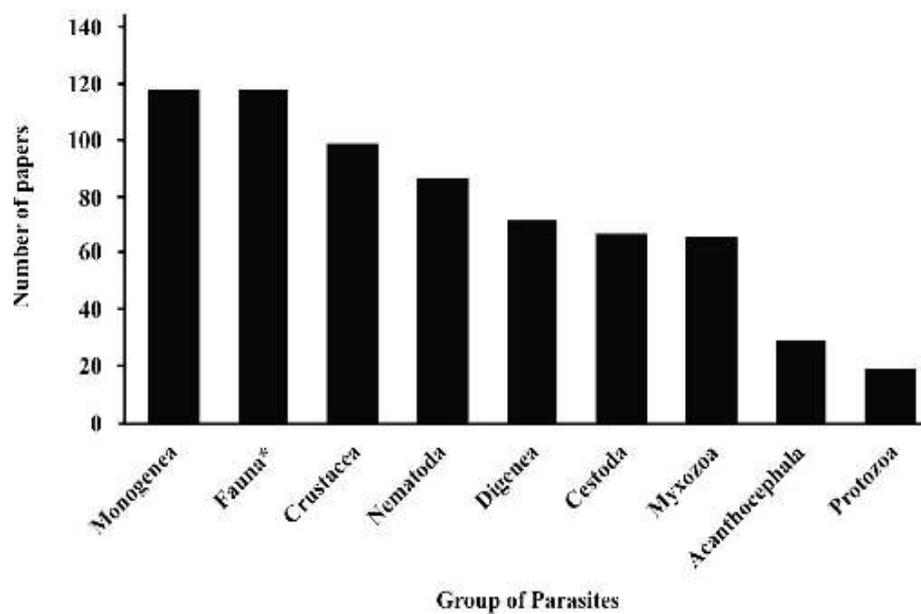


Figure 2. Number of publications by a group of parasites addressed in articles. *Items that have more than one group of parasites.

Regarding the impact factor of the article it appears that most of the articles (39%) is recorded in journals without impact factor, followed by magazines with factors ranging from 0.51 to 1 (24%) and 2.01 to 2.5 (22%) (Fig. 7).

As shown in Figure 8, most of the articles was recorded in Lattes leading researchers in the field (53%), followed by ISI (29%) and Other and Scielo less than 20% (Fig. 8).

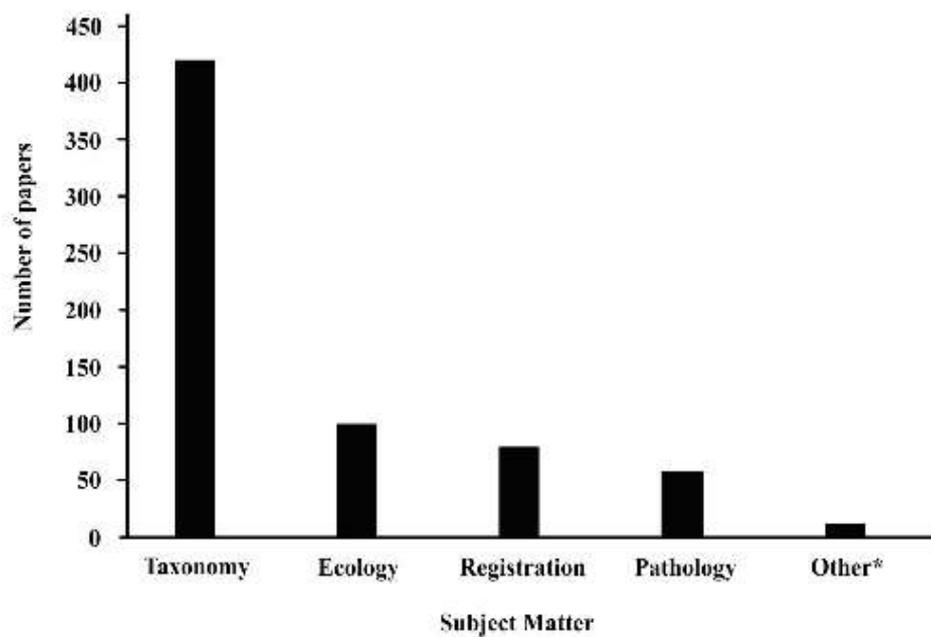


Figure 3. Number of publications by subject matter in scientific articles. * Other issues addressed.

