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Environmental perception of artisanal fishermen in the region of Ilha Grande National Park, PR/MS, after the formation of the Itaipu reservoir: traditional knowledge and human-nature interaction

Percepção ambiental dos pescadores artesanais da região do Parque Nacional de Ilha Grande, PR/MS, após a formação do reservatório de Itaipu: conhecimentos tradicionais e interação pessoa-natureza

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ABSTRACT

The flooding of the Sete Quedas fall for the formation of the Itaipu hydroelectric power plant, on the Paraná River, had impacts on fishing. The objective of this study was to analyze the environmental perception of fishermen in the region of Ilha Grande National Park, the environmental changes that occurred after the formation of the Itaipu reservoir and their relationship with fishing in the region. Data collection was carried out through interviews, with a semi-structured script approved by the Ethics Committee of Western Paraná State University. This script consisted of 26 questions aimed at identifying the socioeconomic characteristics of the activity and the changes that occurred from 1980 to 2020. Qualitative variables were analyzed. The results showed that fishermen have knowledge and perception of the environmental changes that have occurred in the last 40 years, and of the consequences of these changes in the fishing and housing spaces where they are inserted. Moreover, they demonstrated knowledge about changes in the river bed, in the course and on the banks of the Paraná River, about silting up and the decrease and/or extinction of fish species, in line with what has been found in the scientific literature. Thus, for these artisanal fishermen, the flooding caused social, cultural and economic losses. It is necessary for public authorities to act, supported by scientific information, guiding environmental education actions and measures to mitigate the environmental impacts generated and to support the fishermen.

Keywords: fishing; riverside population; environmental conflicts; traditional ecological knowledge.

RESUMO

O alagamento das Sete Quedas para a formação da usina hidrelétrica de Itaipu, no rio Paraná, gerou impactos sobre a pesca. O objetivo deste estudo foi analisar a percepção ambiental dos pescadores da região do Parque Nacional de Ilha Grande sobre as mudanças ambientais ocorridas após a formação do reservatório de Itaipu e sua relação com a pesca da região. A coleta de dados foi realizada por meio de entrevistas, com roteiro semiestruturado, devidamente aprovado pelo conselho de ética da Universidade Estadual do Oeste do Paraná. Esse roteiro contém 26 perguntas direcionadas ao levantamento das características socioeconômicas da atividade e das alterações ocorridas desde 1980 até 2020. As variáveis qualitativas foram analisadas. Os resultados mostraram que os pescadores possuem conhecimento e percepção sobre as mudanças ambientais ocorridas nos últimos 40 anos e sobre as consequências destas nos espaços de pesca e moradia onde estão inseridos. Demonstraram discernimento sobre as alterações no leito, no curso e nas margens do rio Paraná, sobre assoreamento, bem como ciência da diminuição e/ou extinção de espécies de peixes, alinhados com o encontrado na literatura científica. Assim, para os pescadores artesanais, o alagamento acarretou perdas sociais, culturais e econômicas. Torna-se necessária a atuação dos poderes públicos, amparados por informações científicas, orientando ações de educação ambiental e medidas mitigadoras dos impactos ambientais gerados e de apoio aos pescadores.

Palavras-chave: pesca; população ribeirinha; conflitos ambientais; conhecimento ecológico tradicional.

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Introduction

Aiming at greater economic development between the 1970s and 1980s, the electricity sector took up space in environmental discussions, when the promotion of large hydroelectric projects (Oliveira, 2018) promised to solve the problems of energy demand (Pimentel, 2012). These, despite their importance for the country's economy, brought several environmental, social and political impacts (Suassuna, 2007; Maldaner et al., 2019). Since then, the construction of hydroelectric plants (Pimentel, 2012) is the basis of the country's demand for electricity.

In order to build these plants, it is necessary to modify the course of the rivers, such as by transforming the lotic environment into a semi-lentic one, and this is facilitated by the occurrence of flooding (Agostinho, 1994; Benedito-Cecílio et al., 1997). With flooding, water reservoirs are created for energy production of different proportions (Agostinho and Júlio Jr., 1999; Agostinho et al., 2008), from run-of-river and small reservoirs (Luiz et al., 2003) to large ones, which flood wide areas of the terrestrial environment (Terrin and Blanchet, 2019). Through these floods, changes occur in the water regime and the formation of microclimates which impair the biological diversity present there, and may even extinguish certain species of the fauna and flora (Terrin and Blanchet, 2019).

