revista online de extensão e cultura
REALIZAÇÃO

DOI 10.30612/realizacao.v12i23.20671
ISSN: 2358-3401

Submitted September 19, 2025
Accepted September 30, 2025
Published October 6, 2025

ENVIRONMENTAL EDUCATION PRACTICES ON MANGROVE PLANTS IN THE COMMUNITY OF VILA SÃO PEDRO, PAÇO DO LUMIAR, MARANHÃO, BRAZIL

PRÁTICAS DE EDUCAÇÃO AMBIENTAL SOBRE AS PLANTAS DO MANGUEZAL NA COMUNIDADE DE VILA SÃO PEDRO, PAÇO DO LUMIAR, MARANHÃO, BRASIL

PRÁCTICAS DE EDUCACIÓN AMBIENTAL SOBRE PLANTAS DE MANGLAR EN LA COMUNIDAD DE VILA SÃO PEDRO, PAÇO DO LUMIAR, ESTADO DE MARANHÃO, BRASIL

Dinnie Michelle Assunção Lacerda
Centro de Ensino Pires Collins
ORCID: https://orcid.org/0000-0003-4129-8010
Deyvison Ricardo Canela da Silva
Centro de Ensino Pires Collins
ORCID: https://orcid.org/0009-0006-4427-6916
Camila Pereira Feitosa dos Santos
Centro de Ensino Pires Collins
ORCID: https://orcid.org/0009-0008-7160-1088
Camila dos Santos Pires
Universidade Federal do Pará
ORCID: https://orcid.org/0000-0001-8555-5117
Eduardo Bezerra de Almeida Jr.[1]
Universidade Federal do Maranhão
ORCID: https://orcid.org/0000-0001-7517-4775

Abstract: This article aims to promote environmental education through data on mangrove plant reproduction, fostering awareness and stimulating debates within the school and community about conservation and botany. The community of Vila São Pedro, Paço do Lumiar, MA, represents an area whose characteristics endorse the need for scientific research on its

[1] Autor para Correspondência: ebaj25@yahoo.com.br

natural resources, as it borders an extensive mangrove area, from which some of the residents extract resources directly and indirectly. Phenological studies seek to clarify the seasonality of biological phenomena, such as flowering, fruiting, production and leaf fall. And they are important for understanding how plant species respond to climate, understanding mangrove ecology, productivity and contribution to the coastal environment to raise awareness of mangrove protection and conservation.
Keywords: Botany, Phenology, Mangrove, Society.

Resumo: O objetivo deste artigo é promover a educação ambiental a partir dos dados sobre a reprodução das espécies vegetais do manguezal como meio de sensibilizar e levantar debates com a comunidade escolar da Vila de São Pedro acerca da importância da conservação do manguezal e dos temas na área de botânica. A comunidade de Vila São Pedro, Paço do Lumiar, MA, representa uma área cujas características endossam a necessidade de pesquisas científicas sobre seus recursos naturais, pois margeia uma extensa área de mangue, de onde parte dos moradores extraem recursos direta e indiretamente. Os estudos fenológicos, procuram esclarecer a sazonalidade dos fenômenos biológicos, como a floração, a frutificação, produção e queda de folhas. E são importantes para compreender como as espécies vegetais respondem ao clima, na compreensão da ecologia dos mangues, da produtividade e da contribuição para o ambiente costeiro para sensibilizar as pessoas para a proteção e conservação do manguezal.
Palavras-chave: Botânica, Fenologia, Manguezal, Sociedade.

Resumen: : El objetivo de este artículo es promover la educación ambiental basada en datos sobre la reproducción de especies vegetales de manglar como medio para sensibilizar y generar debates con la comunidad escolar de Vila de São Pedro sobre la importancia de la conservación de los manglares y las problemáticas en el área de botánica. La comunidad de Vila São Pedro, Paço do Lumiar, estado de Maranhão, representa un área cuyas características avalan la necesidad de investigación científica sobre sus recursos naturales, ya que limita con una extensa zona de manglares, de donde algunos de sus habitantes extraen recursos directa e indirectamente. Los estudios fenológicos buscan esclarecer la estacionalidad de fenómenos biológicos, como floración, fructificación, producción y caída de hojas. Y son importantes para comprender cómo responden las especies de plantas al clima, para comprender la ecología, la productividad y la contribución de los manglares al medio ambiente costero para crear conciencia sobre la protección y conservación del ecosistema de manglares.

