



BATATA LAKE

ECOLOGICAL
RESTORATION JOURNEY



Results

AFTER 35 YEARS OF WORK
ON THE BATATA LAKE

99 scientific publications, including 78 articles and 21 book chapters, have been published on the restoration of Batata Lake.

[Check out scientific article here](#)

120 hectares of vegetated 'igapó' [flooded] forest, the equivalent to 111 soccer fields.

171 species of fish recorded in the fishing activity undertaken with the help of community members.

More than **800** thousand seedlings of 'igapó' species planted.

8,53 NTU (nephelometric turbidity units) was the average water turbidity index in the impacted area of Batata Lake in 2023 - well below the 100 NTU limit set by the National Environment Council and close to the lake's natural conditions.



A Message from the CEO

MRN's history with the Batata Lake began in a way that we are not proud of. At a time when society's concerns about environmental preservation were much lower than they should have been and in compliance with the legislation of that time, the company dumped part of its tailings into the lake.

Despite the fact that the material was just soil taken from the region without any alteration other than the slightest presence of bauxite, the impacts on Batata were visible, not only from an environmental point of view, but also from a social perspective. The existence of fauna, flora and humans was altered, to a greater or lesser degree, by the Company's actions.

Fortunately, the values we practice and which guide our actions - sustainability, integrity and respect for people - have not allowed us to just resign ourselves to the situation. They have guided decisions that are helping to repair these impacts and the good results of which, we believe, should be shared.

This material presents, in a transparent way, everything that has been done by MRN at Batata Lake since 1989, the effects of these efforts and the views of external experts. It is also an opportunity to clarify doubts and help distinguish between what is myth and what is truth.

Over time and with the efforts of MRN and many stakeholders, the Batata Lake is recovering. We can't change the past, but we are building the future by generating economic development with respect for people and the environment. This is the legacy we want to leave for the communities and for the Amazon.

“

With the efforts of MRN and many stakeholders, the Batata Lake is recovering. We are building the future by generating economic development with respect for people and the environment.

”

Guido Germani | MRN CEO

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Experts' View



Prof. Francisco de Assis Esteves, PhD., biologist, PhD in Limnology, researcher and professor at UFRJ

The Batata Lake has become a hub of knowledge in areas of science that are still relatively unknown, not only in Brazil, but also abroad. Today, the Batata Lake is a benchmark of successful environmental management. This success is due to a great deal of ecological research that has been going on for decades. The immense bank of information has supported decision-making and the application of nature-based technologies aimed at environmental restoration.



Prof. Fábio Rubio Scarano, PhD., forest engineer, PhD in Ecology and professor at UFRJ

Natural regeneration and planting together have been responsible for the return of abundance and diversity to the impacted areas; this established vegetation produces shade, leaf litter, organic matter, thus creating new habitats and organic substrates for other species to establish themselves naturally.



Erica P. Caramaschi, biologist, PhD in Ecology and Natural Resources, and professor at UFRJ

The monitoring of fish in the Batata showed that the silted area gradually acquired, through natural regeneration and planting, an underwater architecture favorable to colonization. The various food resources allow species of different feeding habits to use it or settle there. Consequently, fish such as aracus, branquinhas, tucunarés and maparás are available for fishing.



