



Fishing modification due to dam, pollution and introduction fish species in the Tietê River, SP, Brazil

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Abstract

The aim of the present study is to examine the modification on fishing in the Tiete river in consequence of pollution, damming up and of introduction of species. The results revealed modification on utilization of fishing equipment. Before the dam used innumerous equipment such as gillnets, cast net and long line, etc. After the dam, dominated the gillnets and cast net. Another important point is the reduction on professional fishing and the increase of sport fishing in consequence of the reduced fish catching and of the biggest profit of other activities. A clear change in the composition of fish caught during long years was observed, with the predominance of rheophilic species as *Salminus maxillosus*, *Prochilodus lineatus* and *Pseudoplatystoma corruscans* before damming up and its reduction after it. Evidences show that until 1960 the refined fish caught that includes species as *Salminus maxillosus*, *Piaractus mesopotamicus* and *Pseudoplatystoma corruscans* dominated fishing. Since 1961 to popular fish caught (*Pimelodus maculatus*, *Hoplias malabaricus* and *Astyanax altiparanae*) started to dominate. The introduction of at least twelve exotic species was recorded, the most common being *Plagioscion squamosissimus*, *Cichla* sp and *Tilapia rendalli* being the *Plagioscion squamosissimus* the most frequent specie caught in the medium and low part of the river. The fishing also has been suffering influence of pollution and deforestation. In the upper Tiete river the

fishing is inexistent for its water are totally polluted. The deforestation contributed for some species, mainly the frugivorous, such as *Brycon orbygnianus* to become scarce in the Tietê river.

1 Introduction

The basin of Paraná river is intensely dammed, what it transforms the river and its tributary, in a dam's cascade sequence. The Tietê river is main tributary of the left margin, it owns countless dammings, which they initiated in decade of 60. Besides the dammings, the Tietê river suffers countless impacts such as the pollution for domestic and industrial sewages, deforestation of the marinal vegetation and sedimentation. Such impacts has started to to be intensified since 1920, receiving presently 4500 t year⁻¹ of sewage from the Metropolitan Area [1]. All of these impacts and the profound alterations by which the river has passed, contributed for expressive alterations in different characteristics of accomplished fishing in this Brazil's Important River.

Fresh water fishing in Brazil is a traditional activity, initially practiced by the indian, transforming itself in an important economic activity in Brazil's Several Regions [2]. Fishing data are scarce and interrupted on the Tietê river, highlighting the work developed by Monteiro [3], Machado et al. [4] and CNEC [5] before the dammings and Torloni et al. [6] after the dammings. Along years the fishing on the Tietê river suffered profound alterations, among them the reduction of the fishing stock, mostly in extracts that cut São Paulo's Metropolitan Area. Modification in the composition of the fish also occurred in view of the dammings, retreat of the ciliary wood and species introduction. With this, there were also modifications in the techniques and in the fishing equipment used by the fishermen. The present work characterizes the fishing of the Tietê river along years and shows the transformations that the fishing suffered along years until current days.

2 Tietê river: characterization

The Tietê river crosses practically the whole territory in São Paulo State, it flows from Serra do Mar until Paraná river. It is the main tributary of the left margin of Paraná river, having its nascent located in Salesópolis' Municipal district and its mouth near to Itapura's Municipal district. Its total length belongs to 1150 Km and the great difference of its course has been being seized for the several dams construction destined to the electric power production. It is, nowadays, a navigable river in the extract of the dam of Jupia, on Paraná river (40 Km) and in the extracts among Barra Bonita dams and of Nova Avanhandava (443 Km). Its basin owns about 72.000 Km², and 96% of urban areas. The river cuts one of the regions more densely populated of South America, totalizing 210 municipal districts (Illustration 1).

3 The fishing on the river Tietê: historical context

Historically the first reports of fishing on the Tietê river date from the 17th century [10], but previously to that the Indian had already accomplished the fishing. Until 18th century the fishing was accomplished mostly in the High Tietê, being the region of Pari (floodplain situated between Tietê river and its tributary Tamanduateí) the main center fishing, being the fish a great vendor for the population. They used as fishing equipment the dragging and tingujada (to poison the fish). The Indian employed the Pari rods trap, forming an enclosure, also called “paritá”. In the 18th century, it was already prohibited the use of the net of drag and of timbó, because they already knew the risk of this kind of fishing for the fishes populations [10].