Palabras clave: *Apis mellifera*, Capacitación, Extensión rural

INTRODUCTION

Mangroves extend along almost the entire Brazilian coastline, appearing from the extreme north, in Amapá, to the southern coast in Santa Catarina (LAMBERTI, 1969). They are ecosystems composed of woody tree and shrub species that occupy the intertidal zone in the tropics and subtropics (FELLER, 2010). In addition to being important for humanity economically, due to fishing resources, mangroves are essential for ecological dynamics, preventing the silting of rivers and contributing to the fight against global warming, due to their enormous capacity to sequester carbon (SOUZA et al., 2018).

Despite being classified as Permanent Protection Areas under Brazilian Federal Law 4771/65, mangroves face persistent anthropogenic pressures, including deforestation and pollution. Therefore, studies on the ecology of these areas represent an important tool for understanding the relationship between mangrove species and the local environment, as well as assisting in actions for the conservation of this ecosystem (SOARES, 1999; SANTOS et al., 2018). In regions where the population takes resources directly from nature for subsistence and/or income, knowledge of the values of natural assets and their impact on these activities is key to developing proposals that aim to obtain the commitment of local residents to the conservation of their natural resources (PEREIRA; DIEGUES, 2010).

In this context, phenological studies seek to clarify the seasonality of biological phenomena, such as flowering, fruiting, production and leaf fall, which are important for understanding how plant species respond to their surrounding environment (DUKE, 1990). This fact is no different for understanding the ecology of mangroves, their productivity and contribution to the coastal environment (FENNER, 1998). Thus, studies related to the phenological seasonality of mangrove species are essential to understand their dynamics and support conservation actions, whether linked to government plans or promoted by the general population (RAMOS, 2022).

Projects that include environmental education aiming to provide information regarding the phenology of mangrove plants and the importance of mangroves for the maintenance of various ecosystem and economic services can collaborate with practices linked to conservation (ALBUQUERQUE et al., 2021). Considering the information presented, and the need to conserve mangrove areas, the community of Vila São Pedro (known as Pau Deitado), Paço do Lumiar, Maranhão, represents an area whose characteristics endorse the need for scientific research on its natural resources, as it borders an extensive mangrove area, from which some of

the residents extract resources.

Studies that consider ecological aspects such as phenology, combined with actions that encourage recognition of the importance of conserving these areas, are essential for maintaining resources and adopting environmentally conscious practices. The Vila São Pedro community has suffered serious environmental problems. Without adequate sanitation conditions, the population deposits garbage in areas close to or within the mangrove, where deforestation and burning are also recorded. In view of this, this study aimed to promote environmental education based on data on the reproduction of plant species in the mangrove as a means of raising awareness and sparking debates with the school community of Vila de São Pedro about the importance of conserving the mangrove and topics in the area of botany.

MATERIALS AND METHODS

The study was conducted in a mangrove area in the Vila São Pedro community, in the municipality of Paço do Lumiar (02°31'50"S and 44°06'19"W), approximately 26 km from São Luís, state of Maranhão. Figure 1 shows a section of mangrove vegetation located in the community. The climate in the region is Aw (KOPPEN, 1948), with a rainy season that begins in January and lasts until June, and a dry season from July to December. The average accumulated rainfall index (30-year average) is around 2,000 mm/year and average annual temperatures vary between 25.5°C and 28.6°C. The human population present in the area has a strong connection with fishing and shellfish gathering activities, which are its main economic base (IBGE, 2021).