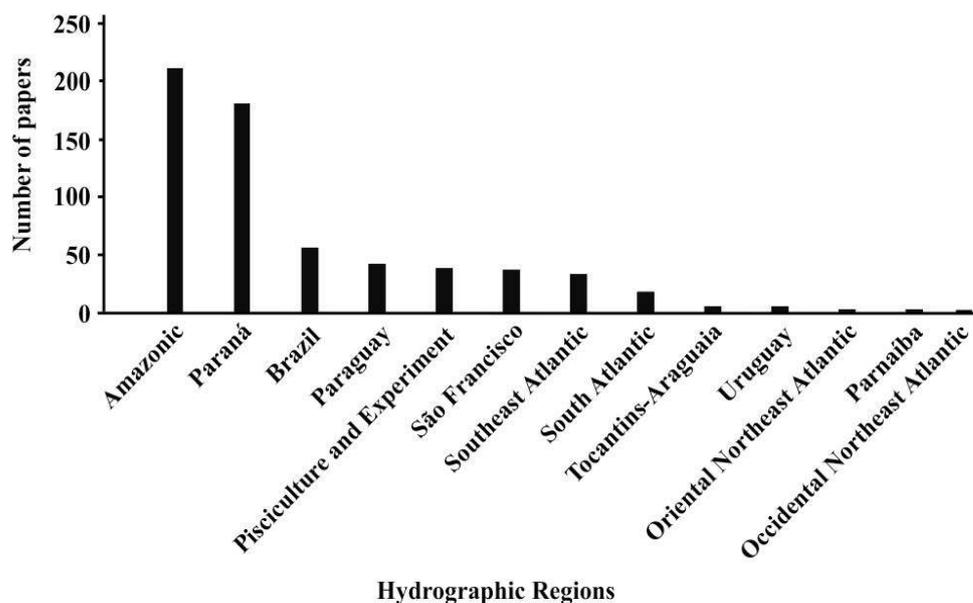


Figure 4. Number of articles published in the river basin of Brazil.

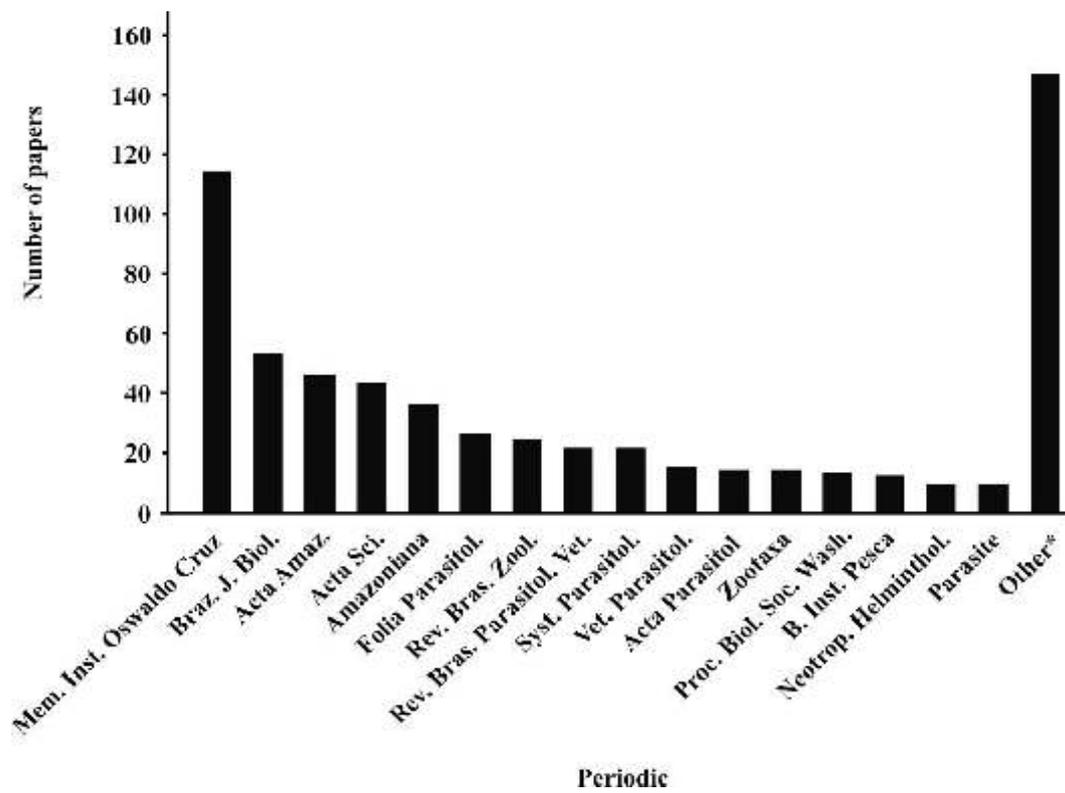


Figure 5. Number of articles published in the area ictioperasitologia in major journals. * Journals with less than 10 publications in the Field.