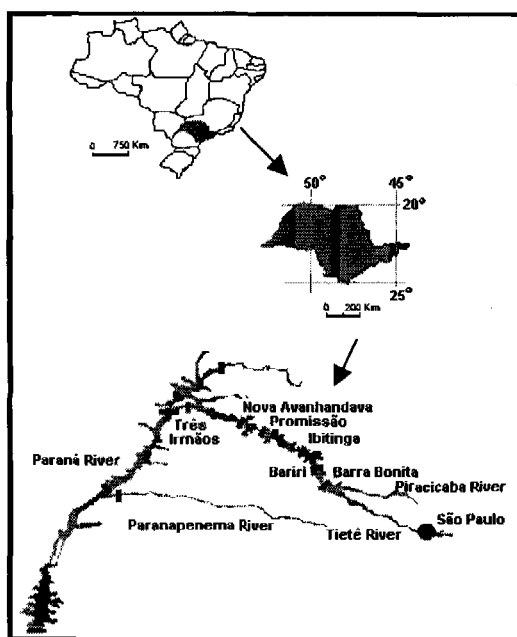


Figure 1: Map of the Tietê basin showing location of Tietê river.

In 1783, Cardoso de Abreu [7], pointed out that countless canoes went up river-above for the fishing, returning after six to seven days, with great loads of fish, mostly pintado (*Pseudoplatystoma corruscans*), jaús (*Paulicea luetkeni*), dourado (*Salminus maxillosus*), pacus (*Myleus* sp), piracanjubas (*Brycon* sp), piabuços (*Leporinus* sp), saupês and piraguasciaras. Smaller postage species were scorned, such as ximborês (*Schizodon* sp), lambaris (*Astyanax* sp, several species), jurupocas (*Hemisorubim platyrhynchos*) and bagres (*Rhamdia quelen*).

In the 18th century, the fishing remained intense in the High Tietê, being responsible for the supply of the cities and towns located in the High Tietê, as well as in the medium Tietê. The fishing in the low Tietê started then to be accomplished. The fishermen went down until Avanhandava's Jump, today

dammed. In this route fished large jaús (*Paulicea luetkeni*), that according to reports of the time reached 90 Kg. With the fishes they cut and salted and later they were sold in towns. According to reports of the beginning of the 20th century the fishes in the Tietê river, in São Paulo's surroundings were being scarce, by the poisoning of waters, loaded of industrial litters and of other activities. But there were still bagres and mandis (*Rhamdia quelen* e *Pimelodus maculatus*), lambaris (*Astyanax* sp, several species) and traíras (*Hoplias malabaricus*).

More recently in the first half the 20th century the fishing in the Tietê river was accomplished using cast net, gill nets, trap and fish line. The boats introduced stern motor, what is an advantage for the fishing compared with the 18th centuries and 19th centuries there where were accomplished in canoes [4]. The species fished were differentiated in three groups determined by the quality of the fish, considering the dourado (*Salminus maxillosus*), pacu (*Piaractus mesopotamicus*), piapara (*Leporinus* sp), pintado (*Pseudoplatystoma corruscans*) and for piracanjuba (*Brycon* sp) as fine, barky fish (*Hypostomus* sp), jurupoca (*Hemisorubim platyrhynchos*) and mandi (*Pimelodus maculatus*) as first-rate fish and bagre (*Rhamdia quelen*), curimatá (*Prochilodus* sp), jaú (*Paulicea luetkeni*), lambari (*Astyanax* sp, several species), piava (*Leporinus* sp), piranha (*Serrassalmus spilopleura*) and traíra (*Hoplias malabaricus*) like popular fish. The sagüürs were very abundant in Tietê, but they were totally scorned, for the commerce [4].