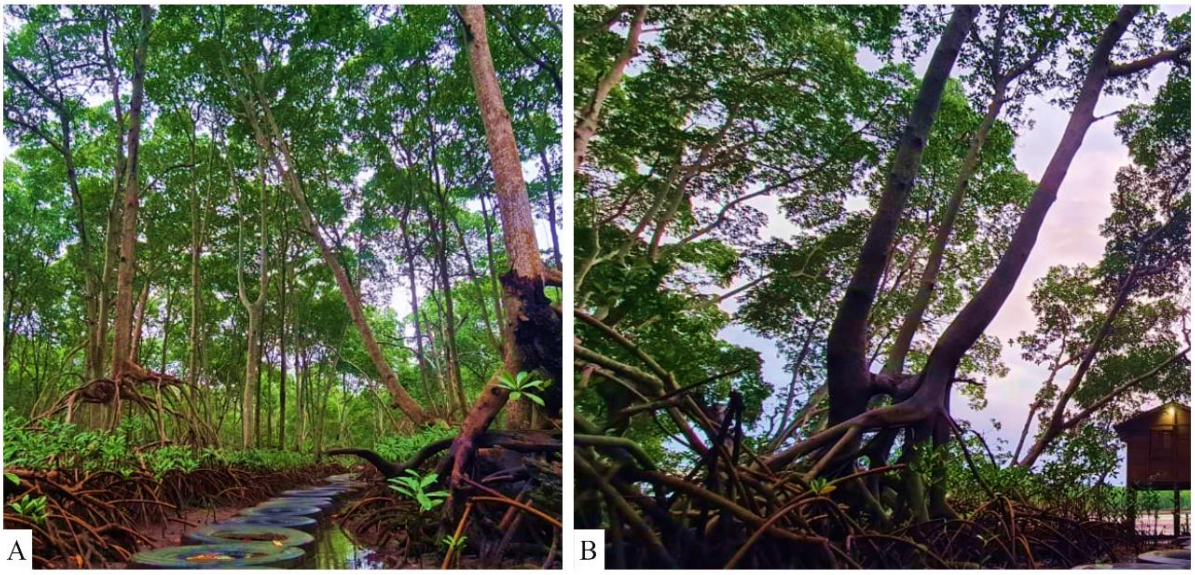

Figure 1. Image of the mangrove area where the study was carried out, Municipality of Paço do Lumiar, Maranhão. Source: Personal collection.

The area is surrounded by several rivers and sea inlets, and has a large adjacent area of mangrove. It has a population of around 11,000, and is served by a paved highway and urban public transport service. It has a water, electricity and asphalt network, but lacks sewage. It has pockets of poverty, characterized by housing in precarious sanitation and living conditions. It is bathed by the sea, and its economy is growing, with fishing and family farming as its main activities.

DEVELOPMENT OF ACTIONS

COLLECTION OF DATA ON VEGETATION

Botanical material and phenological data were collected every two weeks for a period of 12 months. Sampling was carried out in an area measuring 200 m and 10 m wide. After collection, the material was herborized according to standard botanical techniques (PEIXOTO; MAIA, 2013) and identifications were performed using analytical keys, specialized literature and by comparison with material already identified in the Maranhão Herbarium (MAR) of the Federal University of Maranhão (ALMEIDA JR., 2015).

Each plant (individual) was tagged and monitored biweekly, with visual estimates of vegetative (leaf fall/emergence) and reproductive (flowering/fruiting) phenophases. The species identified were *Avicennia germinans* (L.) L. (sereíba), *Laguncularia racemosa* (L.) CFGaertn. (white mangrove) and *Rhizophora mangle* L. (red mangrove

RESEARCH SUBJECTS AND ACTIVITIES

Interventions were carried out with the school community, with actions carried out at the local secondary school, Centro de Ensino Pires Collins, with first-year students. Lectures were given and seminars were presented on the theme of conservation of mangrove areas. Recreational activities were also part of the program, in addition to banner displays, as one of the resources for disseminating the results obtained throughout the research. Two students and a teacher participated in the phenology data collection activities and in the actions carried out in the school community, which also included the participation of undergraduate and master's students and a professor from the Federal University of Maranhão.

RESULTS AND DISCUSSION

PHENOLOGICAL EVALUATION

A total of 79 plants (individuals) were monitored, 13 of which were of the species *Avicennia germinans* , 33 of the species *Laguncularia racemosa* and 33 of *Rhizophora mangle* (Figure 2). For this study, the values referring to the seven individuals of *Conocarpus erectus* L. were not considered because this plant develops in the transition between the mangrove and the restinga.

The results indicate that the vegetative events, production and leaf fall, were minimally affected by environmental factors during the collection period, with leaf fall and renewal occurring continuously. Reproductive phenology showed greater variations in relation to vegetative phenology, showing a decline in the percentages of flowering and propagule production during part of the dry months, from August to October (Figure 3).

