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Analysis of Physicochemical Parameters From The Water of Pará River In Mosqueiro Island of Belém - Pará (Brazil) – 2023-2024

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Abstract
Justification: *The Pará River, also called the Marajó Canal, bathes the river island of Mosqueiro, which belongs to the Municipality of Belém in Pará State (Brazil). The island of Mosqueiro's economy is mainly focused on tourism, fishing, small businesses, and agriculture. Rivers are one of the most fragile parts of Amazonian water resources, in this sense it is necessary to monitor anthropogenic impacts to understand the risks and preservation, especially of a river that is a source of economy for the local population.*
General objective: *To identify possible impacts of urban development on the limnological resources of the Island of Mosqueiro in Belém of Pará.* ***Specific objectives:*** *Identify possible risk agents for local environmental degradation; predict possible impacts on environmental health due to the degradation of limnological resources, among others.*
Methodology: *Water samples were collected from the Pará River in the Furo das Marinhas, Carananduba beach, Murubira beach, at different times and tidal situations (high and low), always in the morning and with in-locus analysis. The pH was measured in the samples using a portable electronic pH meter and compared with test strips as a control. The electrical conductivity values of the water samples were measured using a portable electronic conductivity meter, expressed in* $\mu S/cm^{-1}$*, as well as the sample temperature and Total Dissolved Solids. For environmental temperature, an environmental thermometer was used. The samples were subjected to multiparameter test strips with 3 tests for each sample to identify: alkalinity, lead, bromine, nitrate, nitrite, iron, chromium (VI), copper, Mercury, fluoride, among others. The Secchi disk was used to evaluate turbidity, visibility in centimeters, among others. The qualitative observational method was used to obtain information regarding anthropogenic environmental pollution in the studied river and its surroundings and the presence of wild flora and fauna.*
Conclusions: *There is a need to monitor aquatic and terrestrial biota, implement public policies for selective waste collection, control construction in the beach area, preserve local flora and fauna, including programs to control and/or remove exogenous species; environmental education programs involving the economic sector, government and communities; adequate treatment of wastewater, among others that can guarantee the environmental safety of the island of Mosqueiro.*
Key words*: Environmental chemistry, Water analysis, Limnology, Hydrographic basin, Pará River - State of Pará (Brazil), Mosqueiro Island (Brazil).*

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I. Introduction

The Greek philosopher Heraclitus stated that "*you never cross the same river twice*". The second time it is not the same river we cross, as the characteristics of the water, to a greater or lesser extent, will certainly be different. The dissolution and transport capacity leads to the fact that the quality of water is the result of the processes that occur in the liquid mass and in the water body's drainage basin. It appears that the aquatic system is not formed solely by the river or the lake, but necessarily includes the contribution basin, exactly where the phenomena that will give the water its quality characteristics occur[1].

Large rivers have enormous economic, ecological and social importance. They are highly biodiverse ecosystems and sources of food for millions of people. In addition, they provide transportation through navigation and stimulate local and regional economies. The great rivers of South America are also enormously important from an economic point of view. In addition to meeting the protein needs of local and regional populations, they are used for navigation, irrigation, recreation, and sport fishing[2].

The Pará River, also called the Marajó Canal, appears brown in color, due to the influence of sediments and leaching of rocks from the banks along its course, and bathes the river island of Mosqueiro, which belongs to the Municipality of Belém.

Mosqueiro island is located on the eastern coast of the Pará River, in the south branch of the Amazon River, in front of the Guajará Bay. It has an area of approximately 212 km². It has several beaches, including: Areão, Trapiche, Bispo, Praia grande, Prainha, Farol, Chapéu Virado, Marahu, Porto Artur, Murubira, Ariramba, São Francisco, Carananduba, Paraíso, Baía do Sol, dentre outras[3].

The island of Mosqueiro's economy is mainly focused on tourism, fishing, small businesses, and agriculture. Many residents use the island as a dormitory city, going to work and/or study in seat of the municipality or nearby cities, leaving the island in the morning and returning at night, generally by road.

