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IMPACTS OF THE HYDROELECTRIC POWER GENERATION OVER THE FISH FAUNA OF THE TOCANTINS RIVER, BRAZIL: MARABÁ DAM, THE FINAL BLOW

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ABSTRACT
As the eyes of environmentalists and researchers focused on the Madeira, Xingu and Tapajós rivers dams, one unknown project to bystanders will negatively affect an entire watershed, causing impacts far greater than any other megadam constructed in Brazil. Despite the environmental modifications, little is known about the UHE Marabá dam and its impacts over such a splendid cellar of species: the Araguaia- Tocantins basin. Historically the Tocantins River is the most impacted amazon tributary, with several already built dams, though the Araguaia River is free of dams. Building the UHE Marabá dam will affect both rivers, and probably extinguish many species increasing the already high number of Amazonian endangered fish species. Due to its unique evolutionary history among Amazonian tributaries, the endemicity found in the basin is probably higher than any other Amazon tributary, as some authors consider it as a different watershed, separated from the Amazon. Describing and foreseeing the impacts locally and globally are the main goals of the present study.
Keywords: Amazon; Brazil; conservation; endangered fish species; environmental impacts.

INTRODUCTION

As stated by the Convention on Biological Diversity (Inland Waters Biodiversity Programme 2016) Inland water ecosystems are amongst the most threatened ecosystems due to habitat loss or degradation, water withdrawal, overexploitation, pollution and invasive alien species. According to the Millenium Ecosystems Assessment scenarios (2005), four out of five people live downstream rivers and are served by renewable water sources, and the increase on demand is estimated at a rate of 10% per decade. The same document reported that one of the major threats that compromise the sustainability of inland water systems is the prolific dam building (45,000 large and about 800,000 small dams).

Recently Winemiller *et al*. (2016) pointed that dam building is the main threat for the three most biodiverse rivers of the world, Amazon, Congo, and Mekong. Specifically in the Amazon basin, three areas concentrate operational/under construction and planned dams. The first one is the Andean region, which constitutes a threat for the headwaters of the entire Amazon, with several planned dams. The second region is the Tapajós drainage, in Brazil, which has some operational and several planned dams (WWF 2016), which will create a similar scenario to what happened in the Tocantins River. The third region is the Tocantins-Araguaia drainage, also in Brazil, that already holds several large dams under operation in the Tocantins River, and many other planned in both rivers.

Goulding *et al*. (2003) considered the Tocantins River as the dammed Amazon tributary, because of the several operational dams in its mains channel. At the time of his publication, projects as the Belo Monte dam in the Xingu River, and the Santo Antonio and Jirau dams in the Madeira River were not even licensed. The Tocantins River is considered the most impacted not only by the dams, but also because of the intensive land use.

In this review, it will be shown that the environmental situation of the drainage degraded substantially, because three other dams were built after 2003 in the Tocantins River; Peixe Angical in 2006, São Salvador in 2009 and Estreito in 2011 (ANEEL 2016). Also, the land use was intensified by many agricultural and aquaculture projects, including the "Plano de Desenvolvimento Agropecuário do Matopiba, 2015" (Brasil 2015) planned for the states of

Maranhão, Tocantins, Piauí and Bahia, which are considered the last frontier for agriculture in Brazil. Even though the synergetic impacts of dams are still not well established, I demonstrate that the planned Marabá dam will negatively affect not only the local aquatic ecosystems, but the entire watershed.

The Araguaia-Tocantins basin general aspects

The Araguaia-Tocantins is the fourth largest Brazilian exclusive basin (Goulding *et al*. 2003), with two major rivers. In the west the Araguaia, from its headwater in central Brazil to its mouth in the Tocantins, runs through 1670 km, draining Cerrado and then Amazon Forest. In the east the Tocantins from its headwater in Goiás State to its mouth runs through 2450 km (2640 km considering the Pará River Bay mouth), draining extensive areas of the Cerrado. Some researchers do not consider the drainage as part of the Amazon basin, because two thirds of the drainage coverage is mainly in Cerrado (IBGE 2004). Also, its mouth discharges directly to the Atlantic Ocean. Therefore the basin is not connected directly to the Amazon River and was probably isolated from the Amazon system around 1.8 million years ago (Rosseti & Valeriano 2007). The basin tectonics is actually fairly active, with several subsidence episodes that resulted in the formation of the Bananal floodplain (Araguaia River) during the Quaternary (Saadi *et al*. 2005). The floodplain serves as a natural barrier that isolates the higher Araguaia and higher Tocantins fish faunas (Lima & Ribeiro 2011). Even so, fauna and flora have similar components to the Amazon, especially the freshwater fish fauna which is undoubtedly related to the Amazon. Moreover, the freshwater fish faunas of the Brazilian Shield Rivers share several species for instance with the Tapajós, Xingu and Tocantins basins, which indicates a common origin and probably an older connection.