In 1960 the fishing in the Tietê river started to suffer more intensely the action of the dammings and of the species introduction. The dammings accomplished in the medium and low Tietê practically exterminated locally species as the dourado (*Salminus maxillosus*), jaú (*Paulicea luetkeni*) and the pintado (*Pseudoplatystoma corruscans*). Moreover, herbivorous species that also depended on the ciliary woods became rare [8]. With the goal of compensating the species that disappeared, aiming benefit the fishery, CESP accomplished countless introductions as for corvina (*Plagioscion squamosissimus*), tucunaré (*Cichla* sp), apaíari (*Astronotus ocellatus*), tilápia (*Tilápia rendalli*, *Oreochromis* sp, etc) among other kinds. Nowadays the fish composition is very different from the composition of the 17th centuries, 18th and 19th and the first half of the 20th centuries.

4 Fish: modifications in its composition

In the 18th century, the ciliary wood was already pledged in the high side of Tietê [7]. More recently the dammings in the average and low extract, the species introductions and the continuous loss of ciliary wood and pollution intensified the modifications in the composition of the fish. In the 17th, 18th and 19th centuries predominated in the fishing, migrants species as the dourado (*Salminus maxillosus*), the pintado (*Pseudoplatystoma corruscans*) and jaú (*Paulicea luetkeni*), not meaning that the smaller species were not fished, but they were scorned by its small commercial value (Table 1). From of the 19th century such species started to get scarce in the extract that cuts the São Paulo's Metropolitan Area, just remaining bagres (*Pimelodus maculatus* and *Rhamdia quelen*), lambaris (*Astyanax altiparanae* and *Astyanax fasciatus*) and traíras

(*Hoplias malabaricus*) [7]. From then on the fishing became intense in the average and low extend of the river, where we could still fish noble species.

In the first half of the 20th century the fishing still had its your noble species composition as the dourado (*Salminus maxillosus*), pacu (*Piaractus mesopotamicus*), pintado (*Pseudoplatystoma corruscans*) and piracanjuba (*Brycon* sp) (Table 1). In this time the reservoirs of the Medium and Low Tietê had not been formed. From decade on of 60 these species started to occur in reduced number, what it resulted from decade on of 80 in almost total absence of these species in the composition of the fish in the medium and low Tietê. To leave of this the fish is predominantly compound by curimbatá (*Prochilodus* sp), corvina (*Plagioscion squamosissimus*), traíra (*Hoplias malabaricus*), sagüirus (*Cyphocharax modestus* and *Steindachnerina insculpta*), lambaris (*Astyanax* sp, several species), mandis (*Pimelodus maculatus*) and pirambebas (*Serrassalmus spilopleura*) [6] (Table 1). It should be pointed out that these species are of small size and many were scorned previously besides the increment of species introduced in the current composition.

Table 1. Composition of the fish in the Tietê river from 17th century until the current days.

Period	Composition
17 th , 18 th and 19 th centuries	<i>Paulicea luetkeni</i> , <i>Pseudoplatystoma corruscans</i> , <i>Salminus maxillosus</i> , <i>Piaractus mesopotamicus</i> , <i>Brycon</i> sp, <i>Leporinus</i> sp (várias espécies), <i>Schizodon</i> sp, <i>Astyanax</i> sp (várias espécies), <i>Hemisorubim platyrhynchos</i> , <i>Rhamdia quelen</i> , <i>Hoplias malabaricus</i> , <i>Cyphocharax modestus</i> e <i>Steindachnerina insculpta</i> .
First half of the 20 th century	<i>Salminus maxillosus</i> , <i>Piaractus mesopotamicus</i> , <i>Leporinus</i> sp, <i>Pseudoplatystoma corruscans</i> , <i>Brycon</i> sp, <i>Hypostomus</i> sp, <i>Hemisorubim platyrhynchos</i> , <i>Pimelodus maculatus</i> , <i>Rhamdia quelen</i> , <i>Prochilodus</i> sp, <i>Paulicea luetkeni</i> , <i>Astyanax</i> sp (several species), <i>Schizodon</i> sp, <i>Serrassalmus spilopleura</i> e <i>Hoplias malabaricus</i> .
20 th century (second half until current days)	<i>Geophagus brasiliensis</i> , <i>Astyanax altiparanae</i> , <i>Schizodon nasutus</i> , <i>Plagioscion squamosissimus</i> e <i>Serrassalmus spilopleura</i> , <i>Moenkhausia intermedia</i> , <i>Cichla</i> sp, <i>Metynnys maculatus</i> , <i>Satanoperca jurupari</i>