The general objective of this paper is to identify possible impacts of urban development on the limnological resources of the Island of Mosqueiro in Belém of Pará States, and as specific objectives: Identify possible risk agents for local environmental degradation; predict possible impacts on environmental health due to the degradation of limnological resources, among others.

II. Methodology

Water samples were collected from the Pará River in the "Furo das Marinhas", Carananduba beach, Murubira beach, at different times and tidal situations (high and low), always in the morning and with *in-locus* analysis.

The pH was measured in the samples using a portable electronic pH meter and compared with test strips as a control. The electrical conductivity values of the water samples were measured using a portable electronic conductivity meter, expressed in µS/cm-1 (micronSiemes per centimetre), as well as the sample temperature and Total Dissolved Solids. For environmental temperature, an environmental thermometer was used.

The samples were subjected to multiparameter test strips with 3 tests for each sample to identify: alkalinity, lead, bromine, nitrate, nitrite, iron, chromium (VI), copper, mercury, fluoride, among others. The Secchi disk was used to evaluate turbidity, visibility in centimeters, among others.

The qualitative observational method was used to obtain information regarding anthropogenic environmental pollution in the studied river and its surroundings and the presence of wild flora and fauna.

III. Results and discussions

Mosqueiro Island. Source: Google maps[4].

FURO DAS MARINHAS – East of the island					
Parameters	**Sample 1 18/07/2023**	**Sample 2 18/10/2023**	**Sample 3 24/11/2023**	**Sample 4 13/03/2024**	**Maximum values Tolerability/Source**
Environmental visibility	Normal	Normal	Cloudy	Moderate	-
Wind	Absent	Absent	Absent	Absent	-
Environment temperature Cº	28	29,8	31,8	32,4	-
Ciliary forest	Yes	Yes	Yes	Yes	Varies depending on the type and width of the river
Tide	High	Low	High	Low	-
Aquatic macrophyte	No	No	No	No	Must not present eutrophication
Ph	6,0	6,2	7,0	6,2	5-9
Temp Cº - Sample	31,2	27,5	29,3	27,3	-
Secchi disk depth/Cm	67	45	95	16	-
Color	Light Brown	Light Brown	Greenish	Dark brown	-
Turbidity	Normal	Normal	Normal	Dense	-
Odour	Normal	Normal	Normal	Normal	Substances that produce odor must be absent – CONAMA-BR[5]
Electrical conductivity (mS/cm^{-1})	2,736	4,092	5,164	0,092	Depends on ions and others
TDS (Total Dissolved Solids)	1,378	2,046	2,582	0,046	500 mg/l CONAMA-BR[5]
Alcalinity	-	40	0	0	-
Carbonate	0	0	0	0	-
Water Hardness mg/l	100	100	100	100	<75mg/l Soft 75 at 150 Moderate >150mg/l Hard Mol. et al[6].
Lead	0	0	10	20	0,01 mg/l CONAMA-BR[5]
Bromine	0	10	1	0	0,5mg/l (500 µg/l) WHO[7]
Nitrate	0	0	0	0	0,40 mg/l CONAMA-BR[5]
Nitrite	0	0	0	0	0,07 mg/l CONAMA-BR[5]
Iron	0	0	0	1	0,3 mg/l CONAMA-BR[5]
Chromium (VI)	0	0	0	1	0,05 mg/l – WHO[7] 0,05 mg/l CONAMA-BR[5]
Copper	1	0	0	0	0,005 mg/l CONAMA-BR[5]
Mercury	0	0	0	0	0,0002 mg/l Hg CONAMA-BR[5] 0.006 mg/l (6 µg/l) for inorganic mercury – WHO[7]
Fluoride	0	0	0	0	1,4 mg/l CONAMA-BR[5] 1,5mg/l (1500 µg/l) WHO[7]

(*) Determination for brackish water salinity > 0.5 ‰ and ≤ to 30 ‰[5].