Freshwater fish fauna endemicity of the Tocantins-Araguaia

Several species of fishes are probably isolated from the Amazon system from 1.8 million years, but older events isolated several components of the aquatic biota of the Brazilian Shield Rivers. Thus, although the fish fauna is certainly related to the amazon basin, the Tocantins-Araguaia has a high number of endemic species. The endemicity level is greater than 40% accordingly to Hales & Petry (2013). Several recent studies (last 10 years) described 24 new endemic species from the Tocantins-Araguaia as follow: *Astyanax elachylepis* Bertaco & Lucinda 2005; *Pimelodus stewarti* Ribeiro, Lucena & Lucinda 2008; *Pimelodus joanis* Ribeiro, Lucena & Lucinda 2008; *Pimelodus halisodus* Ribeiro, Lucena & Lucinda 2008; *Anablepsoides tocantinensis* (Costa 2010a); *Melanorivulus jalapensis* (Costa 2010b); *Hasemania kalunga* Bertaco & Carvalho 2010; *Geophagus neambi* Lucinda, Lucena & Assis 2010; *Geophagus sveni* Lucinda, Lucena & Assis 2010; *Sternarchorhynchus axelrodi* Santana & Vari 2010; *Pimelodus luciae* Rocha & Ribeiro 2010; *Xyliphius anachoretes* Figueiredo & Britto 2010; *Moenkhausia aurantia* Bertaco, Jerep & Carvalho 2011; *Moenkhausia dasalmas* Bertaco, Jerep & Carvalho 2011; *Hypsolebias tocantinensis* Nielsen *et al*. 2012; *Ctenocheirodon pristis* Malabarba & Jerep 2012; *Colomesus tocantinensis* Amaral, Brito, Silva & Carvalho 2013; *Leporinus santosi* Britski & Birindelli 2013; *Tetragonopterus akamai* Araujo & Lucinda 2014; *Hyphessobrycon diastatos* Dagosta, Marinho & Camelier 2014; *Serrapinnus aster* Malabarba & Jerep 2014; *Serrapinnus lucindai* Jerep & Malabarba 2014; *Pseudacanthicus* pitanga, Chamon 2015; *Tometes ancylorhynchus* Andrade, Jegu & Giarrizo 2016.

Endangered fishes

The recent list of endangered Brazilian species of fishes (Brasil 2014) included 409 species, which 96 are marine, and the remaining 313 are freshwater or brackish. The majority of the endangered freshwater fishes are distributed in the densest populated areas in South and Southeast Brazil. The freshwater fish fauna of the Amazon is still less affected if a comparison is carry out between rivers in South, Southeast and Northeastern Brazil. Nonetheless, from the 313 freshwater species, 73 species are from the Amazon region.

Particularly in the Amazon, 72 out of 73 species present in the red list are affected by dams because of habitat loss. In the current scenario, it is clear that the problems concerning the Tocantins are critical if compared to other amazon basins, because 48 out of these 73 species are from that basin. Thus, the main cause of disturbance is the many installed and planned dams (Figure 1).

Though the causes are usually well known, it is necessary to stress the impacts of dams to understand how it affects the freshwater fish fauna. The impacts can be summarized as local or synergetic impact, and how it affect the freshwater fish fauna depends of a series of factors. Usually local impacts are related to extinction and faunal changes in diversity and abundance. Synergetic impacts with extended ranges like faunal homogenization; connective loss and reproductive issues affects the ecosystems in different ways, and demands thorough studies to uncover how multiple dams affects a watershed.