Source: [4]; [7]; [6]

Smith et Al. [8] showed clearly the reduction of the migrants species capture on the professional fishing in the area where is situated Barra Bonita reservoir. In 1951 before the damming, it fished a great quantity of curimbatás (*Prochilodus* sp), dourado (*Salminus maxillosus*), jaús (*Paulicea luetkeni*) and pintado (*Pseudoplatystoma corruscans*). In 1989 after the construction, these numbers fell so much that many of these species practically disappeared of this body of water. Agostinho et al. [9] also verified alterations in the composition of the fish from 1977 to 1997, in Paraná river indicating that before the damming most species were migrants such as *Paulicea luetkeni*, *Salminus maxillosus*, *Prochilodus lineatus* and after the damming predominate species not migrants

such as *Pterodoras granulosus*, *Plagioscion squamosissimus* and *Hypophthalmus edentatus*. Agostinho *et al.* [10] comment that in reservoirs occurs the change of the composition and structure of the fishes assemblies, with excessive proliferation of some species and the decrease or even the extinction of others. The most notable answer in the fishes community in dammings was not the species disappearance, but the modifications in its structure [10].

Such impacts do not carry loss for all the species. There are species that benefit mostly by the damming. Most of these species is of small size, adapted to live in lentic environment, because they introduce parcelled spawning, they are not migrants and are adapted to use the most abundant resources in the reservoirs as detritus, superior vegetables, algae and fishes. In the High Paraná we can cite the sagüirus (*Cyphocharax modestus* and *Steindachnerina insculpta*), lambaris (*Astyanax altiparanae*, *Astyanax fasciatus* and *Moenkhausia intermedia*), that complete the reproductive cycle in the own reservoir or in its influential area. For these species, the effect was the opposite, because they had their increased abundances, due to the modification from lotic environment for lentic, turning the most favorable terms [11].

The alteration in the described fishes communities above seems to be the main characteristic of dammings. The tables 2 and 3 show for ichthyofauna predominant before and after of the dammings on the Tietê river. As well as it verified Agostinho *et al.* [9] on Paraná river, on the Tietê river before the damming the migrant species were abundant. Nowadays they predominate not migrants species and also the introduced ones. Moreover, the fishermen point out that fishes as the dourado and the pintado rarely are captured and that the composition of the species in the fishing changed a lot in the last years (decades) in view of the dammings and of the introduction of species. It important to here point out the high capture of introduced species as for corvina (*Plagioscion squamosissimus*), pacuzinho (*Metynnis maculatus*) and cará (*Satanoperca jurupari*). These two last were not very used, but due to their high abundance in the fishing, they have been being used and, sold in the tenderloin form. The fishing now is dominated by rustic species and of small size in substitution of larger species and larger commercial value [9].

The loss of the bank vegetation (riparian), also contributed to change the composition of the fish, reducing the stock of piracanjuba (*Brycon orbignyanus*). These species practically disappeared of the Tietê river. The ciliary wood is important for its feeding, typically herbivorous. Monteiro [3] for example, has already mentioned that the removal of the banks vegetation would bring loss for the feeding of the herbivorous species, frugivorous and insetivorous, besides the shelters loss, letting exposed smaller fishes to the voracity of the carnivorous. In this time, piracanjubas (*Brycon orbignyanus*) were very abundant, but today they are rare, occurring with low abundance in the tributary of the reservoirs and in some rivers above Barra Bonita. The loss of the ciliary wood also got scarce other species as pacu (*Piaractus mesopotamicus*) and pacuzinho (*Myleus tiete*), species that also practically disappeared of the Tietê river. Associate to these impacts were should highlight the introduction of approximately 13 or 14 species on the Tietê river. Many of them, nowadays are the most caught by the artisanal and

sport fishing, such as for corvina (*Plagioscion squamosissimus*) and tucunaré (*Cichla* sp).

Table 2. Composition of the species before the damming of the medium and low Tietê river.