Reinaldo Bozelli, PhD in Ecology and professor at UFRJ

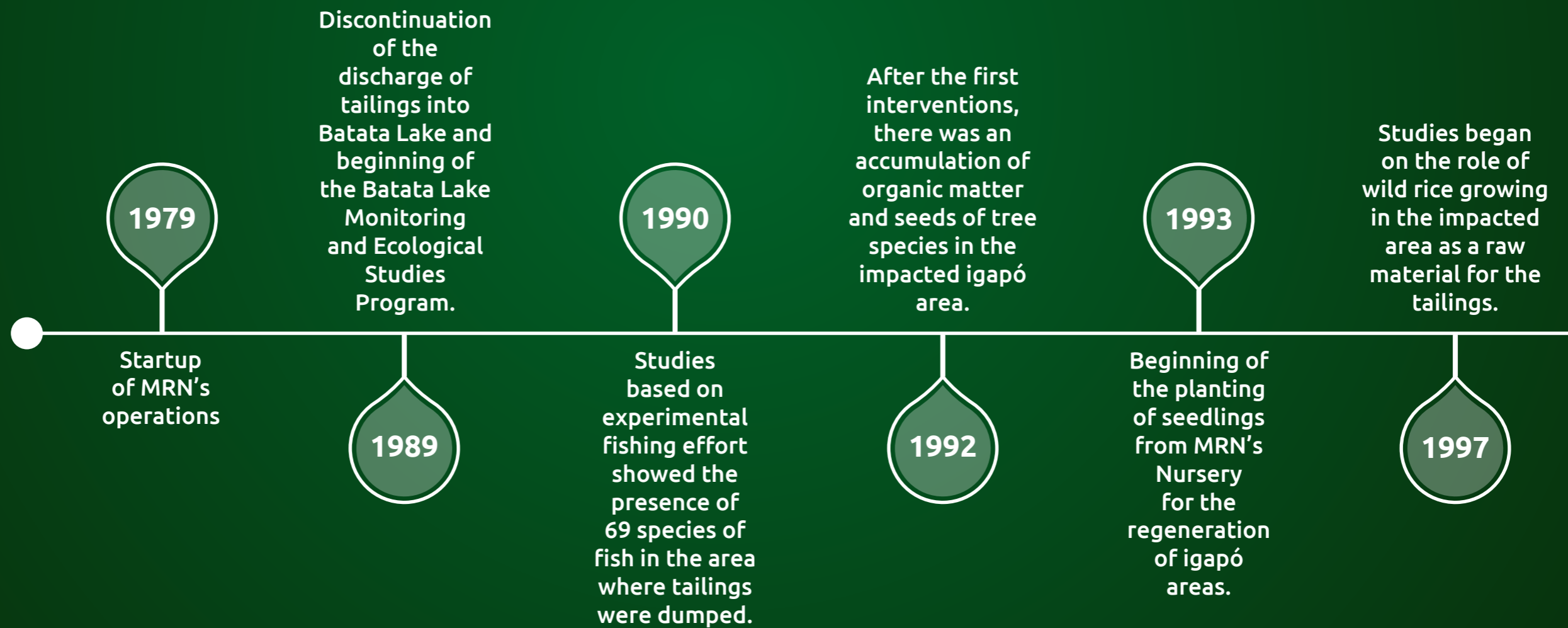
Batata Lake is an emblematic case in the Amazon, with its successful and long restoration process. An achievement of humans, ecological science, managers and entrepreneurs who understand the value of a healthy environment for their business. Above all, it is the result of the unrelenting work of itaubaranas, periquiteiras, jenipaporanas, fish, ants, fungi and bacteria - thousands of beings which, with the light of the sun and the strength of the waters, restore and heal the Batata Lake.

