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Primary analysis of the phytoplanktonic community of the water capture channel of a thermal electric plant in Northeast Brazil

Análise primária da comunidade fitoplanctônica do canal de captação de água de uma usina termelétrica no Nordeste do Brasil

Análisis primario de la comunidad fitoplanctónica del canal de captación de agua de una central termoeléctrica en el Nordeste de Brasil

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Abstract
In the environmental policy of the Pernambuco Thermoelectric Power Plant, there are plans for monitoring the environmental quality. This study is about the marine phytoplankton community, in the area of influence it has followed a regularity of studies in its catchment channel and in the area of disposal of the submarine outfall. Collections were made every three months, between March 2020 and October 2021. Collections were carried out by trawling 20 µm nets in the area of the submarine outfall and using a Van Dorn oceanographic bottle, inside the catchment channel. from the plant. The taxonomic analyzes showed that in the water catchment channel the genera *Chaetoceros* and *Navicula* stood out for their abundance, being represented by 956 and 283 individuals, respectively. At the collection point, the most abundant genera were *Pinnularia* and *Oscillatoria*, with 1978 and 559 representatives, respectively.
Keywords: Phytoplankton; Suape; Thermal power plant.

Resumo
Na política ambiental da Usina Termelétrica de Pernambuco, há planos de monitoramento da qualidade ambiental. Este estudo é sobre a comunidade fitoplanctônica marinha, na área de influência tem acompanhado uma regularidade de estudos em seu canal de captação e na área de descarte do emissário submarino. As coletas foram feitas a cada três

meses, entre março de 2020 e outubro de 2021. As coletas foram realizadas com redes de arrasto de 20 µm na área do emissário submarino e utilizando garrafa oceanográfica Van Dorn, dentro do canal de captação. da planta. As análises taxonômicas mostraram que no canal de captação de água os gêneros Chaetoceros e Navicula se destacaram pela abundância, sendo representados por 956 e 283 indivíduos, respectivamente. No ponto de coleta, os gêneros mais abundantes foram Pinnularia e Oscillatoria, com 1978 e 559 representantes, respectivamente.
Palavras-chave: Fitoplancton; Suape; Usina termaletrica.

Resumen
En la política ambiental de la Usina Termoeléctrica de Pernambuco, existen planes para el monitoreo de la calidad ambiental. El presente estudio trata sobre la comunidad de fitoplancton marino, en el área de influencia se ha seguido una regularidad de estudios en su cauce de captación y en el área de vertido del emisario submarino. Las colectas se realizaron cada tres meses, entre marzo de 2020 y octubre de 2021. Las colectas se realizaron mediante redes de arrastre de 20 µm en la zona del emisario submarino y utilizando una botella oceanográfica Van Dorn, dentro del canal de captación. de la planta Los análisis taxonómicos mostraron que en el canal de captación de agua se destacaron por su abundancia los géneros *Chaetoceros* y *Navicula*, representados por 956 y 283 individuos, respectivamente. En el punto de colecta, los géneros más abundantes fueron *Pinnularia* y *Oscillatoria*, con 1978 y 559 representantes, respectivamente.
Palabras clave: Fitoplancton; Suape; Central térmica.

1. Introduction

Water is an important natural resource on Earth, with approximately 1,265,000 trillion m³. However, for human use little is used (Botkin & Keller, 2000; Lins et al., 2010). The water resource is composed of approximately 97.5% of salt water (seas and oceans) and 2% is accumulated in the polar ice caps. The availability of inland waters, those used for human use, is only 2.5% (Clarke & King, 2005; Ana, s/d; Oliveira, 2021).

Human beings perform various activities in coastal regions, linked to tourism, fishing, mariculture, commercial navigation, water sports, among others (Moreira, 2021). All activities need water; however, these same activities are capable of causing impacts on the marine environment (Lampareli, 2006). In this sense, environmental monitoring is always necessary, following environmental changes in the environment (Conrado, 2020). Monitoring seeks to analyze and identify points of concern in the environment; qualitative and quantitative characteristics in order to monitor environments for different periods. It is necessary to consider social, economic and institutional aspects depending on the analysis model on the environment (Ramos & Luchiari, n.d.; Bruzza, 2015).

From the perspective of water management used in thermoelectric plants, strategies are included that aim to find effective systems that promote the reduction of their environmental impacts. It is necessary to have a compatible market cost due to competition in the electricity sector. It is necessary to propose maintaining a harmonious relationship with the parties involved in the business (Matos et al., 2010). Thus, environmental monitoring aims to monitor the quality of the plant's wastewater. Knowing how they are treated within the standards required by law and that can cause changes in parameters, such as causing impacts on the marine habitat (Cavalcante & Mendes, 2013).

Phytoplankton is composed of microorganisms that perform photosynthesis (algae, cyanobacteria and some bacteria) and belong to a polyphyletic group that are found partially or continuously in aquatic environments (Brasil, 2011). Over the years they have stood out for being organisms that have a great representation in the aquatic environment in continental, estuarine and marine waters.