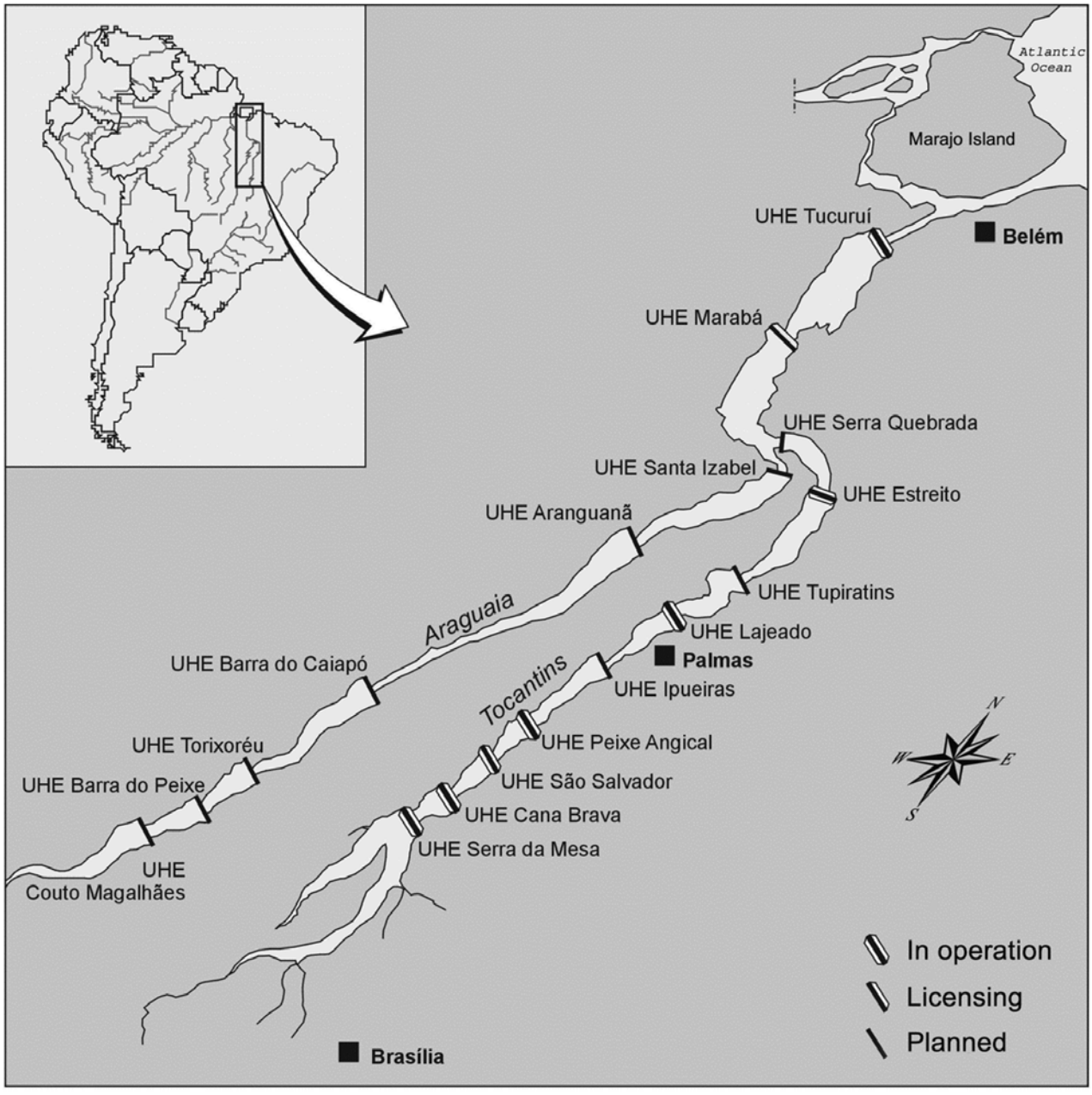

Figure 1. Schematic map illustrating operational, licensing and planned dams of the Tocantins-Araguaia basin (modified from Agostinho, Akama & Lucinda 2009).

Dam impacts and the Tocantins River case

Dam impacts over the aquatic ecosystem are well known for a long time. Particularly in the tropics, the impacts are fully and thoroughly discussed in a vast literature (*e.g.*, Baxter 1977; Northcote *et al*. 1985; Agostinho 1993, 1994; Agostinho *et al*. 1999; Wu *et al*. 2004; Nilsson *et al*. 2005; Ansar *et al*. 2014; Winemiller *et al*. 2016). Usually "megadams" are associated with environmental alterations resulting in severe changes in terrestrial and aquatic biodiversity as well as in ecosystems functioning.