An example of these large hydroelectric projects is the Itaipu Hydroelectric Plant, which began operating in 1982. It is located on the Paraná River, between Brazil and Paraguay, producing energy that corresponds to 10.8% of the energy produced in Brazil (Itaipu, 2010). However, it replaced the natural obstacle previously represented by the Sete Quedas, and the authorization for this flood was based on studies carried out between 1977 and 1981 (Ribeiro et al., 2012). With its construction, the hydrology of the Paraná River was altered, influencing the entire biota of the river channel and its surroundings, causing major changes in fishing yield and the replacement of fish species that had been caught until then (Agostinho et al., 2008; Hoeinghaus et al., 2009). In addition, traditional riverside populations were displaced from their properties due to the flooding, which reflected in a restructuring of the regional space in terms of population, especially in tourism (Giacomin, 2005) and fishing (Hoeinghaus et al., 2009).

It is noteworthy that the resettlement of riverside communities for the purpose of construction works is an outcome of hydroelectric plant implementation (Guerra and Carvalho, 1995). However, socio-environmental conflicts arise as a result of these endeavors. Due to the flooding of the surrounding areas (especially the Sete Quedas), social, cultural, economic (Giacomin, 2005) and environmental changes took place. Together with the Iguaçu River Falls in Foz do Iguaçu, Paraná, the old Sete Quedas National Park on the border of the states of Paraná and Mato Grosso do Sul, between the cities of Guaíra and Mundo Novo, provided a spectacle of beauty, with some of the most popular venues for tourists from all over Brazil (Schneider, 2009) and the world.

Over the years and with the environmental changes in the region, several species that were commonly captured in abundance by fishermen gave way to introduced species with less economic value (Agostinho and Júlio Jr., 1996; Agostinho et al., 2008; Hoeinghaus et al., 2009; De Paula, 2017). In addition to this economic loss, the fishermen had their customs and knowledge affected by the sudden change in the environment (Paula, 2011). This fact may represent an abrupt change in social and behavioral paradigms, in the face of changes in the natural environment (Guerra and Carvalho, 1995; Giacomin, 2005). In this sense, the knowledge withheld by artisanal fishermen (subsistence fishing), who depend directly on natural resources (Carvalho, 2002; Assis et al., 2020), helps to understand the anthropic impacts and may provide a basis for environmental education actions (Cecchin and Limberger, 2011). Such knowledge is the result of environmental perception and, according to Tuan (1980, p. 284-285), "all men share common attitudes and perspectives, but the vision that each person has of the world is unique and in no way is futile". This means that each individual has their own interpretation of space, according to their reality.

Similarly, environmental perception is portrayed by Silva-Meneses (2018) as knowledge that allows individuals to feel the environment around them, strengthening the community's relationship with nature. For the fishermen, this empirical knowledge of their surroundings is a consequence of the daily use of natural resources. It allows them to formulate their vision of the environment (Carvalho, 2002), which is in turn translated into traditional ecological knowledge that relates the wisdom of riverside dwellers in relation to activities practices exercised with the use and dependence on natural resources (Doria et al., 2014).

The utilization of the term "environmental perception" in studies depicting the relationship between society and the environment, as stated by Randow (2015, p. 18), "contributes to a more rational utilization and management of environmental resources and landscapes, enabling the interplay of local knowledge from the perspective of individuals, communities, or the population as a whole".

From this perspective, "artisanal fishermen are one of the protagonists of this person-environment relationship, and their actions directly influence this environment, therefore their perceptions determine their actions" (Moraes et al., 2018, p. 3). Thus, grasping the environmental perception of this population is important for public management that aims at preservation and environmental education, helping to detect existing problems and, from there, to carry out educational practices (Zeineddine et al., 2022). It is important to always remain attentive to changes that occur in the environment, especially in areas that have been modified by human action. In this sense, the artisanal fishermen who work in the region of Guaíra/PR and Mundo Novo/MS, and who are still active, were and are spectators of these environmental changes.