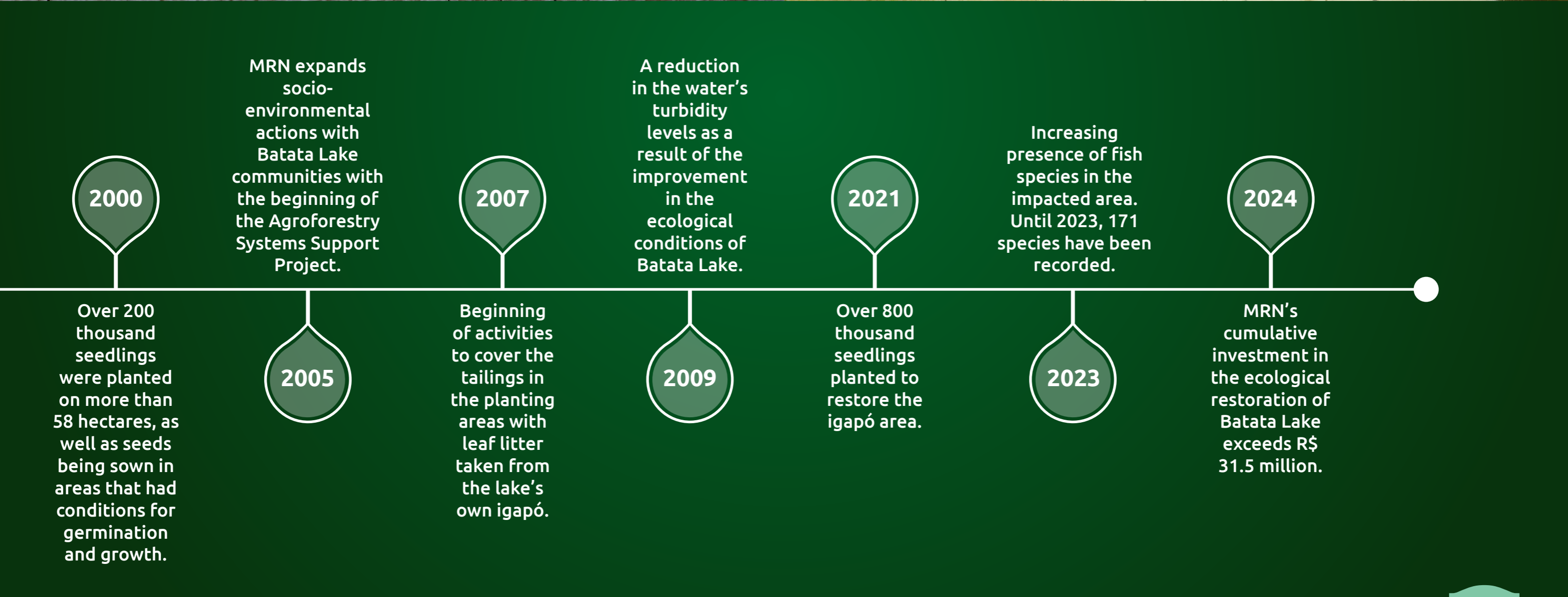


Prof. Fábio Roland, PhD., biologist, PhD in Ecology and Natural Resources, and professor at UFJF

Knowing how Batata Lake functions based on robust, long-term monitoring has provided subsidies for managing areas where natural regeneration has not taken place. Science has made it possible to manage igapó soil species, which has facilitated the growth of trees; science has learned from nature how to recover a flood lake.