Extend	Before dam
Medium	<i>Prochilodus</i> sp, <i>Hypostomus</i> sp, <i>Pimelodus maculatus</i> , <i>Pseudoplatystoma corruscans</i> , <i>Salminus maxillosus</i> , <i>Paulicea luetkeni</i> , <i>Brycon</i> sp, <i>Piaractus mesopotamicus</i> e <i>Astyanax</i> sp (several species)
Low	<i>Prochilodus</i> sp, <i>Hypostomus</i> sp, <i>Pimelodus maculatus</i> , <i>Pseudoplatystoma corruscans</i> , <i>Salminus maxillosus</i> , <i>Paulicea luetkeni</i> , <i>Brycon</i> sp, <i>Piaractus mesopotamicus</i> , <i>Leporinus</i> sp, <i>Schizodon</i> sp, <i>Rhamdia quelen</i> e <i>Acestrorhynchus lacustris</i>

Table 3. Composition of the species after the damming in reservoirs of the Tietê river.

Reservoir	After dam
Barra Bonita	<i>Cyphocharax modestus</i> , <i>Astyanax altiparanae</i> , <i>Steindachnerina insculpta</i> , <i>Plagioscion squamosissimus</i> e <i>Moenkhausia intermedia</i>
Bariri	<i>Geophagus brasiliensis</i> , <i>Astyanax altiparanae</i> , <i>Schizodon nasutus</i> , <i>Plagioscion squamosissimus</i> e <i>Serrassalmus spilopleura</i>
Ibitinga	<i>Serrassalmus spilopleura</i> , <i>Astyanax altiparanae</i> e <i>Steindachnerina insculpta</i>
Promissão	<i>Moenkhausia intermedia</i> , <i>Cichla</i> sp, <i>Astyanax altiparanae</i> , <i>Serrassalmus spilopleura</i> , <i>Plagioscion squamosissimus</i>
Nova Avanhandava	<i>Astyanax altiparanae</i> , <i>Plagioscion squamosissimus</i> , <i>Serrassalmus spilopleura</i> , <i>Moenkhausia intermedia</i> , <i>Metynnis maculatus</i> e <i>Satanoperca jurupari</i>
Três Irmãos	<i>Metynnis maculatus</i> , <i>Cichla</i> sp, <i>Schizodon nasutus</i> , <i>Satanoperca jurupari</i> , <i>Serrassalmus spilopleura</i>

5 Species introduction

More than 20 fishes species of other basins were introduced into the Basin of the High Rio Paraná. [12]. On the Tietê river, countless species of exotic and alloctone fishes were introduced during the passing years. According to Petrere *et al.* [1], the species started being introduced into the reservoirs of the medium and low Tietê. For example, the corvina (*Plagioscion squamosissimus*) was introduced into São Paulo's State in 1966 by CESP, in Pardo river, arriving to the Grande river and soon after to Paraná river and in the reservoirs of Ilha Solteira and Jupiá, when they initiated the colonization of the Tietê river [13;14]. For the other introduced species there are no reports or information of their authorship [14;1]. Many of these species have been registered in experimental and artisanal fishing on the river Tietê. These species were introduced for food production ends, increase of the stocks and increment of the professional and amateur fishing. Only to have an idea to what point the introductions, arrived from 1980 to 1990 several farmers launched on the Tietê river from the high by planes young fishes, mostly of blackbass (*Micropterus salmoides*) (Prof. Torloni, pers. comm. for Miguel Petrere Jr.).

Most introductions were accomplished from the construction of the reservoirs such as blackbass (*Micropterus salmoides*) in Ponte Nova dam, for corvina (*Plagioscion squamosissimus*) and tucunaré (*Cichla* sp) in the reservoirs of the medium and low Tietê. Other species also could have arrived to the river Tietê through the dammings, like tilápias (*Tilapia rendalli* and *Oreochromis niloticus*) introduced into the São Paulo's State in 1952 by São Paulo Light, imported from Congo, with the goals of populating the dams in Serra do Mar's top and the carp (*Ciprinus carpio*) introduced about in 1939. That does not mean that there were new introductions of these species in more recent years