Given the above, we analyzed the environmental perception of fishermen in the area of the Ilha Grande National Park (IGNP), on the Paraná River, about the changes in fishing in the region after

the formation of the Itaipu reservoir, having as a research problem two basic questions:

- What is the environmental perception of the artisanal fishermen in the IGNP region of the upper Paraná River, in view of the environmental changes of the last 40 years?;
- What is the relationship between the artisanal fishermen and the conservation units on the upper Paraná River?

Methodology

Study area

The study was conducted in the municipalities of Guaíra and Mundo Novo, both located on the banks of the Paraná River, in the transition between the Paraná River and the Itaipu reservoir and the Ilha Grande archipelago, comprising both lotic and semi-lentic stretches of the upper Paraná River.

The municipality of Mundo Novo ("23º 56'03.72" S; "54º 17'19.94" W) has an area of 443 km^2 (Apolo11, 2019a) and approximately 18 thousand inhabitants (IBGE, 2020b). It is located in the extreme south of the state of Mato Grasso do Sul (MS), bordering the state of Paraná and Paraguay.

The municipality of Guaíra (24° 04' 48" S; "54° 15' 21" W) has an area of 504.7 km^2 (Apolo11, 2019b) and approximately 33 thousand inhabitants (IBGE, 2020a). It is located to the west of the state of Paraná (PR), bordering the state of Mato Grosso do Sul and Paraguay. Similar to Mundo Novo, Guaíra also has a privileged fishing area (professional, sports and artisanal). Most of the fishermen in Guaíra are affiliated to the region's fishermen colony, the Z13.

Guaíra and Mundo Novo are among the nine municipalities that border the IGNP. The park was created in September 1997 with the aim of mitigating the social, economic and environmental impacts caused by the formation of the Itaipu reservoir and the extinction of the Sete Quedas, and as an attempt to preserve the natural ecosystems.

Procedures

Forty-four artisanal fishermen were interviewed, 18 from the municipality of Mundo Novo and 26 from the municipality of Guaíra, between July 2019 and July 2020. The interviews were carried out at their homes and at the Z-13 fishermen colony in Guaíra. To carry out the research, a qualitative (descriptive) approach was used, in which the researcher uses a script to subsidize the interview and understand how the object of the research behaves, always paying attention to the opinion of the interviewees (Lüdke and André, 1986). In the same manner, Minayo et al. (2001, p. 22) state that:

> Qualitative research responds to very particular questions. It is concerned, in the social sciences, with a level of reality that cannot be quantified. In other words, it works with the universe of meanings, motives, aspirations, beliefs, values and attitudes, which corresponds to a deeper space of relationships, processes and phenomena that cannot be reduced to the operationalization of variables.

For the collection of information, a convenience, non-probabilistic sampling design was used (Vieira, 2011) given our access to the population of fishermen. Semi-structured interviews, which "feature a script with open questions and are indicated to study a phenomenon with a specific population" (Manzini, 2012, p. 156), were carried out.

To guide the interview, our script was previously sent and approved by the ethics board of the Universidade do Oeste do Paraná, by Opinion nº 3.544.439. This script contains 26 questions aimed at ascertaining the socioeconomic characteristics of the activity and the changes that occurred from the 1980s until 2020. The same script was used for all interviewees, and these interviews were recorded and transcribed in their entirety.

With the timeframe approach to the effects of the formation of the Itaipu reservoir, some criteria were established for the selection of fishermen: being an artisanal fisherman, fishing in the region surrounding the IGNP and having been active before and after the formation of the reservoir. The fishermen were chosen using the snowball sampling method (convenience and non-probabilistic). This technique is "used in social research where the initial participants of a study indicate new participants who in turn indicate new participants and so on, until the proposed objective is reached, the saturation point" (Baldin and Munhoz, 2011, p. 50). In other words, when "no new names are offered or the names found do not bring new information to the analysis framework" (Vinuto, 2014, p. 203). To start the research, the chosen fisherman were appointed by local people.