"Furo das Marinhas" on the edge of Mosqueiro Island, with emphasis on the mangrove forest. Photo by Aureliano Guedes II

CARANANDUBA BEACH – Northwest of the island					
Parameters	**Sample 1 18/07/2023**	**Sample 2 18/10/2023**	**Sample 3 07/12/2023**	**Sample 4 13/03/2024**	**Tolerability/Source**
Environmental visibility	Normal	Normal	Normal	Normal	-
Wind	-	Low	Absent	Absent	-
Environment temperature Cº	31,2	32,8	27,4	32,8	-
Ciliary forest	Yes	Yes	Yes	Yes	Varies depending on the type and width of the river
Tide	High	Low	High	Low	
Aquatic macrophyte	Absent	Absent	Absent	Absent	Must not present eutrophication
Ph	6,2	6,2	6,8	6,2	5-9
Temp Cº - Sample	29,8	33,0	29,4	29,1	-
Secchi disk depth/Cm	43	50	64	23	-
Colour	Light brown	Light brown	Light brown	Dark brown	-
Turbidity	Normal	Normal	Normal	Normal	-
Odour	Normal	Normal	Normal	Normal	Substances that produce odour must be absent – CONAMA-BR[5]
Electrical conductivity-(mS/cm). Ω±1cm	1,884	4,452	3,840	0,118	Depends on ions and others
TDS (Total Dissolved Solids)	0,942	2,226	1,920	0,059	500 mg/l CONAMA-BR[5] 1,000-10,000
Alcalinity	0	0	0	0	
Carbonate	0	0	0	0	
Water Hardness mg/l	25	250	250	250	<75mg/l Soft 75 at 150 Moderate >150mg/l Hard Mol. et al[6].
Lead	0	0	0	15	0,01 mg/l CONAMA-BR[5]
Bromine	0	1	0,5	0	0,5mg/l (500 µg/l) WHO[7]
Nitrate	0	0	0	0	0,40 mg/l CONAMA-BR[5]
Nitrite	0	0	0	0	0,07 mg/l CONAMA-BR[5]
Iron	0	0	0	2	0,3 mg/l CONAMA-BR[5]
Chromium (VI)	0	0	0	1	0,05 mg/l – WHO[7] 0,05 mg/l CONAMA-BR[5]
Copper	0	0	0	0	0,005 mg/l CONAMA-BR[5]
Mercury	0	0	0	0	0,0002 mg/l CONAMA-BR[5] 0.006 mg/l (6 µg/l) for inorganic mercury – WHO[7]
Fluoride mg/l	25	0	0	0	1,4 mg/l CONAMA-BR[5] 1,5mg/l (1500 µg/l) WHO[7]

(*) Determination for brackish water salinity > 0.5 ‰ and ≤ to 30 ‰[5].

Carananduba Beach with low tide with an emphasis on *Ardea alba*. Photo by Aureliano Guedes II.

MURUBIRA BEACH – West of the island					
Parameters	**Sample 1 18/10/2023**	**Sample 2 24/11/2023**	**Sample 3 13/03/2024**	**Sample 4 22/05/2024**	**Tolerability/Source**
Environmental visibility	Normal	Normal	Cloudy	Normal	-
Wind	Absent	Absent	Absent	Moderate	-
Environment temperature Cº	27,8	31,8	31,4	28,0	-
Ciliary forest	No	No	No	No	Varies depending on the type and width of the river
Tide	Low	High	Low	High	-
Aquatic macrophyte	Absent	Absent	Absent	Absent	Must not present eutrophication
Ph	6,2	6,2	6,2	6,2	5-9
Temp Cº - Sample	30,1	31	25,7	30,1	-
Secchi disk depth/Cm	51	25	17	28	-
Color	Light brown	Light brown	Dark brown	Clay brown	-
Turbidity	Normal	Normal	Normal	Normal	-
Odour	Normal	Normal	Normal	Normal	Substances that produce odor must be absent – CONAMA-BR[5]
Electrical conductivity-(mS/cm). Ω±1cm	3,970	4,162	0,74	0,030	Depends on ions, geological aspects, pH and others
TDS (Total Dissolved Solids)	1,985	2,081	0,037	0,025	500 mg/l CONAMA-BR[5] 1,000-10,000
Alcalinity	0	0	0	0	-
Carbonate	0	0	0	0	-
Water Hardness	250	250	0	100	<75mg/l Soft 75 at 150 Moderate >150mg/l Hard Mol. et al[6].
Lead	0	0	10	0	0,01 mg/l CONAMA-BR[5]
Bromine	0	1	0	0	0,5mg/l (500 µg/l) WHO[7]
Nitrate	0	0	0	0	0,40 mg/l CONAMA-BR[5]
Nitrite	0	0	0	0	0,07 mg/l CONAMA-BR[5]
Iron	0	0	0	5	0,3 mg/l CONAMA-BR[5]
Chromium (VI)	0	0	0	0	0,05 mg/l – WHO[7] 0,05 mg/l CONAMA-BR[5]
Copper	0	0	0	0	0,005 mg/l CONAMA-BR[5]
Mercury	0	0	0	0	0,0002 mg/l Hg CONAMA-BR[5] 0.006 mg/l (6 µg/l) for inorganic mercury – WHO[7]
Fluoride	0	0	0	0	1,4 mg/l CONAMA-BR[5] 1,5mg/l (1500 µg/l) WHO[7]