The impacts over the terrestrial ecosystems are usually locally restricted to the flooded areas, and do not extend much further compared to the impacts over the aquatic ecosystems. Thus, the effects on the aquatic fauna are certainly more extensive, reaching not only the flooded area, but also downstream and upstream the dam and its reservoir.

For the aquatic ecosystems, impacts are similarly listed in the literature and vary from: local habitat changes, change in the biotic fauna and flora, flood pulse alterations, habitat loss (including spawning and recruitment areas), habitat fragmentation and subsequent changes or complete loss of the connectivity between populations among others. Because many of these impacts are already listed and explained (see Winemiller *et al*. 2016), the focus will be on some impacts that are underestimated and sometimes do not get accounted in the licensing process for the Marabá dam future scenario. Thus, two non-studied impacts should also be addressed; a) mass mortality of fishes below dams, a common event for many dams of the Tocantins River; b) the channel dwelling fishes, a group with of fishes that was never focused in all dams of the Tocantins River, and should be considered an important target for conservation due to its particularities.

An historic overview of the dams in the basin is necessary to understand the present and future scenarios of both Tocantins and Araguaia rivers. As mentioned in the "Smithsonian Atlas of the Amazon" (Goulding *et al*. 2003), the Tocantins is the Amazonian Dammed River. No other Amazon tributary shows as many large dams, from headwaters to near its mouth.

The UHE Tucuruí dam was the first built in the basin in 1986 and its lake flooded square 2,400 km. It is the second largest lake in the Amazon, currently capable of producing 8,370 MW, (plus 3,000 MW in a planned upgrade). Tucuruí was built in the lower Tocantins, almost without environmental concerns during the military government, and it should be an example of inadequate assessment of environmental impact studies (Goulding *et al*. 2003). As it disregarded environmental concerns, there are no fish passages, which lead to the upstream extinction of large migratory catfishes such as *Brachyplatystoma rousseauxii* (dourada common name in portuguese) and *Brachyplatystoma vaillanti* (piramutaba common name in portuguese) and probably reflected in several other species extinction or population depletion. Though fish passages sometimes do not work as expected, as pointed out by many recent articles (Pelicice & Agostinho 2008, Pelicice, Pompeu & Agostinho 2014), the absence of such structures is an evidence of environmental was overlooked when the dam was built. Accordingly to Leite & Bittencourt (1991) only 80 species of fishes were present in the area of the reservoir lake, which in 1986 INPA researchers had identified around 350 species, leading to a local extinction rate of more than 75%. The environmental impacts downstream Tucuruí were never assessed for the fish fauna, but, an unpublished thesis, reported several impacts resulting in the destruction of biotopes (Manyari 2007 p. 141). The biotope destruction resulted in the loss of diversity and abundance of fishes, and Fearnside (2015) reported that the fishing industry below the dam was eliminated. Even though it is certainly that Tucuruí dam changed the river morphology downstream it is not possible to know how it affected the fish fauna because the lack of previous information.

A second dam was built in the headwaters of the Tocantins river, the UHE Serra da Mesa dam (operating since 1996), and it is the largest Brazilian artificial lake. The dam generates a significant amount of power (1275 MW), but it´s main task is to regulate the river discharge, and the impacts of controlling the flow is not well understood yet. The local impacts are well reported and because it is located in the headwaters of the Tocantins, we do not know how the dam affected the connectivity for migratory fishes. The

local extinction rates were also not assessed and the monitoring program reports and environmental studies are not available in the Brazilian Institute of Environment and Renewable Natural Resources - IBAMA (IBAMA website accessed in August 2016).

The third dam built in the river, the UHE Lajeado (operating since 2001, and renamed Luis Eduardo Magalhães) peak generation is 903 MW, and created a lake with 1003 km^2. None of the monitoring reports and environmental studies is available in the IBAMA website. The reservoir is situated in the middle reaches of the Tocantins River. Although the lake is considerably large, it operates as run-of-the river, a characteristic shared with all other dams built in the Tocantins River after 2001, which supposedly causes less environmental impacts than Tucuruí and Serra da Mesa dams, both cumulative dams. Nonetheless, it is questionable if the impacts of run-of-the river dams are environmental friendly, and there is no published studies comparing environmental impacts of run-of-the-river dams and cumulative dams.