On the Tietê river, from 80 species of identified fishes, 13 species are introduced, and 4 are exotic and nine are alloctones. This number can be larger, because of the great number of fishing and properties with pisciculture, can be increasing the occupation of the basin for new species of accidental or deliberate form objectifying the activity of sport fishing. The most abundant species and easier of capture are blackbass (*Micropterus salmoides*) and tilápia (*Oreochromis niloticus*) in Ponte Nova dam (high Tietê), for corvina (*Plagioscion squamosissimus*), tucunaré (*Cichla* sp), the sardine (*Triportheus signatus*), for tilápia (*Tilapia rendalii*) and cará (*Satanoperca jurupari*) in the average and low extract. In the past the species introductions were seen with interest for the increase of the commercial fishing. Today, however it is consensus that such practice is inadvisable and could have contributed for the reduction and even the disappearance of native species [15].

6 The modalities fishing

According to Petrere [2] there are four kinds of fisheries in Brazil, the sport, the artisanal of great scale and small scale and the one of subsistence. Depending on the region where is inserted the river can have these several kinds fishing. In the southeast region where its inserted the Tietê river predominates the sport fishery and of subsistence, also in spite of being the artisanal of small scale. The fishing on the Tietê river nowadays is very heterogeneous, constituted by the professional fishing (artisanal), amateur and sport. The distinction between amateur and sport fishing should be made, since the amateur fishing that is accomplished by the population in general, without the goal of fishing a specific species and using the fishes for the consumption. He who accomplishes the sport fishing search certain species as tucunaré (*Cichla* sp) and does not necessarily consumes them

The fishing on the Tietê river was of commercial nature and in smaller scale, sport [8]. According to CNEC [5] the fishing on the Tietê river was artisanal, being the amateur fishing spread by the whole status and foun on the river. In Salesópolis, in the high Tietê, the fishing was artisanal [4]. More recently the sport fishing grew on the river Tietê, mostly after the species introduction as tucunaré. Many cities located in the banks of the river as Barra Bonita, Pereira Barreto, Araçatuba, accomplish fishing tournaments using these species as main attractiveness for the fishermen and to spread the tourism for the fishing. The sport fishing is the second sport practiced most in Brazil, and certainly one of the most practiced by everybody

7 Measures for the maintenance and recovery of the fishing stocks

In spite of there are countless ways to mitigate impacts and to improve the terms of the Tietê river, none of them is of easy implementation. It is notorious that measure as treatment of the domestic and industrial effluent, recovery of the ciliary woods, combat to the species introduction and not damming of the rivers or even the use of more efficient techniques so that the fishes transpose the dams, would contribute so that the fishing stocks would be kept or returned to a state next to original, as it is the countless species case that occurred previously to the impacts that the river Tietê suffered has been suffering. Hilsdorf & Petreire Jr. [15] pointed out that the preservation of ichthyofauna and the recovery of the stocks depend on measured that avoid the degradation of the river. According to the Organization of the United Nations for Food and Agriculture (FAO), the commission for the continental fishing of Latin America and of the Caribbean, the most serious problem for the continental fishing is the degradation of the environment

Vieira & Pompeu [16] point out among measures that should be encouraged for the preservation and maintenance of the fishes diversity are the adequate treatment of domestic effluent and industrial, preservation of the ciliary wood, increase of the structural complexity of changed environments. Fishing according to these same authors can be auxiliary tools for the preservation of the fauna of native fishes, especially those that are becoming rare. However, its use as option of environmental repair should be reviewed, because in lots of cases they were responsible for introductions of exotic and alloctone species, causing damages to the environment that will never be repaired.

Restocking is a valid measure to recover the fishes populations, with the goal of increasing the gain of needy populations. This action should be accompanied of measures of treatment of the industrial and domestic effluent and of protection of the ciliary woods [15]. Moreover, measures that make possible the preservation and the handling of fishes on the Tietê river should be implemented such as: transform adjacent areas to the reservoirs as implantation recovery activities permanent preservation and objects areas of the original vegetation; preservation of tributary that are used by the migrant species for the reproduction; identification of the exotic and alloctone species that are responsible for the biodiversity loss, promote the handling of these species through the professional fishing and/or sport, increase the habitats through fish attracts, control of the fishing and prohibition in reproduction season and control of the use of fishing equipment.