(*) Determination for brackish water salinity > 0.5 ‰ and ≤ to 30 ‰[5].

Murumbira beach with low tide with an emphasis on *Ardea alba*. Photo by Aureliano Guedes II.

In the chemical composition and processes in brackish waters, the dilution produced by freshwater in contact with seawater does not follow an expected theoretical linear pattern. For example, the concentration of bicarbonate drops very little when diluting seawater with fresh water. The concentrations of chlorides, sodium, and calcium, present approximately linear dilutions. The distribution of trace metals such as iron, manganese, cobalt, zinc, copper, and cadmium depend on the concentration of suspended material and its vertical distribution. In estuaries, in addition to sediments of inorganic origin, there is a wide variety of organic matter in suspension, resulting from the decomposition of organisms and excretion products[2].

Temperatures, both environmental and water, are important related to water density, preservation of microfauna and microflora, mainly nitrifying bacteria, among others, and are important in measuring pH. In this sense, the variation in the temperature of the water samples and the environment shows the characteristics of the hot humid climate of the studied region, therefore with a strong influence on the characteristics of the flora, fauna, hardness and pH of the samples. The temperatures of the samples varied, in the different collection periods, between 25.7ºC and 33ºC, while the environmental temperature varied between 27.4ºC and 32.8ºC. in the various measurement periods.

In temperature of water in tropical regions, conductivity values in aquatic environments are related to the geochemical characteristics and the climatic conditions (dry and rainy season) they are located, but can also be influenced by the trophic state, mainly in environments under anthropogenic influence[8].

In the case of pH from inorganic sources, it can be considered one of the most important abiotic variables in aquatic ecosystems, and at the same time one of the most difficult to interpret. This complexity in interpreting pH values is due to the numerous factors that can influence it. In addition to ion concentration, pH values can be influenced by temperature. In most cases, the variation in pH in natural waters depends on the concentrations of H_3O^+ ions, caused by the dissociation of carbonic acid[9].

Regarding pH, plant and animal communities in aquatic ecosystems have a close interdependence. This phenomenon occurs as aquatic communities interfere with pH, just as pH interferes in different ways with the metabolism of these communities. Regarding communities, pH acts directly on the permeability processes of the cell membrane, therefore interfering with intra and extracellular ionic transport and between organisms. Communities can interfere with the pH values of the environment in different ways. For example, through the assimilation of CO_2, that is, through autotrophic activity, as during the synthetic photos process, both aquatic macrophytes and algae can raise the pH of the environment. This fact is especially significant in environments that have relatively low water alcalinity values, such as Amazonian ecosystems[9].

The pH is also related to the hardness of the water, in the case of the beaches of Carananduba and Murubira, and the "Furo das Marinhas", the samples were between 6 and 7, and with water hardness varying due to rainfall influences and season of the year; however, it can be classified, in terms of hardness, as soft water in the "Furo das Marinhas" and, presenting soft to moderate hardness on the beaches of Carananduba and Murubira, without risks to human and environmental health.