The fourth dam UHE Canabrava (operating since 2002) is the second smallest dam, with a lake of only 139 km^2 with 450 MW of installed power. Environmental studies and monitoring reports are available in the IBAMA website (accessed in August 2016). It is located downstream Serra da Mesa dam, and accordingly to the monitoring studies is the reservoir with less diversity among all dams in the Tocantins River, but the causes were not established.

The fifth dam UHE Peixe Angical (operating since 2006) has 452 MW of installed capacity and a lake with 294 km^2. Environmental studies and monitoring reports are available in the IBAMA website (accessed in August 2016). The reservoir is situated between Lajeado dam and Serra da Mesa dam, also flooded one important tributary of the Tocantins River, the Paranã River. Although it´s local impacts were studied, the impacts over the Paranã and how it affected the fishes were not accounted.

The sixth dam UHE São Salvador (operating since 2009) is the smallest and less productive dam, with 241 MW of installed capacity and a lake with 104 km^2. Environmental studies and monitoring reports are available in the IBAMA website (accessed in Auguts 2016). The dam is situated between Peixe Angical and Canabrava dams, and with its construction, the river channel from Serra da Mesa to Peixe Angical have a cascading of dams. When it started operations, mass mortality below the dam was recorded for several species of migratory fishes (Elineide E. Marques, personal communication).

The last dam built in the Tocantins River, UHE Estreito (operating since 2012) has 1087 MW and a lake with 590 km^2. Environmental studies are available in the IBAMA website (accessed in August 2016). The dam is situated between Lajeado and Tucuruí dams, and its impacts are yet to be assessed. When it started operating, mass mortality of large catfishes (*Zungaro zungaro*) was reported for the reservoir, but the causes were not determined.

From its 2500 km of extension, the Tocantins River has nowadays only two long stretches free of dams and both with ca. 400 km. One is located between Estreito and Lajeado dams, and the other between Estreito and Tucuruí dams. Both areas should be focused as priority areas for conservation, thus free of dams.

Synergetic impacts of all dams

Each dam of the Tocantins River contributed with local extinctions and changes in the fish fauna, accordingly to the environmental studies, but the impacts sometimes extends further away downstream and upstream. Also, the synergetic effects of all dams is far greater than just the faunal homogenization and changes in the hydrological cycle. A clear example of a previously unknown synergetic effect were the recently records of mass mortality occurred in the Lajeado dam. Large schools of migratory fishes reached the dam and died below the dam in 2012 and 2014, thus IBAMA fined the Lajeado Dam Consortium for the mass mortality. But the causes should also be associated with the operation of the Estreito dam, located 370 km downstream, which caused disturbance on the migratory pattern, thus leading the fish schools to reach the Lajeado dam. The environmental impacts were not restricted to the lake and/or the downstream effects, but rather affected areas further upstream. Such change in migratory pattern probably happened for each dam built in the Tocantins, but was not

discussed and evident due to the non-existence of previous dams.

The two main synergetic impacts presented in the literature, and occurring for the dams operating in the Tocantins, are population connectivity loss, and faunal homogenization. Although there is some relationship between both, they will be considered apart, as attempts for remediation connectivity loss can create greater impacts, as shown by Pelicice & Agostinho (2008).

Connectivity loss caused by the dams over the Tocantins River is impossible to mitigate in its upper portions, because the dams were built close to each other creating a cascade of reservoirs. The migratory fish fauna above Peixe Angical dam will be restricted to short migration species, because there is virtually no long reaches free of dams. Also, as it was reported for Lajeado dam, its effects over migratory fishes were rather negative (Pelicice & Agostinho 2008), thus the transposing ladder was deactivated. Estreito dam impacts are not well understood and the dynamics have yet to be studied. And finally, Tucuruí dam truly isolated the Tocantins and Araguaia from its lower portion and its impacts are gigantic and influence both upstream the lake and downstream the dam.