Batata Lake Restoration Milestones

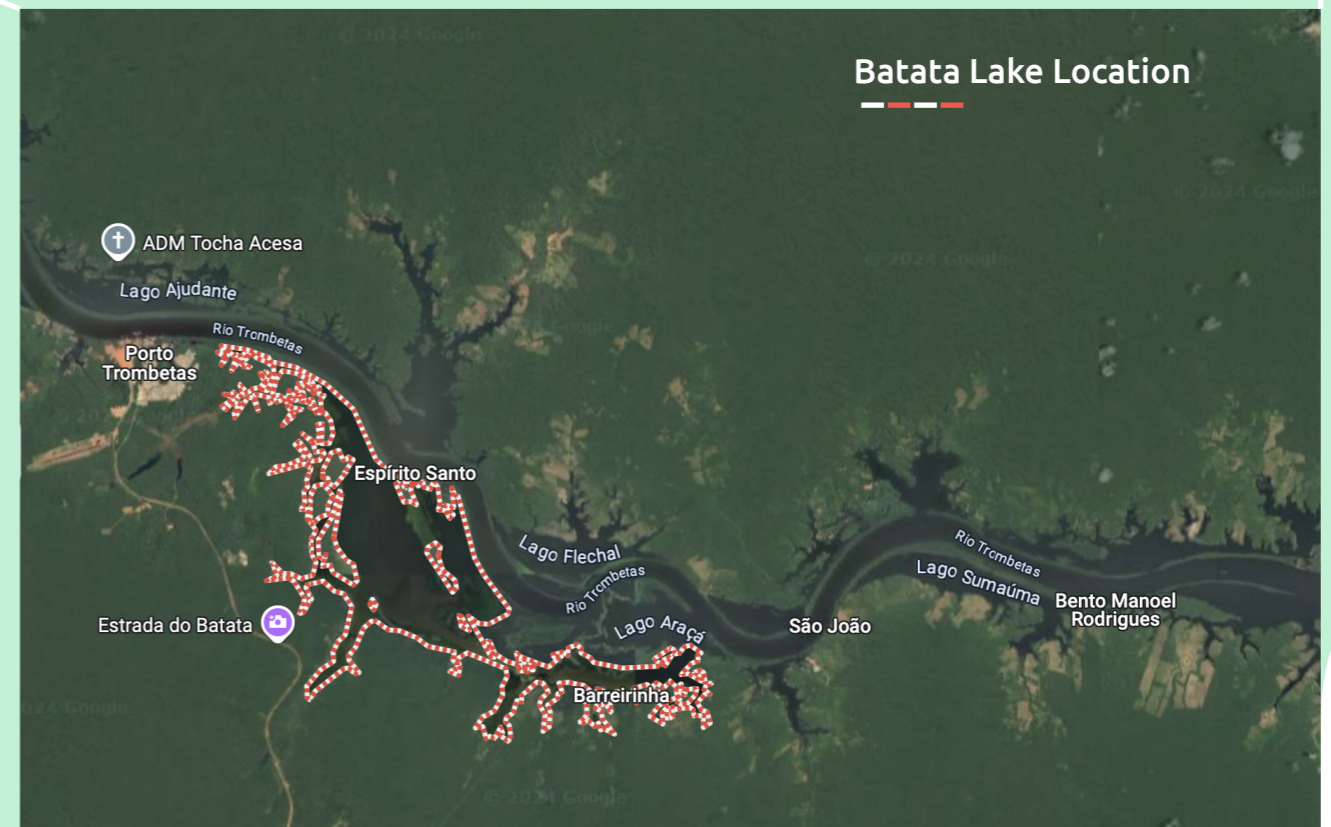






Batata Lake restoration areas

Batata Lake is a typical floodplain lake with an area of approximately 2,100 hectares, equivalent to 1,944 soccer fields. It is located in the district of Porto Trombetas, in the municipality of Oriximiná (Pará State), on the right bank of the Trombetas River, a left-bank tributary to the Amazon River.



What happened?

When the bauxite reserves in western Pará began to be exploited in 1979, the tailings from washing the ore were dumped directly into Batata Lake, in accordance with the methodologies and legislation of that time. Every day, 50,000m³ of tailings were discharged into the lake, which consisted of aqueous mud made up of water clay, silt and sand.

As a result, 639 hectares of the lake, or 30% of the area, have been impacted by the accumulation of tailings in the water which, when settled, have caused siltation and the death of igapó areas. It has also transformed previously permanently flooded areas into seasonally floodable areas due to the accumulation of tailings, which in some parts reached 16 meters. The presence of finer, less dense clays turned the water column into a reddish color, thus intensifying the turbidity.



Did you know?

Bauxite tailings are made up of water clay, silt and sand, and do not contain any chemicals that could harm your health. Aluminum, which is present in high concentrations in bauxite, is also not released into the environment during the ore extraction and washing stages.



Pathways traveled

First steps taken by MRN



1. TAILINGS DAM SYSTEM

In 1989, MRN stopped dumping tailings into the Batata Lake, and replaced it with a system of tailings reservoirs, which are built in areas where bauxite has already been extracted. At the end of their service life, the company replants the tailings ponds with native Amazonian plants.