At the beginning of the interview, the objective of the research was presented and each fisherman signed an informed consent form, where secrecy was assured in the disclosure of information, therefore their answers were discussed and portrayed by numbers.

Results and Discussion

General information about the fishermen

Typically, Brazilian artisanal fishing is practiced by independent fishermen, who carry out the activity individually or in partnerships (Diegues, 1988). This scenario was observed among the fishermen from the regions of Guaíra/PR and Mundo Novo/MS, for whom fishing is the main source of subsistence and family income. As a result, the majority of these fishermen work in fishing activities six days per week. Artisanal fishing is of great importance to the riverside population, as it provides the sustenance of numerous families, both for consumption and sales (Da Silva, 2014). In addition, it contributes to regional trade.

The interviewed fishermen use relatively simple and common equipment for catching fish (sleeping net and longline), have an advanced average age, and fish around the IGNP, which they consider to be the best area to catch the best fish. The use of gear known by the population in general and the sale of the produce without intermediaries (Diegues, 1988) are common practices in artisanal fishing.

Of the total number of fishermen, 86% were male and 14% female. Although women participate in fishing activities, this remains a profession predominantly practiced by men (Araújo and Parente, 2016). Women have always been a part of fishing in some way, whether by helping their husbands, weaving nets or even fishing; however, they were not considered to be fishermen (Zanchett, 2020). This fact is also portrayed by Souza and Silva (2018), who highlight the direct or indirect participation of women, often without being recognized as "fisherwomen". This has changed over time, but even today fishing is considered a male activity (Zanchett, 2020). One of our interviewees (fisherwoman 4, 60 years old) stated that she was unable to retire due to the National Institute of Social Security (INSS) not considering five years of her work (we do not know the reason for the INSS decision).

The respondents' age range fell between 54 and 59 years old. The second-highest participation rate (34%) was found among those aged between 47 and 53 years old, indicating that they are fully active in their profession when compared to the age group of the economically active Brazilian population (Oliveira, 2019). The age groups with the lowest contributions were between 60 and 64 years old, between 65 and 69 years old (7% each), between 70 and 74 years old (5%), and between 75 and 79 years old (only 2%). The age range pattern obtained in our results is very similar to that obtained in the studies conducted by Souza and Silva (2018) and Soares et al. (2019), in which the average age was between 43 to 52 years. This can be attributed to the aging of the riverside population and the reduction of fish stocks (Souza and Silva, 2018), as well as to younger generations choosing to abandon the profession.

Regarding education, 75% of the fishermen attended elementary school, 14% completed high school, and 11% declared themselves illiterate. Barreto et al. (2018) explain that the low education level among fishermen is related to the physical demands required by the activity. The need to feed their families by selling fish makes them work for longer periods, forsaking the need to attend school (Barreto et al., 2018). Their dedication to fishing can affect family income, as education is linked to the possibility of supplementing income with other sources (Lima et al., 2012).

The results showed that 65% of the interviewed fishermen receive one minimum wage (+ or - US$ 260) per month for the sale of fish and 35% reported receiving two (2) wages (+ or - US$ 520). However, the latter group claims to be able to earn more because they have retired as fishermen, thus adding pension to the fruits of their labor.

Environmental perception: artisanal fishermen and the person-nature relationship

"According to the International Labour Organization, fishermen are defined as workers who dedicate themselves to the entire process of the fishing sector, from catching fish to various tasks related to it" (Ramires et al., 2012, p. 38). This makes them sensitive and aware of all the changes that occur in the environment in which they are inserted, and their day-to-day empirical knowledge can support important questions when it comes to policies to maintain and understand nature (Abreu et al., 2020).

When asked about the Paraná River prior to the formation of the reservoir, the fishermen reported a significant change in the water landscape and a decrease in the abundance of the local ichthyofauna after its creation. Among others, the following responses were obtained:

- "*It used to be quiet, there were the Sete Quedas. It was beautiful! There was plenty of fish*" (Fisherman 24, 64 years old);
- "*It was the most beautiful thing in the world! There was plenty of fish, clean water, lots of wood on the shore*" (Fisherman 11, 69 years old).