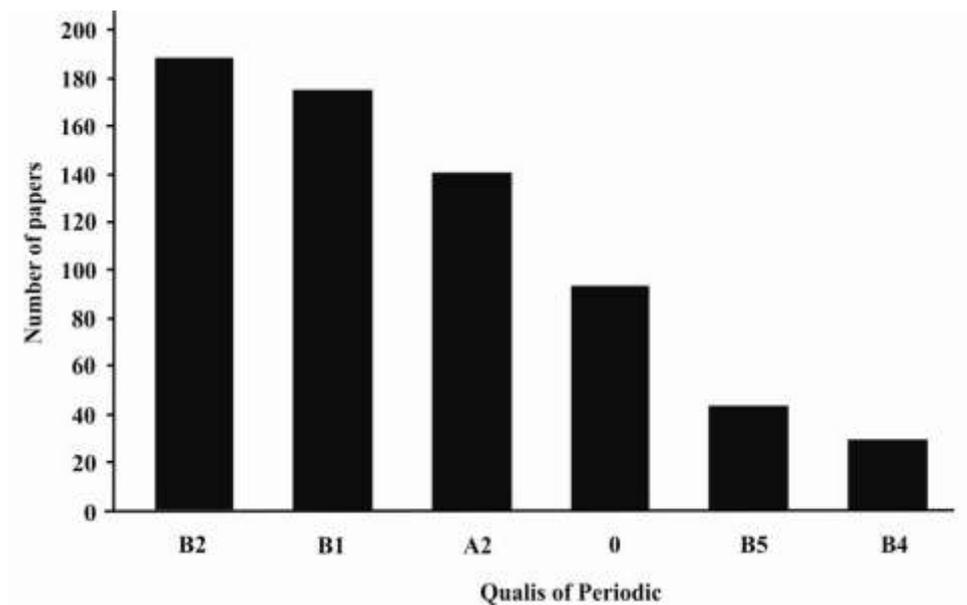


Figure 6. Number of articles from journals and Qualis (area Biodiversity).

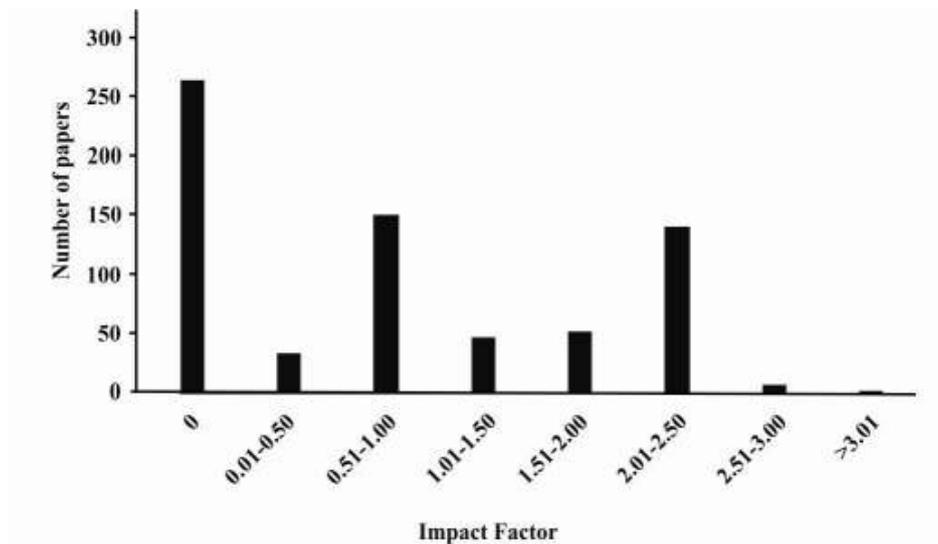


Figure 7. Number of articles and impact factor of scientific journals.

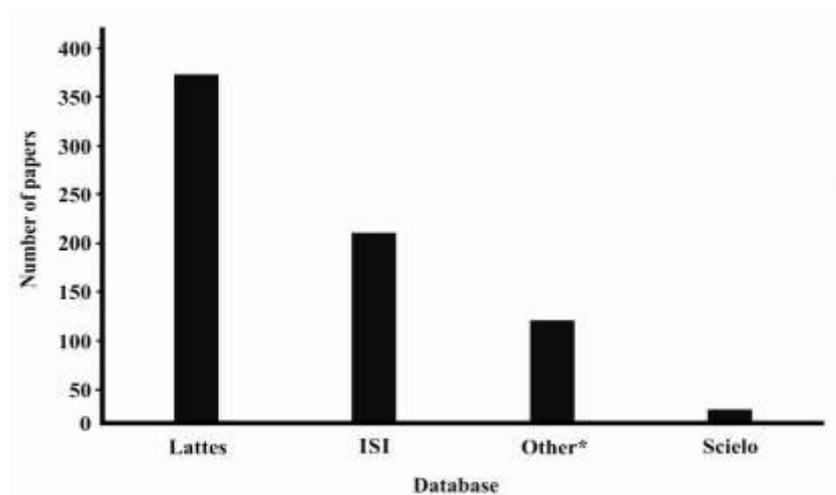


Figure 8. Number of articles published in the area ictioparasitologia and the database where they were registered. * Other items in collections.