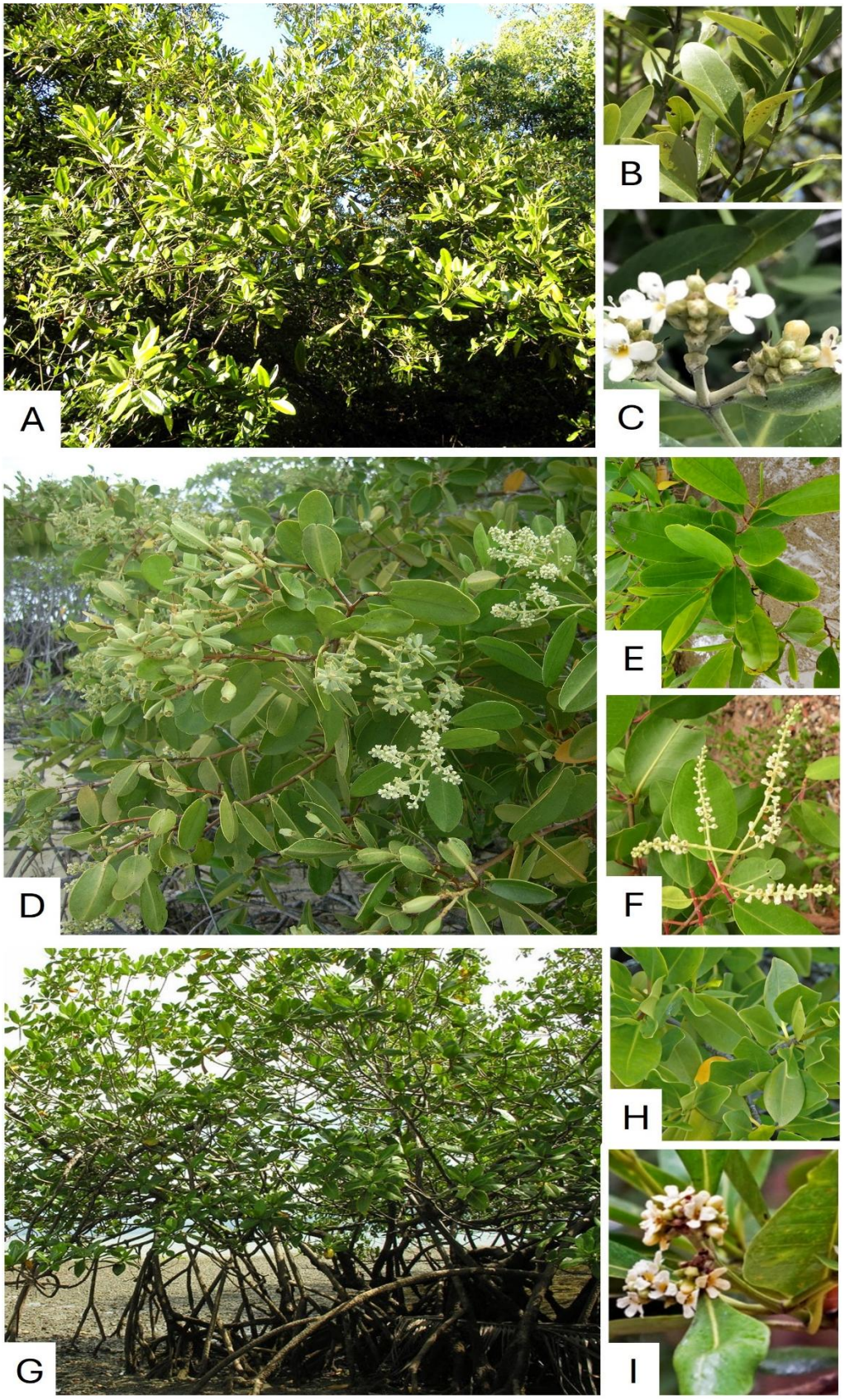

Figure 2. Species monitored during the study. A) Sereíba - *Avicennia germinans* , plant size, B) leaf, C) flower detail; D) White mangrove - *Laguncularia racemosa* , plant size, E) leaf, F) flower detail; G) Red mangrove - *Rhizophora mangle* , plant size, H) leaf, I) flower detail.

Source: Personal collection.