2. BATATA LAKE ECOLOGICAL STUDIES AND MONITORING PROGRAM

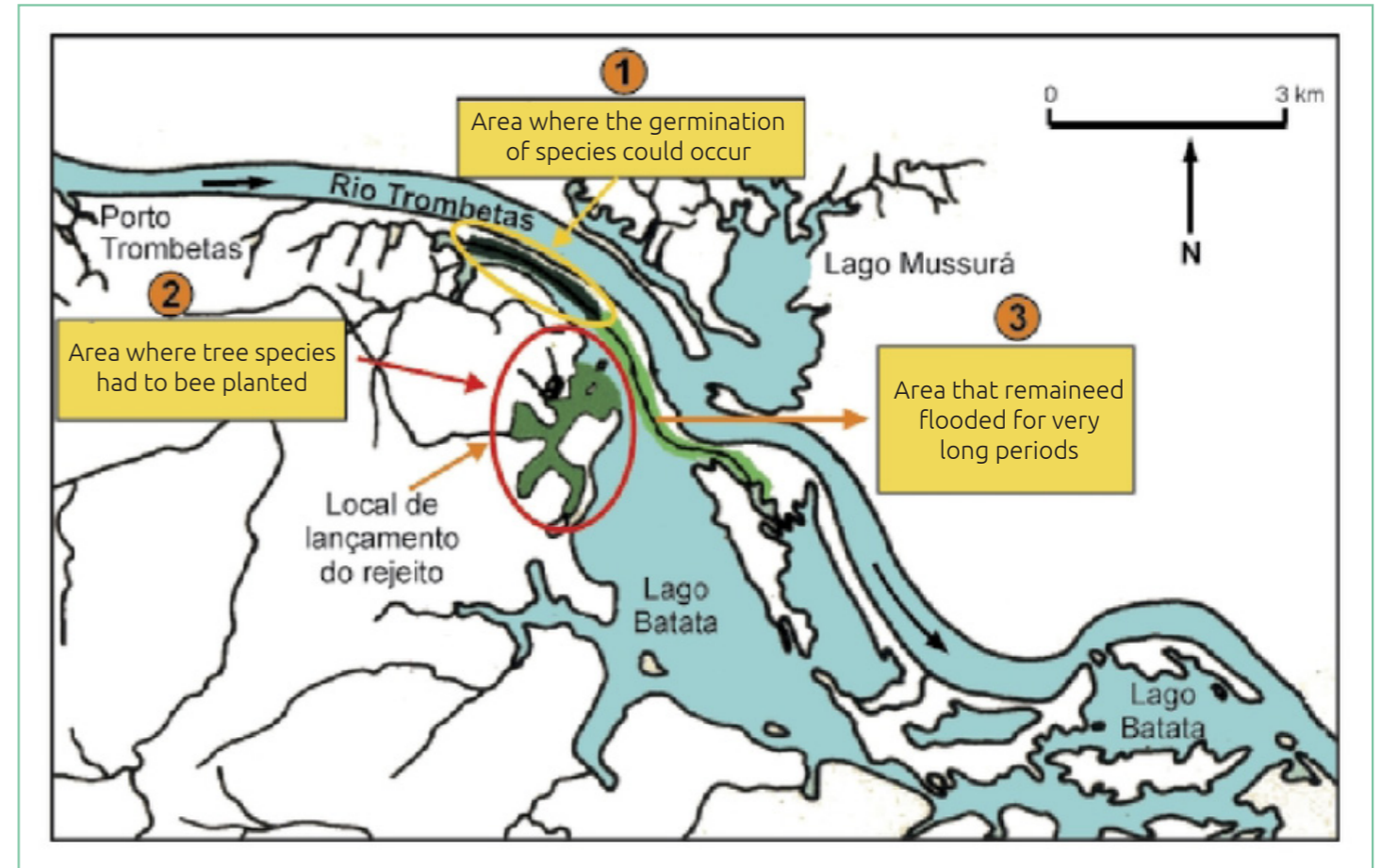
Also in 1989, MRN signed an agreement with the Federal University of Rio de Janeiro (UFRJ) to begin the restoration journey through the Batata Lake Ecological Studies and Monitoring Program.

3. DEMARCATION OF AREAS OF INTERVENTION FOR RESTORATION

After the first studies in the impacted areas, UFRJ researchers defined intervention methodologies for the lake restoration work.

Batata Lake restoration areas

- 1 Impacted igapó area where the germination and natural development of tree species could occur.
- 2 Impacted igapó area where natural forestation was not possible and tree species had to be planted.
- 3 Impacted igapó area that remained flooded for very long periods.



Did you know?

The work undertaken at Batata Lake is considered ecological restoration which, according to IBAMA, is characterized as human intervention to trigger, facilitate or accelerate the natural process of ecological succession of the altered ecosystem so that it reaches the standards of the reference ecosystem or as close to it as possible.



Igapó area where the natural development of tree species was possible

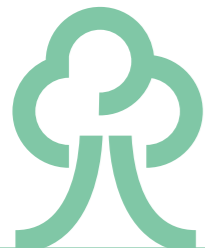


WORK PERFORMED



Following an analysis by UFRJ researchers of the impacted area, the presence of small igapó plants sprouting on the tailings was observed, the result of the natural process of colonization of the area by seeds from the Trombetas River, during the flood period, to Batata Lake. However, some of these seeds were carried by the currents back to the river from the lake.

The researchers then decided to implement physical barriers made from embaúba stems to retain the seeds in the lake, which grew to form a new natural igapó vegetation. Over time, the tree species began to act as natural barriers to retain the seeds, and it was no longer necessary to use new physical barriers.



RESULTS

- The natural igapó vegetation is at an advanced stage of restoration, with species already producing flowers and fruit, with their ecological functions re-established.
- With the re-establishment of vegetation, the presence of fish of different feeding habits has been recorded in these areas.



Did you know?

The igapó is a typical vegetation of the Amazon rainforest and is characterized by remaining flooded most of the year. It is home to animals that live in trees and in the water, and has a rich diversity of tree species, some of which are submerged close to their tops for long periods.



Igapó area where tree species needed to be planted



WORK PERFORMED

Based on a study of the area where igapó species had been naturally forested, the researchers identified the best adapted species, from which seeds were collected and taken to MRN's Nursery for the generation of seedlings.