Bibliography

- [1] Petreire, M. Jr., Agostinho, A.A., Okada, E. K., Júlio Jr., H. F., Review of the Fisheries in the Brazilian portion of the Paraná/Pantanal basin (Chapter 11). *Management and ecology of lakes and reservoir fisheries*, ed. I.G. Cowx: England, pp.123-144, 2002.
- [2] Petreire Jr., M. A pesca de água doce no Brasil. *Ciência Hoje*, 110 (19), pp. 28-33, 1995.



- [3] Monteiro, F. S., *Contribuição ao estudo da pesca no rio Piracicaba*. Tese ESALQ, pp. 76, 1953.
- [4] Machado, C. E. M., Miguel, J., Abreu, L. C. & Martins, M. A. B., *A Pesca no rio Tietê*, Publicação n° 8, Secretária de Agricultura, pp. 1-29, 1968.
- [5] Consórcio Nacional de Engenheiros Consultores (CNEC), *O barramento dos rios e a fauna ictiológica*, SP, pp.122, 1969.
- [6] Torloni, C. E. C.; Corrêa, A. R. A.; Carvalho Jr., A. A.; Santos, J. J.; Gonçalves, J. L.; Gereto, E.J.; Cruz, J A.; Silva, D. C.; Deus, E. F. & Ferreira, A S., *Produção pesqueira e composição das capturas em reservatórios sob concessão da CESP nos rios Tietê, Paraná e Grande, no período de 1986 a 1991*. Série Produção Pesqueira, 1; CESP, pp. 73, 1993.
- [7] Nóbrega, M., *História do rio Tietê*, São Paulo, Governo do Estado, pp. 219, 1978.
- [8] Smith, W. S., Espíndola, E. L. G., Pereira, C. C. G. F. & Rocha, O., Impactos dos reservatórios do médio e baixo Tietê (SP) na composição das espécies de peixes e na atividade de pesca. *Recursos hidroenergéticos: usos, impactos e planejamento integrado*, São Carlos, SP, pp. 57-72, 2002.
- [9] Agostinho, A. A.; Okada, E. K.; Gregoris, J., A pesca no reservatório de Itaipu: Aspectos Sócio-Econômicos e Impactos de Represamento. *Ecologia de Reservat6t6rios: Estrutura, funç6o e aspectos sociais*, ed. Henry, R., pp. 279-320, 1999.
- [10] Agostinho, A. A.; Julio Jr., H.F. & Borghetti, J. R, Considerações sobre os impactos dos represamentos na ictiofauna e medidas para sua atenuação. Um estudo de caso: Reservatório de Itaipu. *Rev. Unimar*, 14, pp. 89-107, 1992.
- [11] Castro, R. M. C.; Arcifa, M. F., Comunidades de peixes de reservatórios do sul do Brasil. *Rev. Bras. Biol.*, 47 (4), pp. 493-500, 1987.
- [12] Agostinho, A. A.; Vazzoler, A. E. A. M. & Thomaz, S.M, The high River Paraná Basin: limnological and ichthyological aspects. *Limnology in Brazil*, ed. Tundisi, J. G.; Bicudo, C. E. M.; Matsumara-Tundisi, T., Rio de Janeiro, ABC/SBL, pp. 59-103, 1995.
- [13] Braga, F. M. de Sousa., Alimentação de *Plagioscion squamosissimus* (Osteichthyes, Scianidae) no reservatório de Barra Bonita, Estado de São Paulo. *Iheringia*, Ser. Zool., Porto Alegre, (84), pp. 11-19, 1998.
- [14] Agostinho, A. A.; Julio Jr., H.F., Peixes de outras águas. *Ciência Hoje*, 21(124), pp. 26-44, 1996.
- [15] Hilsdorf, A. W. & Petrer, M., Conservação de peixes na bacia do rio Paraíba do Sul. *Ciência Hoje*, 30(180), pp.62-65, 2002.
- [16] Vieira, F. & Pompeu, P. dos S., Peixamentos: Uma alternativa eficiente ?. *Ciência Hoje*, 30(175), pp. 28-33, 2001.