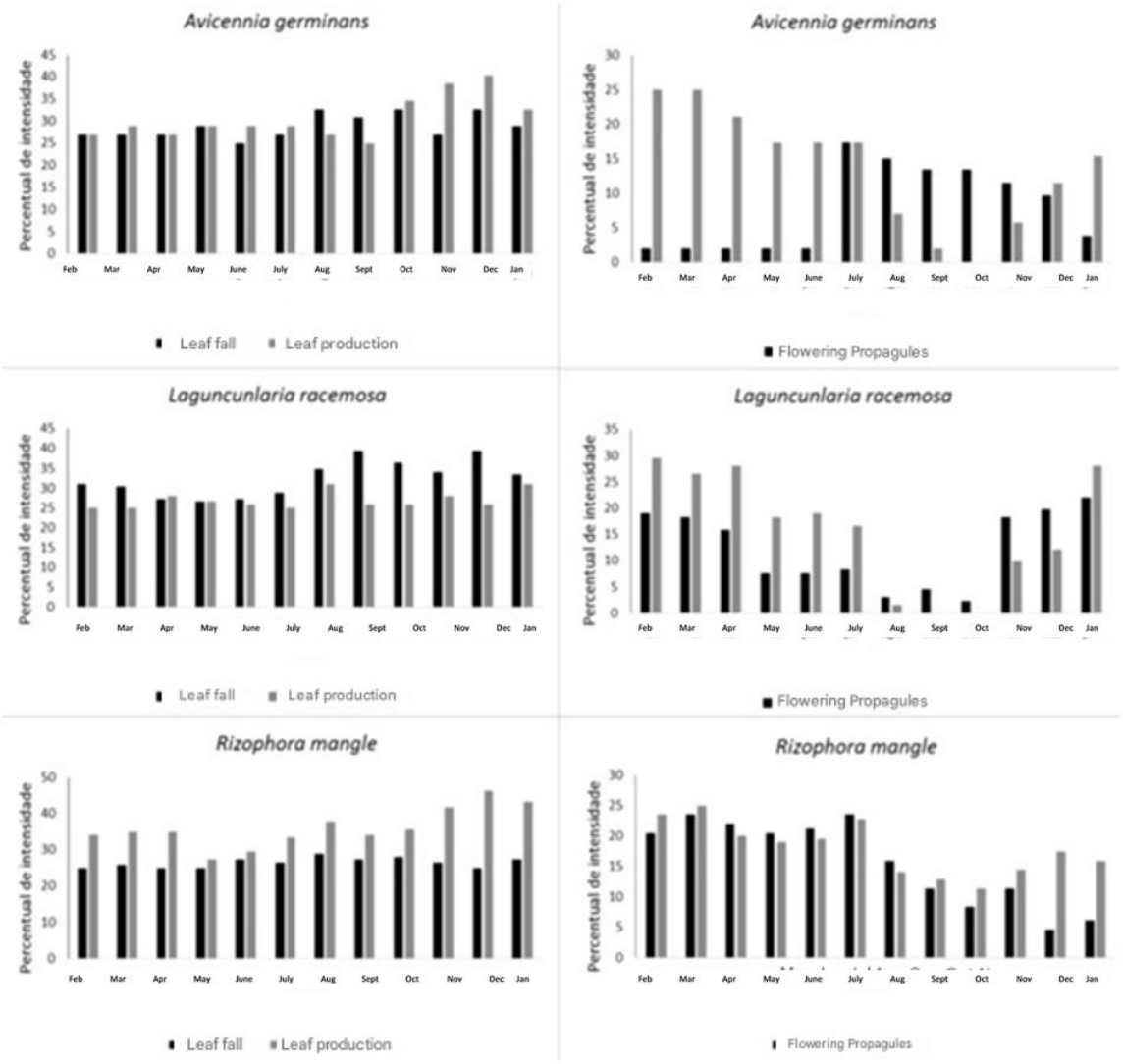

Figure 3. Percentage of leaf fall intensity, leaf production, flowering and fruiting in a mangrove area in the municipality of Paço do Lumiar, Maranhão, for the months of February 2018 to January 2019. Months of the year are represented by their initials.

The results obtained also contribute information on important aspects of the ecology of mangrove species, showing that the differentiated behavior exhibited by these plants, mainly in reproductive aspects, keeps the community in permanent productivity; providing floral and fruit resources at all times of the year. In addition, they add evidence on the mechanisms that govern the phenological behavior of particular species and provide data that can be used to implement measures related to the management and conservation of mangroves.

ACTIONS AIMED AT THE SCHOOL COMMUNITY

Lectures and seminars were held on the theme of mangrove conservation between June 6 and 9, 2018, during the National Environment Week (SNMA) activities at the Pires Collins Teaching Center. The SNMA focused on disseminating the results of the study and information about the importance of mangroves for maintaining ecosystem functions and the natural resources used in the area. Recreational activities were also part of the program; among the activities, there were conservation circles in which plants, animals, and the importance of mangrove conservation for the local community were presented. In the board game, students had to answer questions about mangroves related to the topics that had been presented in the lectures; thus, students advanced on the board as they answered the questions correctly. Some of these activities can be seen in Figure 4.