A large variation in electrical conductivity (in millisiemens per centimetre) - mS/cm) of the studied areas can be observed, where the smallest factors were related to rainfall in the days prior to sample collection, they also showed a large change in the rainiest period and total dissolved solids (TDS), showing the great relationship between the two parameters.

Nitrate (NO_3^-) is found naturally in the environment and is an important plant nutrient. It is present at varying concentrations in all plants and is a part of the nitrogen cycle. Nitrite (NO_2^-) is not usually present in significant concentrations except in a reducing environment, because nitrate is the more stable oxidation state. It can be formed by the microbial reduction of nitrate and in vivo by reduction from ingested nitrate. both surface water and groundwater because of agricultural activity (including excess application of inorganic nitrogenous fertilisers and manures), from wastewater disposal and from oxidation of nitrogenous waste products in human and other animal excreta, including septic tanks. Nitrate can also occasionally reach groundwater because of natural vegetation. Surface water nitrate concentrations can change rapidly owing to surface runoff of fertiliser, uptake by phytoplankton and denitrification by bacteria, but groundwater concentrations generally show relatively slow changes. Nitrate and nitrite can also be produced as a result of nitrification in source water or distribution systems[7].

Rivers transport nitrogen in the form of nitrate, nitrite or ammonia, and silicate in soluble form[2]. The nitrite concentration is always very low (< 60 mg N-NO–2. ℓ^{-1}), as this chemical substance can be reduced chemically and/or through the activity of bacteria that reduce nitrate or oxidise ammonium. Especially in tropical waters, this concentration is very low and is often below the method's detection limit. Nitrite may occasionally accumulate in pockets with oxygen tensions below 1 mg O2ℓ^{-1} and in conditions of low stratification[2]. Inorganic nitrate is highly soluble and abundant in waters that receive high concentrations of nitrogen, resulting from the discharge of domestic sewage or agricultural activities[2].

In the samples collected on the island of Mosqueiro ("Furo das Marinhas", Murubira beach and Carananduba beach) no nitrite and nitrate were identified that could cause damage to human and environmental health. However, public policies for sewage treatment, selective collection of domestic waste and environmental education are needed to avoid future problems.

The main natural sources of trace elements for the continental aquatic environment are the weathering of rocks and the erosion of soils rich in these materials, other sources of trace elements have assumed great importance: industrial activities, through solid tributaries that are released directly into the atmosphere and liquids that are released into small streams or directly into rivers and lakes; Hg in mining activities; domestic effluents and surface water from areas cultivated with chemical fertilisers and mainly from those where agricultural pesticides are used (these contain the most varied trace elements such as: Cd, Hg, Pb, Cu, etc.). The atmosphere is also an important source of trace elements for aquatic ecosystems. There are several sources that enrich the atmosphere with trace elements, which through wet and dry precipitation can reach the aquatic environment. Among these sources, marine and biogenic aerosol stand out, resulting from the disintegration and dispersion of plants and animals, natural fires, particles of volcanic origin, and others carried by the wind (dust) and mainly industrial emissions directly into the atmosphere (anthropogenic source)[10].

Hexavalent chromium [Cr (VI)], among the various ionic forms of Cr, is the most toxic. This is generally an industrial by product widely used for pigment production, leather tanning, wood processing, chrome plating, metallurgical and chemical industries, stainless steel manufacturing, welding, cement production, ceramics, glass, etc. Cr (VI) levels have increased in soil, water and air, mainly due to increased use by industries and inadequate disposal of these residues in the environment[11].

In the last sampling collected on 13/03/2024 at “Furo das Marinhas” traces of Cr (VI) were detected and in the last sampling on Caranamduba beach on 13/03/2024 this chemical element was also detected, in these cases requiring new collections, in case the presence of (Cr (VI) is repeated, adequate tracking should be carried out to identify the strength for indications for depollution procedures; in no sample on Murubira beach this chemical element was identified.

The presence of copper was only identified in the first sampling on 18/07/2023 at “Furo das Marinhas”, as in other samples collected at this location, this trace element was not repeated and was considered as something punctual; in all samples collected on the beaches of Murubira and Carananduba, this trace element was not detected.