The seedlings were developed and planted in a 120-hectare area which, after the tailings were dumped, was no longer permanently flooded and became a seasonally floodable area. Topsoil rich in organic matter, microorganisms and a seed bank was also added, helping to increase the diversity of tree species.



RESULTS

- 120 hectares have been vegetated. The new igapó forest is already producing flowers and fruit and there are insects, reptiles and birds on a large scale.
- The ecological conditions created are favorable to the formation of new igapó areas in the lake.
- The addition of topsoil rich in organic matter and microorganisms improved the nutritional conditions of the compacted bauxite tailings, accelerating the restoration process.



Did you know?

MRN's Nursery has the capacity to produce 1 million seedlings of more than 100 native species, which are used to reforest areas that have already been mined. MRN also rescues species before mining for later reintroduction, such as orchids, bromeliads and araceas.



Impacted igapó area that remained flooded for long periods of time



WORK PERFORMED

Cultivation of wild rice to accelerate the accumulation of organic matter for the ecological restoration of a 16-hectare area unsuitable for the germination of igapó species because it remains waterlogged for periods of up to 10 months.

Wild rice has a life cycle of five months and the biomass resulting from the species is now deposited on the compacted tailings at the bottom of the lake, allowing for an increase in organic matter and nutrients.

RESULTS

- The accumulation of nutrients resulting from the biomass of wild rice, added to the effects of planting seedlings in the igapó areas, is transforming the former bauxite tailings into a clay complex with added organic matter.
- This organic matter is essential for nourishing microorganisms that serve as food for carnivorous fish such as tambaqui and tucunaré.
- The formation of organic matter on the tailings minimized their resuspension during the flood. It also improved the aesthetic aspects of the area during the ebb period, reducing the typical red color of the tailings.