When the question was what changed with the flooding, the following were some of their answers:

- "*Fish have decreased and there is a lot of siltation*" (Fisherman 4, 55 years old);
- "*Everything has changed, the number of fish has decreased a lot, and the ravine has become shallower*" (Fisherman 5, 74 years old);
- "*The amount of fish has decreased a lot*" (Fisherman 24, 64 years old);
- "*Sometimes we sit and reminisce, and it makes us want to cry. Anytime you came to the river, you had fish to catch*" (Fisherman 21, 52 years old).

Most of the fishermen's answers revolved around the "lack of fish", and this became clearer when the question was: "Do you think that someday there will be a lack of the fish that you are used to catching?" All the fishermen replied that "they are already missing". Agostinho et al. (2007) confirmed this, reporting that the disappearance and/or reduction of several fish species that were once abundant before the reservoir's construction are due to various factors, with the alteration of habitat being the most significant impact.

In fact, the construction of dams has been directly linked to decreasing population sizes and species richness (Nilsson et al., 2005), which affects the population dynamics and the attributes of all fish fauna (Sabinson et al., 2014). The changes caused by dams are related to modifications in the hydrodynamic characteristics that alter the physical and chemical characteristics of the river and, consequently, the well-being of the biota present in it (Tundisi et al., 2002; Moura et al., 2014).

The reduction in catches of fish with greater commercial value is another factor to be taken into account when considering the fishermen's responses: "*It was the richest river in the country [...] It had fish in abundance and fish of high commercial value*" (Fisherman 23, 58 years old).

Typically, migratory species such as the *Dourado* (*Salminus brasiliensis*), the *Pintado* (*Pseudoplatystoma corruscans*) and the *Jaú* catfish (*Zungaro zungaro*) are considered of greater commercial value. As a result, damming primarily and negatively affects these migratory fish species (Suzuki et al., 2004). As migratory fish species rely on extensive movements to complete their life cycle, dams obstruct their migration routes, limiting upstream movements (Agostinho et al., 2003; Pelicice et al., 2015) and reducing the likelihood of their offspring reaching downstream feeding sites (Agostinho et al., 2007; Winemiller et al., 2016). Furthermore, with the formation of the reservoir, the main hydrological and limnological triggers for reproduction, such as water level, turbidity, (Vazzoler, 1996; Baumgartner et al., 1997; Agostinho et al., 2007) and flow velocity (Agostinho et al., 2007; Pelicice et al., 2015), experienced a changed regime (Agostinho et al., 2007). For example, in the upper Paraná River there are at least 18 species of migratory fish under the influence of several dams (Suzuki et al., 2004; Suzuki et al., 2009; Lopes et al., 2020), some of them at risk of extinction (ICMBio, 2018). In addition to reporting the disappearance of species, the fishermen also claimed that the size of fish is decreasing over time. The following are some of their statements:

- "*Species such as* Pintado, Dourado, *and* Pacu *not only became scarce, but also significantly decreased in size*" (Fisherman 27, 55 years old);
- "*Yes, they are much smaller. They're not even big enough to take, but what are we going to do? If we don't catch them, we don't fish*" (Fisherman 21, 52 years old).

Research has been conducted to understand the reasons for the decrease in size and biomass (condition factor) of fish over time in hydrographic basins with reservoirs, (Hoeinghaus et al., 2009; Moura et al., 2014) and genetic alteration is among the potential causes (Perônico, 2017). This modification might be the result of selective fishing practices that prioritize fish size, driven both by financial reasons and legal considerations regarding the size of fish that can be caught (Agostinho et al., 2007). The statement made by fisherman 21 reflects the views of the majority of fishermen, who claim that they are unable to catch fish that meet the minimum size required by law. Consequently, they end up catching smaller fish, even during the closed season. Some openly assert this, while others appear more embarrassed, but end up revealing their thoughts during the interview.

When it came to the comparison between the fish species that existed before the formation of the reservoir and those currently caught, including introduced and invasive fish, the fishermen claimed that the fish they catch now are of lower commercial value and are of different species than those that were present before the reservoir was created.