A source of water that is in contact with ores containing lead sulfide, or by another source of natural contamination, or other anthropic sources, with penetration into the human or animal organism via the gastrointestinal, dermal and/or respiratory route, may have effects accumulation in individuals, which at a level above the tolerability threshold, may cause pathologies related to calcium transport in the body, in the gastrointestinal tract and problems in the central nervous system (CNS) and peripheral nervous system (PNS) in a diffuse manner[12].

In the “Furo das Marinhas” the presence of trace element leads was detected in the samples: 3rd from 24/11/2023 and 4th from 13/03/2024, which may have originated from surface leaching of the soil or another reason due to heavy rains that occurred during the period. However, other sources may cause concern for human health, requiring more collection and tracking of the source of this trace element to ensure the health of those who use shellfish collected in this area or use the water for consumption. On Carananduba beach, the presence of lead only occurred in the 4th sample, collected on 13/03/2024, requiring tracking; on Morumbira beach, the presence of lead was only found in the 3rd sampling on 13/03/2024, not being repeated in other samples, indicating a specific situation. A fact that, in the case of “Furo das Marinhas”, may indicate some correlation with samples in other researched locations where the presence of lead occurred. It is recommended that there be further tracking to identify the source, whether seasonal or not.

It is believed that the formation of methylmercury in the aquatic environment occurs mainly through a reaction mediated by microorganisms (e.g., sulfate-reducing bacteria). However, other abiotic mechanisms (photochemical methylation, transalkylation, etc.) are also capable of producing methylmercury in the environment[13].

Mercury toxicity in the body can result in various pathologies, both acute and chronic, mainly in the Central Nervous System, Respiratory Tracts, Urinary Tracts, Gastrointestinal Tracts, Hematopoietic System, resulting in dementia, depression, stomatitis, insomnia, among others[12].

In all samples collected in different locations on the island of Mosqueiro (“Furo das Marinhas”, beaches of Murubira and Carananduba), in different periods and climatic and tidal situations, the trace element mercury was not detected.

The trace element copper was not detected in any samples collected on the beaches of Morubira and Carananduba; in “Furo das Marinhas” the presence of copper only occurred in the first sample, not occurring in any other, therefore, having a momentary origin.

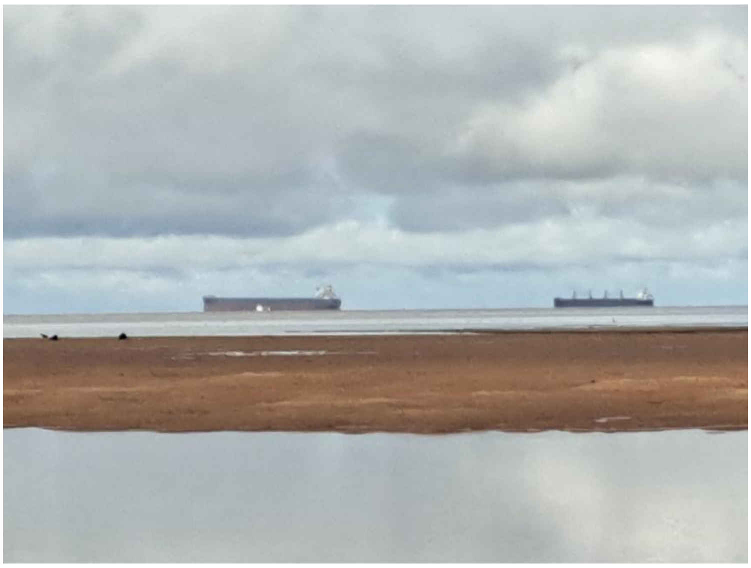
The presence of the trace element iron was detected in the last sampling of all collection areas on the island of Mosqueiro, including momentarily changing the color of the water at Murumbira beach, when the waters were very rough. It is worth mentioning that the banks of the Pará River, including Mosqueiro Island, have rocks composed of the iron element, which may have been identified in the samples due to the presence of heavy rains that occurred during the period, causing possible leaching of the soil and these ferruginous rocks.