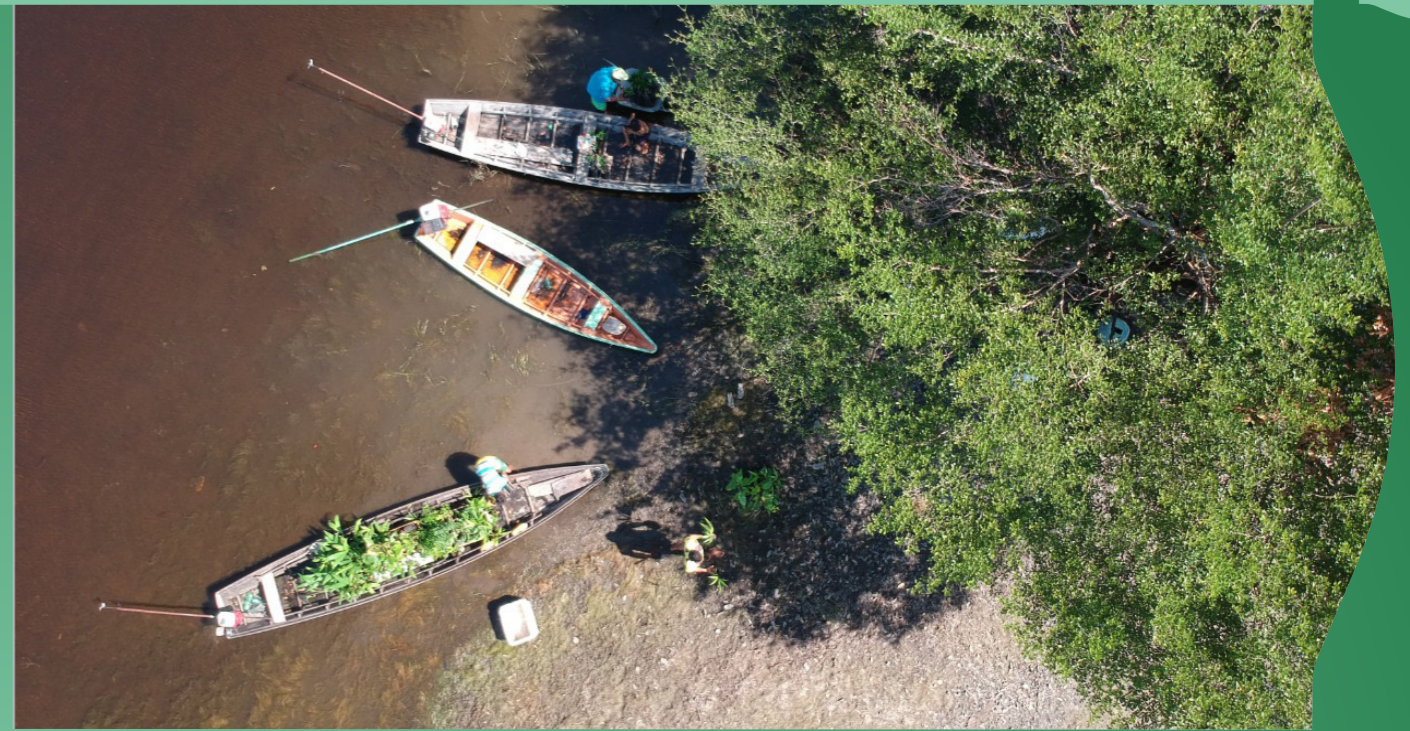


Did you know?

By 2023, 171 species of fish have been recorded in the impacted area of Batata Lake, including species that are widely consumed in the region, such as tambaqui, tucunaré, mapará and aracu.



Batata Lake water turbidity reduction



WORK PERFORMED

Monitoring carried out by the UFRJ researchers identified that the periods of flood and ebb in the region contribute to reducing turbidity and restoring the lake's ecological conditions.

The ebb period favors the cultivation of wild rice, used as a strategy to accelerate the formation of organic matter on the tailings, which reduces resuspension rates and the consequent water turbidity.



RESULTS

- Studies show that interventions in igapó areas where natural colonization has taken place, as well as where tree species and wild rice seedlings have been planted, have been reflected in the restoration of the ecosystem.
- Over the years, the turbidity values in the permanently flooded and impacted area of Batata Lake approach the turbidity values of the non-impacted areas



Did you know?

Turbidity is formed by the presence of suspended particles in the water, which takes on a cloudy, non-transparent appearance. The particles can have different origins, such as erosion, the discharge of materials from industrial activities and untreated domestic sewage.

Participatory Monitoring at Batata Lake

- The research and monitoring activities at Batata Lake involve the participation of the communities, who act as assistants in the field work.
- The monitoring work is conducted at 8 sampling stations at the Batata Lake.
- The monitoring evaluates chemical, physical, biological and ecological aspects of the lake, based on Limnology – the science that uses these parameters to measure water quality and its relationship with the balance of the aquatic ecosystem.



Socio-environmental Programs for Batata Lake Communities

ACTIONS RELATED TO ENVIRONMENTAL CONSTRAINTS:

Agroforestry Systems Support Project

Involves 18 families, offering technical assistance, training, material and equipment to encourage family farming and increase income generation and environmental preservation.

Microsystems and Artesian Wells Project

With 5 structures ready by August 2024 at Batata Lake, the project aims to increase the supply of drinking water. Microsystems are powered by solar panels.

Malaria Prevention Project

Prevention activities in the communities are conducted in partnership with the Municipal Health Department, with spraying actions against the mosquito that transmits the disease.

Environmental Education Project

Educational activities focused on environmental conservation and improving quality of life, with workshops and a Training Course for Multipliers in Environmental Education and the Environment.

'Leme' [Rudder] Project

Workshops, technical visits and information blitzes on the adoption of safe practices during river navigation, with the aim of creating a safer environment on rivers.



VOLUNTARY ACTIONS

Young Apprentice

Opportunity for young people to acquire practical and theoretical knowledge in a specific area by encouraging their training, and by promoting future employability and social inclusion.

Portas Abertas [Open Doors] Project

Provides job vacancies at MRN with training for the position and scholarships for higher education courses in Administration, Accounting and related areas.

Promoting education

Through the Basic Education Support Program (PAEB), it provides comprehensive education to students, with free school and teaching materials, transportation and food.

Professional Training Courses

Provides training to develop skills and technical knowledge aimed at a particular area or professional function.



Did you know?

Bom Jesus and Boa Esperança are the communities that live in the Batata Lake restoration area and are served by MRN's socio-environmental projects, comprising 112 families.



Batata Lake is teeming with life

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We live from fishing and often get our food from Batata Lake. We also use the lake to go to work. People from Trombetas go there to see the scenery from the beaches. It's come and go by canoe or boat every day.

Nerizane Repolho Lopes, a resident of the Boa Esperança community, who has benefited from professional qualification programs supported by MRN.