- "*The richest fish are no longer enough for us here*" (Fisherman 35, 54 years old);
- "*Now more fish have been introduced, the* Armado *is the one that is still guaranteeing the money*" (Fisherman 28, 55 years old);
- "*The* Cascudo Preto *that brought in money, now when it gets caught it tastes bad*" (Fisherman 9, 58 years old).

The introduction of species is seen by energy companies as one of the measures to reduce environmental impacts, especially on the ichthyofauna, caused by the construction of reservoirs, but due to factors that include lack of monitoring and appropriate studies, this resource has proven to be less effective in some Brazilian reservoirs (Agostinho and Júlio-Jr., 1996). The impact of introduced or invasive species is considered of great ecological importance (Vitule et al., 2012) and is directly related to changes in the functional diversity of the fish assemblage (Milardi et al., 2019). Moreover, the increase in the abundance of non-native species is associated with the decrease in "ecosystem services" (Attayde et al., 2011). Among the causes of global biodiversity loss, the introduction of exotic species is considered the most important (Leprieur et al., 2008).

Among the species mentioned by the fishermen, the Silver Croaker *Curvina* (*Plagioscion squamosissimus*) was introduced into the Pardo River Basin in 1967 (Machado, 1974; Nomura, 1984) with the purpose of increasing fish yield (Agostinho et al., 2007) and found favorable environmental conditions in several Brazilian reservoirs. It became the only introduced species that was successful in terms of abundance and biomass in the floodplain of the upper Paraná River (Agostinho and Júlio Jr., 1999).

With the purpose of understanding the fishermen's perceptions regarding the IGNP, they were asked if they had knowledge of the park's importance to the region. The following results were obtained: 69% of fishermen did not know the importance or did not want to answer; 29% responded that it was important for the environment, fauna or flora; and 2% believed that the conservation unit was created to harm the fishermen. Below are some statements:

- "*Important for the preservation of the river and fish*" (Fisherman 4, 55 years old);
- "*It is important because it is a place that no one can sell, it is important for animals, for reproduction*" (Fisherman 6, 79 years old);
- "*Responsible for 50% of the extinction of fishermen*" (Fisherman 23, 58 years old);
- "*None, they did it to annoy the fisherman*" (Fisherman 21, 52 years old);
- "*It is the nursery of the river, very important for the animal*" (Fisherman 11, 69 years old);
- "*I don't know...*" (Fisherman 5, 74 years old).

Subsequently, the fishermen were asked if the conservation unit was important for fishing. The majority (70%) of the fishermen did not know how to answer; 18% answered that it was not important for fishing, and 12% answered that it had some kind of importance for fishing.

- "*Fruit trees give us fish*" (Fisherman 2, 51 years old);
- "*Reproduction of fish and preservation of fish*" (Fisherman 4, 55 years old);
- "*They created the conservation unit and the fishermen were harmed*" (Fisherman 38, 58 years old);
- "*None, it interferes with fishing*" (Fisherman 25, 55 years old).

The negative perception that fishermen have towards the IGNP may be due to a lack of informative educational actions (environmental education) before, during, and after its creation, considering the expropriations and conflicts that occurred at that time (Moreira, 2017). Laws and prohibitions are implemented for the creation of conservation units aiming to conserve biodiversity in the area, but this series of prohibitions generates conflicts with the population that depends on that environment for their livelihood (Gonzaga et al., 2014).

The model of conservation units adopted in Brazil is in line with a policy that holds that, to conserve, it is necessary to relocate populations that have always lived in and cared for that location (Hassler, 2005). This has caused and still causes significant conflicts with the riparian population who has always taken care of the land (Acevedo et al., 2013; Alvite and Ferreira, 2022). In his research, Arruda (1999, p. 90) concludes that this model of conservation units, "by ignoring the conservation potential of culturally differentiated segments that have historically preserved the quality of the areas they occupy, has possibly disregarded one of the only appropriate avenues to achieve its proposed objectives".