The impacts of connectivity loss over the ecosystem in the Tocantins River cannot be accessed with the current knowledge. Monitoring studies provided by each dam are not available, but it is clear that the migratory fishes have either become extinct locally, or have different levels of population depletion. It is necessary to focus the studies in ecosystem level as proposed by Freeman *et al*. (2003), but in this regards there is scarce information about other aquatic taxa inhabitant of the Tocantins River, such as mussels, shrimps algae and other invertebrates that can affect the entire functionality of the river. The first group of fishes affected by dams and the connective loss is the long-term migratory species. As stated by McIntyre *et al*. (2015) a triple jeopardy happens for migratory fishes whenever a dam is built, because impact are bound to happen for a) breeding areas, b) recruitment and feeding areas and c) migratory corridors. By building dams the connectivity is eliminated, and even amongst dams with transposing structures, the reservoir per se is the main cause of impact.

As recent studies report faunal homogenization as a result of dam building, and some cases the impact is aggravated if the dams are built in cascading. Unfortunately, we have no idea how the megadams built in the Tocantins channel are affecting the river in this regard. In a thorough study, Poff *et al*. (2007) related how the dams across North American affected the rivers geomorphologically, functionally and ecologically. Particularly for fish communities the broad scale control was considered the key factor. As for the Tocantins River, we do not have enough data and taxonomic accuracy to perform a similar study. In order to do such a study, first it is necessary to understand how species are distributed along the longitudinal gradient along the main channel, and also biological characteristics. As environmental impact studies are scarce and cannot provide accurate data, performing such a task in the present is impossible. First is necessary to correctly assess the data, because of several taxonomic discrepancies, with different names for the same entities are commonly found. Additionally, incomplete inventory studies for each dam pose difficulties to do an analysis to understand how dams are affecting the basin and its synergetic impacts.

A third unknown impact must be also pointed; the loss of channel-dwelling-fish species diversity. In this regard, no studies whatsoever were executed for any dams built in the Tocantins River. The only available study on channel fishes related to dams in Amazon was done for the Madeira River, but there are no available reports yet about the impacts over channel fishes. As for the Tocantins, without previously information, only conjectures can be done. The Federal University of Tocantins made few attempts to collect fishes in the Lajeado reservoir, but no channel fishes were captured.

MATERIAL AND METHODS

This study was based on data and information gathered among several sources for the Tocantins River. Priority was given to the analysis of published research as the Tucurui Dam books and articles of all dams available. But, as many dams do not have scientific data published, the use of information from Licensing and Monitoring studies from hydroelectric dams was necessary.

All the impacts related to dams are discussed in the literature, but some impacts are not thoroughly investigated. Particularly the synergy was never assessed, and it was necessary to infer based on the current knowledge the possible scenarios for the aquatic fauna, which takes in account not only the present dams, but also the planned.

DISCUSSION

UHE Marabá - the final blow

Brazilian government strategic planning for the expansion of electricity power generation has considered the Marabá dam as priority and the licensing process is currently advanced. The focus of the environmental studies are, as usual, related to the local impacts and do not account for the cumulative impacts over the entire watershed of the Tocantins- Araguaia. There is no system scale approach, a necessity for dam planning as stated by Hartmann *et al*. (2013). Thus, the authors summarized hydropower sustainability as building the right dams in the right place. For the Tocantins River dams a system scale planning would probably prove to be a formidable argument against building any other dam in the river. As for the Marabá dam it should be considered the wrong dam, in the wrong place. As it will be show below the impacts of the dam extends not only to the Tocantins River, but also for the Araguaia River. Impact prediction is necessary to understand how the dam will affect the fish fauna, and also the dynamics of the river in one of the last free-of-dams reaches of the Tocantins, and it is important to stress that there are no mitigations possible for them.

Local impacts are expected to happen such as substitution of lotic by lenthic regime flow, followed by faunal changes and local extinctions of fishes (Baxter 1977, Agostinho *et al*. 1999, Winemiller *et al*. 2016). Nevertheless, there are three drastic impacts that will affect both Tocantins and Araguaia Rivers. The first is the loss of several rapids in both rivers, such as São Sebastião rapids in the Tocantins River. The rapids are the exclusive habitat of many reophilic species, and based on the biology of the several endangered fish species of the Tocantins River, it is probably the last possible habitat of at least half of them. Brazil, as a signatory of the Convention on Biological Diversity, should protect the species in the red list, but building the Marabá dam goes contrary to this. The second important impact is caused by flooding several lakes near Marabá, the most extensive floodplain of the Tocantins River, and the place on which recruitment occur for migratory and non-migratory fishes. Flooding these lakes will negatively affect not only the Tocantins, but probably the lower portions of the Araguaia River. The third is related to the necessity to preserve long river reaches free of dams. For conservation purposes free of dams areas are an important target, because it preserves the ecosystem functionality. Building the UHE Marabá will affect one of the last two remaining areas without dams in the Tocantins River.