Murubira Beach at high tide, reaching the protection wall, with emphasis on the ferruginous color of the water at that moment. Photo by Rosana do S. Maciel Quaresma.

Fluorides were not found in "Furo das Marinhas" and Murubina beach in any sample collection; on Carananduba beach, fluoride was only found in the 1st sample, on 18/10/2023, and did not occur at any other time of collection, therefore it is presumed to be a momentary occurrence.

It is worth mentioning that waterway traffic of cargo ships was identified in the Northwest part of the island of Mosqueiro in Murubira beach and West in Carananduba beach; In "Furo das Marinhas", in the East part of the island, only small boats were observed used for fishing crab, shrimp and fish, as well as school transport, connecting with land transport, for riverside students. Navigation activities must be monitored and guided regarding pollution risks.

School transport boat and canoe for fishing and transport anchored at "Furo das Marinhas". Photo by Aureliano Guedes, PhD



Cargo ships in constant transit in front of Carananduba beach. Photo by Aureliano Guedes II

Lotic systems are affected by the following modifications: pumping water for irrigation of public or private supply (farms), which alters the flow and structure of rivers; organic and inorganic pollution from industrial and agricultural sources (point and diffuse sources). Pesticides, herbicides, heavy metals and discharge of untreated sewage are some of the threats to the integrity of rivers; intensive land use, which leads to an increase in suspended material and the discharge of substances and elements in large quantities into lotic systems; introduction of exotic species, which alter the food web and the natural process of community interaction; removal of riparian vegetation, which is extremely important in maintaining buffer conditions for rivers. This removal, in addition to reducing the organic matter available to fish and invertebrates, no longer protects the banks and slopes of rivers, altering their morphometry; construction of dams for hydroelectricity and public supply; alteration of floodplains and flooded areas associated with dams for agriculture, construction of canals or urbanisation; bridges and passages, which interferes with the functioning of rivers, alters the substrate (physical and chemical compositions) and removes and affects organisms; construction of large areas for irrigation, with considerable withdrawals of water for this activity, contamination by domestic (sewage) and industrial waste, are the two biggest threats to lotic systems[2].

Several species of fauna were observed during the collection of water samples, among which stand out: *Anableps anables*, *Macrobrachium amazonicum*, *Egretta thula*, *Ardea alba*, *Vanellus chilensis* (Molina, 1782), *Falco peregrinus, Crotofapha ani, Portunus spinimanus*, *Armases benedicti* (Rathbun, 1897), *Ucides cordatus cordatus*, *Pitangus sulphuratus*, *Brachyplatystoma filamentosum*, *Cichla spp*. among others.

Murumbira beach with low tide with an emphasis on *Ardea alba*. Photo by Aureliano Guedes II.

The island of Mosqueiro is not an area where the species (Western Reef-Heron) *Egretta gularis gularis* (Bosc, 1792) occurs, however, the team observed a specimen on Carananduba beach, during sample collection on 07/12/2023.

The introduction of exotic species, by accident or deliberately by man, has caused numerous problems in aquatic ecosystems, causing direct or indirect effects in the short, medium and long term. This introduction can cause extensive changes to the food web. If the introduced species is a predator, for example, severe negative effects on the trophic structure are likely to occur[2].

Some exogenous species were observed in the fauna of Mosqueiro Island, such as: giant Malaysian shrimp (*Macrobrachium rosenbergii*), often sold as the "pitú" species (*Macrobrachium acanthurus* and *Macrobrachium carcinus*) by the local population. However, *Macrobrachium rosenbergii* has preyed on local species, with an emphasis on the Amazon ghost shrimp (*Macrobrachium amazonicum*), often fished in inadequate sizes, having deleterious effects on the natural development of the species.

IV. Conclusions

There is a need to monitor aquatic and terrestrial biota, implement public policies for selective waste collection, control construction in the beach area, preserve local flora and fauna, including programs to control and/or remove exogenous species; environmental education programs involving the economic sector, government and communities; adequate treatment of wastewater, among others that can guarantee the environmental safety of the island of Mosqueiro.

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