Below are some statements from the fishermen related to the IGNP:

- "*Before the National Park was created by decree, there were around one thousand families living within the park area. These were not one thousand individuals, but rather one thousand families. They used to cultivate crops such as rice, beans, and chicken, among other things. When they were forced to leave, they received a meager compensation, and I was closely involved in the compensation process*" (Fisherman 1, 48 years old);
- "*When the preservation unit was created, the fishermen were harmed, they took away our right to work, to camp. They were restricting. We, while here, didn't let the island burn like that. One thing you may not know is that most of the fishermen who were harmed are dead because they went to work as smugglers*" (Fisherman 38, 58 years old).

Unfortunately, this fisherman's speech is a reality in this region. Conflicts with traditional populations must be avoided, and, ideally, these populations and their knowledge (traditional ecological knowledge) should be used as a tool for preserving the areas. This approach is being used in developed countries, with an innovative focus on conservation — ethnoconservation — where humans are regarded as an integral part of nature (Pereira and Diegues, 2010). The concept of ethnoconservation, in a more straightforward way, would mean to say that "it is, therefore, a shared management of natural resources between the State, environmental organizations, and local populations" (Da Silva Júnior, 2009, p. 90), allowing the population to understand and assist in biodiversity conservation.

In the last question, an opinion was requested on how Guaíra and Mundo Novo would be if the Sete Quedas still existed:

- "*When it comes to Sete Quedas, we can count on one hand those who are still alive to tell you the truth. Apart from the well-known waterfalls, there were 19 more falls that were only known by fishermen and those who passed by plane at that time. Today, with the technology we have, it would be the greatest wonder in the world, and all the falls would be explored. Today there would be more inhabitants than Foz do Iguaçu because there were 30 wonders like those. There is a huge loss of tourist and economic potential. Today, that would not have happened, and we would have called the press from all over the world*" (Fisherman 38, 58 years old);
- "God *forbid! It would be too big, bigger than Foz, the city would no longer have a place to build a house in*" (Fisherman 24, 64 years old).
- According to the fishermen, everything is being directed towards the shortage of fishermen in this region.
- "*In a little while, no one will go fishing anymore and whoever goes fishing won't catch any fish*" (Fisherman 38, 58 years old);
- "*The fisherman nowadays no longer takes his son and grandson fishing, as he used to. Soon there will be no more fishermen*" (Fisherman 24, 64 years old).

Due to poor pay and a lack of fish resources in reservoirs, the fishermen have become more concerned with the future and education of their children so that they can secure jobs with better earnings, making fishing an activity to cope with unemployment rather than an exclusive means to support their families (Silva-Meneses, 2018; Souza and Silva, 2018). On the other hand, Guaíra and Mundo Novo are close to the border with Paraguay. Due to this, there is a tendency towards finding remuneration through cigarette smuggling, which, despite being an illicit activity, becomes a more profitable option for young people who are easily tempted (Alvares, 2018).

Conclusions

During the research, the fishermen's emotions when talking about the Paraná River, the extinct Sete Quedas Park, and the environmental changes that have occurred became evident. In addition to that, during the interviews, they demonstrated knowledge of the

changes in the Paraná River's bed and margins, its course, siltation, extinction and/or reduction of species, aligned with what has been found in scientific literature. This shows that they have an environmental perception regarding the changes that have occurred in the region over the last 40 years.

In fishing, there is a relationship between the fishermen's knowledge, the methods used to catch fish, and the entire environment in which they operate. Despite their lack of opportunities in academic life, they revealed in their speech knowledge of the consequences of the changes that occurred in their fishing and living spaces. This shows that this knowledge can and should be used by government institutions to try to reconcile environmental changes with the subsistence needs of this population.

During the interviews, it became evident that there is a negative perception towards the IGNP and the conservation units. This leads us to a profound reflection: the fishermen are capable of relating the construction of the reservoir and the modifications in the environment, perceived in practice during their work, but despite this, they do not understand the importance and necessity of creating conservation units for the maintenance of biodiversity and environmental quality. This leaves us questions to be answered in future works, such as the effectiveness of the implementation model of these institutions, which should take into account the environmental, social, and cultural needs of the population in their surroundings.

In view of the above, it is necessary for municipal, state and federal public authorities, supported by scientific information, to undertake environmental education actions and mitigation measures to reduce the environmental impacts generated by damming and to support the fishermen.

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