In these ecosystems, their presence is essential, due to primary productivity, being the main responsible for the production of oxygen on the planet (Aquino et al., 2011). Weighted by the initiation of the flow of organic matter from the trophic network of aquatic environments, aiding in their fertilization, thus directly supplying herbivores and indirectly supplying animals with higher trophic levels. Also referring to species that have economic interests (Sousa et al., 2009).

The flowering phenomenon is the excessive growth of microalgae that are part of phytoplankton. Some of them are harmful or carriers of toxins, such as some cyanobacteria, generating negative consequences for the chemical conditions of the water. This can change the aquatic environment (Lagos et al., 2003). These individuals contain numerous strategies for their survival in different environmental conditions (Nashimura; et al., 2015). Many research that are related to phytoplankton biomass and the definition of its species propose data that indicate the quality of the water. They provide information necessary for a greater understanding of other communities and ecosystems. These microorganisms are considered environmental indicators, through the analysis of the trophic state of the aquatic environment in which they are found. They serve as a good tool in the area of environmental management of coastal zones (Matos et al., 2012).

This work determined the diversity and abundance of phytoplankton in the water catchment channel and in the accommodation tank in the area of direct influence of the cooling system of UTE Termopernambuco. It is a monitoring study of phytoplanktonic individuals existing in these two environments

2. Methodology

The Pernambuco Thermoelectric Power Plant (Termope) is located on the south coast of northeastern Brazil (8°24'12.9"S 34°58'00.6"W), in the state of Pernambuco, with a predominantly tropical, hot and humid climate. In the year 2021, the average rainfall ranged from 35.5mm to 494.3mm, with the months from April to July having the highest rates (APAC, 2022) (Figure 1).

Figure 1. Image of the Pernambuco Thermoelectric Power Plant (TERMOPE).

Source: https://escadacom.wordpress.com/2011/09/14/a-maior-usina-termeltrica-do-mundo-ser-em-pernambuco/.

Samples were collected from 2020 to 2021, in March, November (2020), August and October (2021). Two points were chosen in the Termope water collection system, totaling 8 samples (2 samples for each month). The first collection point was at the entrance of the water catchment system (8°24'24.2"S 34°57'53.3"W), this point was considered as a control area.

The second collection point was located in the pass-through tank, water disposal area for the submarine outfall (8°24'19.6"S 34°57'55.2"W).

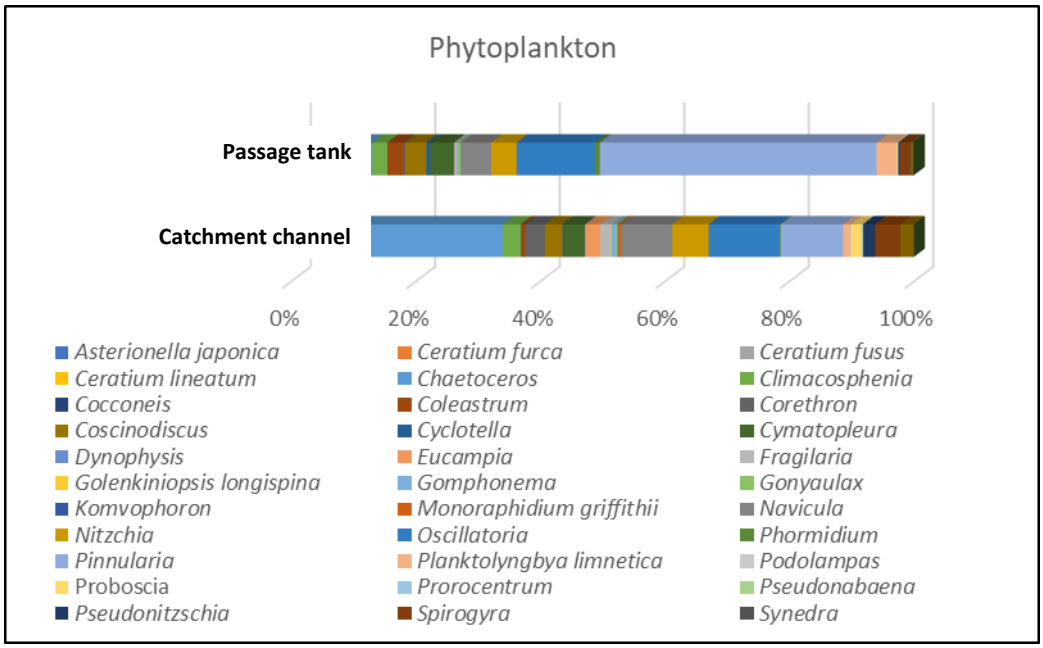
Phytoplankton were collected by filtering 100 liters of marine water, collected with a Van Dorn oceanographic bottle or by trawling a 20µm thick phytoplankton net. All samples were placed in 250mL pots and fixed in 4% formaldehyde saline solution, previously buffered with Sodium Tetraborate. Then, the samples were labeled and placed in a transport box for the Environmental Studies Laboratory of the Advanced Institute of Technology and Innovation – IATI. In the laboratory, the samples were homogenized and divided into triplicates for identification with the aid of a microscope.