“

The lake has many beaches and is a great place for family leisure. It's also the route we use the most and one of the main sources of food for residents. This work to restore Batata Lake, which takes time to produce results, will be reflected in the future, as the lake returns more and more to its true nature, with plenty of fish and game in the area.

Bianco Gomes da Silva, resident of the Bom Jesus community, benefiting from qualification programs supported by MRN.



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I use the lake for commuting, bathing and fishing. The lake is very important to us, since we live far from Trombetas and we can't afford to buy food there, so we get our food from the lake as well.

Emilly Sthephanny Almeida de Moraes, resident of the Bom Jesus community, who has benefited from qualification programs supported by MRN.



“

I'm glad for the partnership with MRN, as it is reclaiming the lake. When I arrived here 15 years ago, it looked much redder and today it's improving. The part where the undergrowth died has been reforested and the edges are recovering. Thank God the lake is teeming with fish.

Raimundo Andrade Aguiar, leader of the Bom Jesus community at the Batata Lake



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Water Control and Monitoring

MRN has a program in place to control water quality in its areas of operation during the implementation, operation and decommissioning of mines.

Monitoring is carried out on surface water (monthly) and groundwater (three times a year).

The participation of neighboring communities involves planning and monitoring samples.

Analysis reports, maps and monitoring information are shared with the community.



Research and monitoring at Batata Lake continue to be undertaken to enrich the scientific knowledge base reference of the ecological restoration process.

ONGOING STUDIES

- Turbidity monitoring.
- Continuous improvement of the quality of the old tailings.
- Aquatic monitoring, at flood and ebb, to monitor nutrient parameters and the chemical composition of the water, the presence of microorganisms that enable photosynthesis processes and the species that colonize the igapó areas.
- Monitoring the formation of the organic matter layer on the tailings.
- Limnological monitoring: nutrients in the water, such as nitrogen and phosphorus, and organisms such as phytoplankton, zooplankton and aquatic insects.

COLLECTING SAMPLES FOR MONITORING AT 113 SAMPLING POINTS

- Araticum – 29
- Jamari – 25
- Moura – 9
- Nhamundá – 3
- Saracá – 33
- Urupuanã – 8
- Água Fria – 3
- Trombetas – 3



MYTHS AND TRUTHS

MYTH

MYTH - BATATA LAKE WILL NEVER BE WHAT IT ONCE WAS.



The impacted area of the lake has had its characteristics altered by the large volume of tailings deposited, which remain at the bottom of the lake. However, the restoration work has transformed these tailings into soil with organic matter and microorganisms that feed carnivorous fish.

The vegetation of the igapó forest has made the ecological functions of the impacted area similar to those of non-impacted areas, thus producing flowers and fruit with the presence of insects, reptiles and birds on a large scale.

MYTH

THE TAILINGS CONTAMINATED THE WATER WITH TOXIC SUBSTANCES.



No chemicals are used in the extraction and washing of bauxite, so there was no contamination by toxic substances. The tailings discharged into the lake consisted of clay, silt and sand.

MYTH

FISHING AT THE BATATA LAKE IS NO LONGER POSSIBLE.



The monitoring carried out at Batata Lake has identified the presence of 171 species of fish in the impacted area by 2023. The data is based on scientific sampling.

MYTH

BATATA LAKE RESIDENTS LIVE WITH ITCHING AND ALLERGIES BECAUSE OF WATER CONTAMINATED BY BAUXITE MINING TAILINGS.



Studies by UFRJ researchers showed that bauxite tailings does not contain chemical components that could have caused itching and allergies.

MYTH

THE TAILINGS CONTINUE TO MOVE THROUGH BATATA LAKE.



Monitoring carried out on the lake, with the participation of local communities, indicates that there is no movement of the tailings beyond the impacted area. At low water, the flow of boats and paddle boats at the site causes the suspension of a thinner layer of tailings, but there is no movement to other areas of the lake.

MYTH

THE FISH ARE CONTAMINATED. THEY ARE NOT SUITABLE FOR CONSUMPTION.



There was no contamination of fish species driven by bauxite tailing. According to researchers from UFRJ, the tailing is composed of water and different types of clay, without the presence of chemicals.

MYTH

ANIMALS THAT DRINK THE WATER FROM THE LAKE DIE.



There was no contamination of Batata Lake by chemicals derived from bauxite tailing, according to researchers from UFRJ. The tailing is composed of clay, silt and sand. No chemicals are used in extraction and bauxite washing.





2nd edition



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