The synergetic impacts caused by the Marabá dam are enormous. Considering that the Tucuruí dam already impacted the river downstream the dam, with Marabá the reduction of sediments will be increased several times and consequently enhance the erosive process. Moreover, the upper Tocantins already has a cascading of reservoir, as mentioned before, and with the building of Marabá, the lower portions will also have a cascading of three megadams, Tucuruí, Marabá and Estreito, flooding hundreds of kilometers of the Tocantins River. Losing connective will affect not only the Tocantins but the lower portions of the Araguaia, once the flooding area will extend almost to Santa Isabel rapids in the Araguaia River. The most important recruitment area of the Tocantins River, the floodplain near Marabá city will disappear, and the impacts over the fish fauna are unknown. Faunal homogenization of the entire watershed is expected to happen, but we do not have enough data to understand its implications. Although the negative effects will not be perceptible to most of the population, the building of Marabá dam will be catastrophic for the entire watershed.

Future directions for monitoring and conservation of the fish fauna of the Tocantins-Araguaia basin

The most crucial step for sustainable usage of the basin is a systematic planning based on solid data. Unfortunately, there is actually no political direction to

comprehend how dams are affecting the Tocantins River and the drainage. The Brazilian government investment on hydroelectricity generation in the Amazon was preconized, for many reasons, in the Tocantins River leading to the installation of several dams. Therefore, environmentalists and researchers focused their attention on the preservation of more pristine Amazon tributaries such as Madeira, Xingu and Tapajós Rivers. Even when methodological tools for systematic conservation planning are available, as proposed by WWF (2016) for the Tapajós basin, the Tocantins is disregarded as an important target for conservation. In fact there is little concern for the Tocantins River preservation by the government and also the federal and state environmental agencies.

Even if the actual scenario for the Tocantins-Araguaia basin could not be more negative, with at least two thirds of the endangered amazon fish species belonging to the basin, there are possible actions that must be executed. Considering the future scenario presented above with the Marabá dam, it is expected that the fish fauna will be drastically affected. Currently fish monitoring procedures, based on individual studies for each dam, cannot allow an evaluation of the overall impact throughout the Tocantins River. Thus, it is necessary to carry out the assessment of these impacts along the river channel, not only on respect to faunal homogenization, but also for reproduction sites, nursery sites and ultimately the dams synergetic impacts. The task is not easy, as the necessary tools to answer these questions requires different methodological approaches from what it is usually asked during the environmental licensing process.

The first step necessary is to evaluate the current status of the Tocantins-Araguaia basin fish fauna, since the Araguaia River also have several planned dams. There are important actions that can be done with fewer efforts. It is urgent to assess fish diversity and its distribution in the basin based from data of all dams Environmental Impact Studies, Environmental Monitoring and other sources of information. Also it is paramount to validate the species account based on the study of the available material on museum collections. This will enable understanding changes through time over the Tocantins River. In the same way, gathering the basic knowledge about biology and resilience for the fish community along the river should be performed. The current Environmental Impact Assessment techniques are insufficient to provide a real scenario about the fish fauna conservation status. A study to understand how the impact of all dams, with a method emphasizing all information for the entire watershed is needed, thus allowing to evaluate the impacts in multi scale can be performed using beta diversity (Soares *et al*. 2015, Socolar *et al*. 2015). Also, it is necessary to incorporate how the Land Use Change – LUC affects the watershed in a multi-scale approach as indicated by Leal *et al*. (2016).

A second approach is to use the information gathered to evaluate the risk of extinctions of species at regional levels, such as proposed by Ginsburg (2001). We do not have information about the conservation status of many species of fishes with broad distribution threatened only in the Tocantins River, because the regional level evaluation was never performed. The regional adjustment can be an optimal tool for understanding how fish species are affected by dams. After performing both evaluations a suitable scenario can be proposed for attaining priority policies, strategies and targets for conservation of the already most endangered Amazonian freshwater fish fauna.

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