The samples were identified at the level of large groups, based on the work of Koening and Lira (2005), Suthers and Rissik (2009) and Rossini (2010). Studies to confirm the occurrence of phytoplankton in the region are being based on information from Koening et al. (1996) and (2002), Ferreira-Correia, Almeida and Dourado (2004) and Garcia and Odebrecht (2009).

3. Results and Discussion

In the analyzed samples, the phytoplankton richness presented a high biodiversity in the two study areas. Representatives of the genus *Pinnularia*, *Chaetoceros, Navicula* and *Oscillatoria* were the most abundant in the catchment channel and in the passage tank. Of the organisms found in the water catchment channel, the genera Chaetoceros and Navicula stood out for their abundance, being represented by 956 and 283 individuals, respectively. At the collection point in the passage tank, the most abundant genera were Pinnularia and Oscillatoria, with 1978 and 559 representatives, respectively (Figure 2).

Figure 2. Wealth and abundance of phytoplanktonic organisms in Termope's transit tank and catchment channel.



Source: Authors.

Of the four most abundant genera found in the samples, three are representatives of the Diatomaceae (*Chaetoceros*, *Pinnularia* and *Navicula*). This result shows that individuals are often found in large numbers. These are species that have defense mechanisms, adaptations to adverse environmental conditions and integration with environmental conditions quite

consistently (Santos et al., 2018). The abundance of these organisms suggests the existence of a shallow, lacustrine environment (Ribeiro & Senna, 2005).

Diatom species have different tolerances to changes in environmental factors. They resist nutrient concentration, organic pollution and changes in water temperature (Kelly et al., 2008). Their wide geographic distribution, high species richness, short life cycle and silica (SiO2) cell envelope are characteristics that make these organisms excellent bioindicators of water quality. They are excellent for environmental monitoring studies (Silva-Lehmkuhl; et al., 2019).

Species of the genus *Chaetoceros* have an efficient adaptation mechanism to ensure the success of their flowering. They develop (in some species) spines/bristles on their cells that damage the gills of their predators. They are also species of ecological and physiological importance in toxicology studies (Bosak; et al., 2016). They live in low levels of nutrients (Kraberg; et al., 2010). It is one of the most abundant genera among marine diatoms. They present cosmopolitan species distributed in coastal areas and in the open sea (M'rabet et al., 2021). Species belonging to this genus contribute to the primary production of the ocean, in the biogeochemical cycles of carbon and silica (Booth et al., 2002).

The genus *Pinnularia* live in environments with waters with high amounts of fulvic and humic substances, with low pH values that favor the development of this taxon. As a general characteristic, we can say that they are normally lanceolate valves with parallel and slightly convex margins, with curved ends (Pereira et al., 2012). *Pinnularia* is one of the richest genera of diatoms. It is often found in freshwater, marine and estuarine environments. They occur a lot in continental, oligotrophic and relatively acidic waters (Souza; et al., 2021).

The genus *Navicula* represents a group of cosmopolitan diatom algae, widely distributed in South America. They inhabit phytoplanktonic biocenosis, periphyton or surface sediments. They can be found in oligotrophic, mesotrophic, eutrophic or hypereutrophic environments. They live in highly electrically conductive or slightly acidic waters. Some species of this genus are considered important in environmental studies due to their ability to indicate impacts of anthropogenic activities. It is known for its resistance to highly polluted or eutrophic environments (Dávila, 2016).

The species of the genus *Navicula* are fundamental parts of the environmental studies tool. Like other diatoms, they have the potential for diagnosing and characterizing the quality of aquatic environments, due to their resistance and sensitivity to environmental adversities (Ruwer; et al., 2020).

Oscillatoria is a genus of cyanobacteria known as filamentous blue algae. They have the habit of moving back and forth, gliding to position the colony facing a source of light in which it produces photosynthesis. Oscillatoria reproduces by fragmentation, facilitated by dead cells that separate a filament into several sections. Normally, the filament breaks into several fragments called hormogonia. Each hormone consists of one or more cells and grows into a filament by cell division. The genus is quite common in various types of habitats such as lakes, ponds, rivers and seas. They have a very wide distribution, except in cold regions (Babu & Wu, 2008).

4. Conclusion

• The research showed that the two environments studied showed good phytoplankton richness;

• Diatoms were the most abundant, mainly the genera *Chaetoceros, Pinnularia, Navicula* and *Oscillatoria*.

• The results of the water catchment channel revealed greater riches for being in open environments in the marine system;

• Even being in an area of direct influence of a thermoelectric plant, the results do not show signs of imbalance in the populations of phytoplankton studied.

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