DISCUSSION

The number of publications about the parasitology of freshwater fish in Brazil is increasing significantly. This is particularly evident when analyzing the past seven years, since the production in this period exceeds that of the last decade. This can be justified because there is now a consensus on the need and importance of studying the fish more effectively, since it represents a precious natural resource for the country, coupled with the need to understand

the biodiversity of parasites of animals combined with an increase in the number of researchers. However, the number of parasites articles is still very small compared to the fish because of about 2,500 species of fish only 1/4 of them were analyzed for parasites (Eiras *et al.*, 2010). It is known that in Brazil there is urgent need to inventory all basins, coupled with the shortage in the number of researchers and the infrastructure needed for sampling, the small number of inventories carried, the dispersion of information that are often difficult to access and the need to for various taxonomic groups

(Agostinho *et al.*, 2005). This is particularly true in the case of fish parasites Brazil.

It is believed that the greater number of articles which relate Monogenea, is due to the fact that each of tropical fish species have about five Monogenea species being the most prevalent group (Pavanelli *et al.*, 2008). This may be an explanation to justify the results found. As regards the Fauna this happens, since most of the fish is parasitized by more than one group of parasite.

The issue was addressed more to taxonomic aspects, fundamental to the development of any type of biological research. Descriptions of species are absolutely necessary when exploring new areas. The most studied are novel environments, the greater the probability of finding species to be described in science, both as regards the fish and with regard to their parasites. The Brazilian School has always had an emphasis on taxonomy, which is reflected in other areas, leading to formation of researchers to profile systematists. In the taxonomy, ecology has aroused considerable interest, as the system host-parasite model represents a very peculiar ecological relationships, requiring a greater effort to their perfect understanding (Dogiel, 1961). Is important to emphasize the absence of theory in science.

The fact that the Amazon is the most prevalent is mainly due to the existence of the National Institute for Amazonian Research (INPA), which brings together many researchers in this area. But the emphasis on the Parana river basin can be explained mainly by the construction of the Itaipu Hydroelectric Plant in 1982, that has performed scientific cooperation agreements with Nupélia (Research Nucleus in Limnology, Ichthyology and Aquaculture of the Universidade Estadual de Maringá, Paraná), allowing the development of a series of researches on the region, in particular in studies of fish parasites.

It is found that the journals that concentrate most of the articles are the Memórias do Instituto Oswaldo Cruz, Brazilian Journal of Biology.

The first, created by Oswaldo Cruz in 1909, is one of the oldest scientific journals of Latin America and with higher impact factor in Brazil. This may be due to concentration in the Instituto Oswaldo Cruz (IOC) most pioneering researchers of this group of animals. Another magazine is the pioneer in Brazil Brazilian Journal of Biology, which began operations in 1941 and was initially linked to the Brazilian Academy of Sciences.

The large number of articles published in national journals with low impact factor can be explained by the lack of concern of researchers with these old ratings, since only recently CAPES and CNPq began to consider them in evaluation processes of production Brazilian scientific, beyond the restriction of language, since it is hardly used the English language. At the time the main goal that ruled the researchers was just dissemination of the results of their research, beyond the limitations of science in the past.

This result advises that the search for articles related to a particular subject cannot be limited only to databases such as ISI, being necessary to consult the researchers Lattes, otherwise a lot of information is lost. However, it is necessary to emphasize the difficulty of this procedure, since not always known leading researchers in certain areas and there is difficulty in obtaining articles very old.

Thus, it is evident that the majority of published articles are referring to the description of new species, because the vast majority of scientists who began this line of research in Brazil are called naturalists, with a much restricted to the identification of new taxa. Another important perspective is the need to focus efforts to increase awareness of biodiversity coupled with the understanding of relations parasite-host, mainly from the point of view of ecology.

The Northeast recorded the lowest number of scientific information on the parasitic fauna of fish. This can be explained by the limited number of researchers engaged in this line of knowledge and consequently ends up requiring

fewer resources from the public organs. Thus, it is the need for public policies aiming to change throughout the year that this current situation creates gaps in the knowledge of the true biodiversity of parasites of our fish.

It is understood that such studies should be encouraged. In addition to presenting a picture of the current state of the art on the parasites of fishes in Brazil, show the need for substantial efforts to study more intensively the parasites of fish, since this biodiversity is still imperfectly known.

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