Figure 4. Activities developed at the Pires Collins Teaching Center related to the project. A- pickling wheel; B- lectures; C and D- board game actions. Source: Personal collection.

Undergraduate students from the Biological Sciences course and master's students from the Postgraduate Program in Biodiversity and Conservation at the Federal University of

Maranhão participated in the development of activities during the SNMA. As part of the actions that preceded the interventions in the community, a group of third-year high school students from the Pires Collins Teaching Center, including scholarship students from this project, produced a short documentary addressing factors related to the ecology, conservation and importance of mangroves.

A banner was also presented with basic information about the project; in which concepts, project objectives, the study site and data on monitoring the vegetative and reproductive phases of mangrove plants were presented (Figure 5). In October 2018, a new action was carried out, with the dissemination of the results of this study in folders, which included concepts, photos of the plants that were selected and explanatory texts on the importance of mangroves in reaching students of different ages in the community.

The articulation between environmental education, citizenship and sustainability is a safe tripod for the adoption of transformative practices in relation to the environment (JACOBI, 2003). Some studies relating ecological characteristics of mangroves with environmental education approaches have been carried out in schools using different strategies. Among them, a study on the mangrove that borders the Sergipe River with elementary school students from Aracaju schools, which addressed local problems as an end activity, generating important reflections and discussions (FARIAS; ANDRADE, 2010).

In the state of Pernambuco, Rodrigues and Farrapeira (2008) worked with students from public elementary and high schools who lived near the mangrove. Through questionnaires, the students demonstrated prior knowledge about the mangrove, and the educational action proved effective in building ecological concepts about the ecosystem.

Silva et al. (2012) conducted a survey considering the conceptions of students from a public elementary school in the city of Recife about mangroves and found that, through teacher mediation, there was a progressive enrichment in the students' vocabulary regarding the use of scientific language on the subject of mangroves. In another study, involving public schools in Acaraú, Ceará, the authors developed a methodological proposal to reduce coastal environmental impacts, starting from the school environment to the community (ALBUQUERQUE et al., 2021).

All these studies demonstrate the importance of teaching practices focused on these themes, in order to build knowledge and, consequently, to develop actions that minimize impacts on mangroves. In this sense, the activities developed in this study drew attention to the relationship between phenology and conservation, clarifying aspects between ecological knowledge and mangrove conservation; showing the population the importance of the

reproductive period of plants that develop and grow in the mangrove.

Figure 5. Banner displayed at the Pires Collins Teaching Center, highlighting the collection activities and results obtained regarding the phenological study. Source: Personal collection.

The context in which the community of Vila de São Pedro is inserted requires actions aimed at environmental education and conservation of mangroves. Thus, interventions are

needed that lead to a reflection on the relationship between the community and its natural environment, from a perspective that allows the dialogue of traditional and scientific knowledge (QUINTEIRO; FONSECA, 2018). The actions carried out were directed in this sense and employed different forms of intervention, providing a stimulating space to rethink individual and collective action for the conservation of mangrove areas. In addition, it is necessary to allow students in elementary school to be involved in research to learn about the local flora, its characteristics and particularities, enabling these actions to be applied in the school community (FERREIRA et al., 2022). This will contribute to the insertion of these students in the context of scientific research, equipping them to develop skills and competencies inherent to scientific work.

FINAL CONSIDERATIONS

The approaches used in this study, developed in the school environment, are an important part of the process of raising awareness and proposing actions at an individual and collective level to better deal with environmental issues surrounding the community.

The different interventions, built from studies on mangrove phenology, made it possible to associate details of the reproductive process of mangrove plants, associated with information about the maintenance of the ecosystem and the impacts they suffer. Student engagement demonstrated that the interventions successfully disseminated knowledge about mangrove ecology and conservation. Finally, we emphasize the importance of carrying out these projects in schools in partnership with higher education institutions to work on Environmental Education and botany topics aimed at the local reality, especially for children. This allows us to show that nature is not an inexhaustible source of resources and that it is necessary to conserve the environment, which can, in addition to generating income, improve the quality of life.

ACKNOWLEDGMENTS

The Foundation for Research Support and Scientific and Technological Development of Maranhão - FAPEMA for financing the project “Characterization of the phenology of a mangrove area on the coast of Maranhão as a tool for the insertion of knowledge related to conservation” (Call for Proposals FAPEMA - GERAÇÃO CIÊNCIA, No. 02327/17). And the team of the Laboratory of Botanical Studies (LEB) of UFMA, for the partnership and availability of human resources.

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