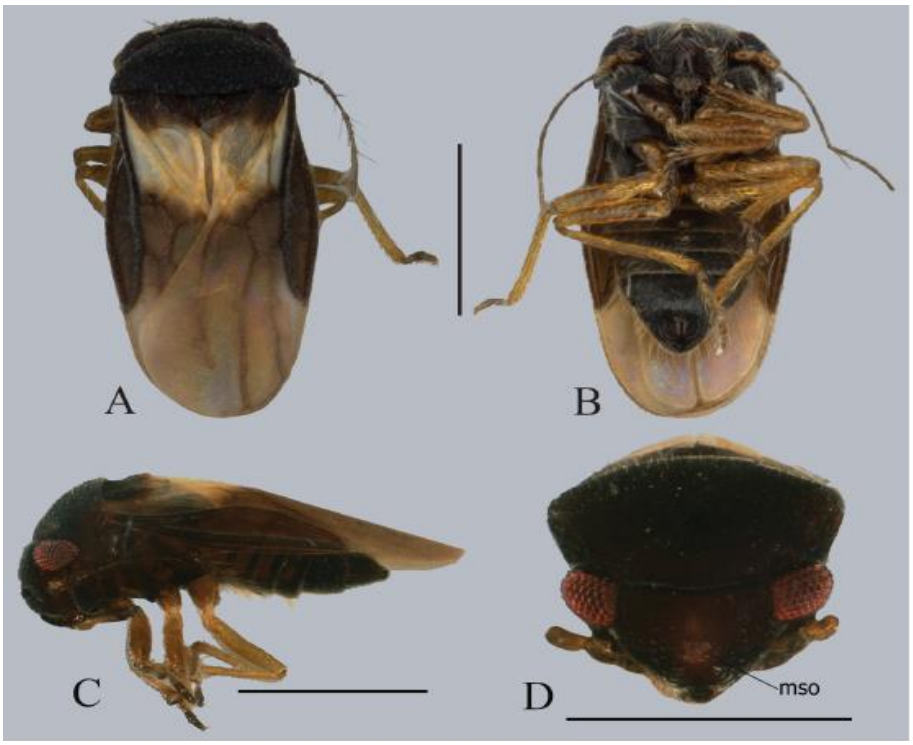
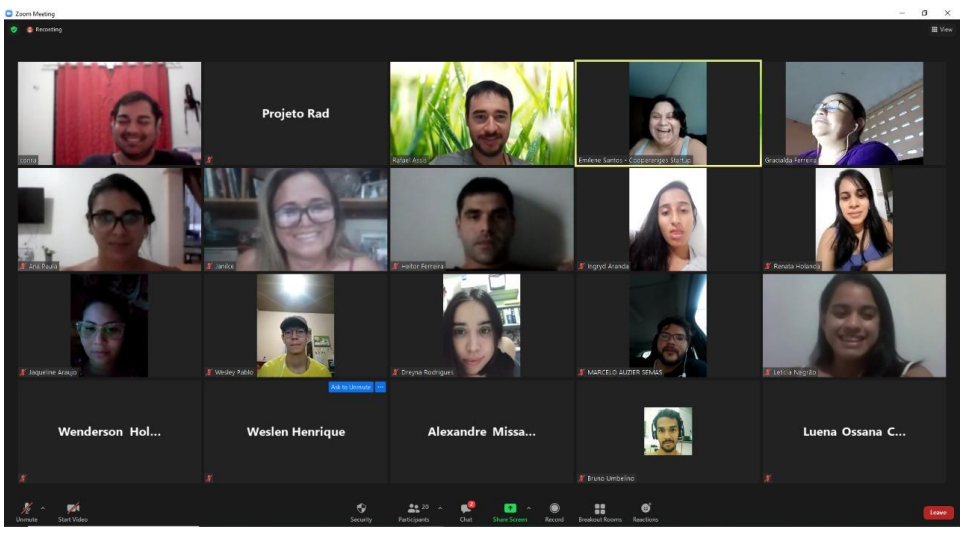
# Annual Report 2020

## The Biodiversity Research Consortium Brazil-Norway (BRC)




BRC with more publications and programs of training. Top: A new insect species, *Voragocoris weirauchae*, is described based on specimens collected in the BRC area, representing the first record of the genus from Brazil (Photo: Jose Antonio Marin Fernandes). Bottom: Students attending the "*International Course on Recovery of Degraded Areas: (Re)Building the Past*". (Photo: Rafael Assis).

# CONTENTS

# 1. Introduction and background

The Biodiversity Research Consortium Brazil-Norway (BRC) carries out research on biodiversity and climate change issues in the Brazilian Amazon. Established in 2013, the consortium comprises the Federal University of Pará (UFPA), the Emilio Goeldi Museum of Pará (MPEG), the Federal Rural University of the Amazon (UFRA), the University of Oslo (UiO) and the Norwegian mining and aluminum company Norsk Hydro (Hydro). The BRC Consortium Agreement initially lasted for fine years (2013-18), but it has been extended for a new five-year period (1 November 2018 – 31 October 2023).

BRC is the result of a Hydro initiative. In 2012, not long after taking over Vale's aluminium operations in Pará, Hydro approached the Natural History Museum (NHM) at the University of Oslo. NHM was given the responsibility to facilitate the creation of a research cooperation based on the recommendations in the Hydro technical report "Reforestation and Wildlife Program - HYDRO Paragominas, Pará, Brazil" by Salomão et al. (2012).

In the BRC Consortium Agreement, the main aim of the cooperation is "*to develop research activities both applied and basic, and build a strong base of outputs in biodiversity and climate knowledge*" among the partners. The consortium shall also contribute to "*increased university – industry partnership*". In addition to joint research and publications, "*graduate education (master and PhD) will be important elements of the consortium activity*."

This report is prepared by the BRC secretariat. It presents the consortium's main results and activities in 2020. In the final section, important lessons learned are presented. We refer to minutes from BRC Board and Scientific Committee meetings and specific event reports for further details.

# 2. Main results 2020

In 2020, BRC made substantial progress on all defined aims – research, partnerships and student involvement – as well as on the consortium's long-term sustainability. Also, BRC made a great progress on with regards communication between all parts involved in the consortium. These achievements took place in despite of all the challenges faced by the pandemic that afflicted the world. The main results in 2020 were:

- Promotion and dissemination of seminars, particularly through virtual platforms, which were important to disseminate results provided by projects supported by BRC and to facilitate discussions between associated researchers;
- Implementation of most research projects that were delayed or pending, particularly those that were approved in the last call (2018);
- Conclusion of projects that have been ongoing since the first BRC call, being the first set of projects to successfully conclude their activities;
- Significant number of publications in scientific journals, with more than 20 articles published/accepted for publication;
- Strengthening on the communication between parts involved in the consortium, which were highly important to discuss and solve issues of common interests;
- Promoting of the research group's internal activities and academic training (such as academic courses and thematic seminars).

- The relevancy of BRC has been recognized by other publishing media (non-academic), resulting in increased access to the general public of BRC's project outputs;
- Maintaining a high number of researchers and students supported by BRC, highlighting the importance of the consortium for the Institutions involved, as well for the science developed in the region;
- The BRC Long-Term Strategic Plan has been prepared and approved by the board, and is ready to be implemented in 2021;
- The consortium has shown to be highly supportive amongst its collaborators when facing unprecedented conditions, such as the challenges that the research groups have encountered during the pandemic.

## 3. The BRC Board

The BRC Board consists of one representative from each member institution. In 2020, the board members have been: professor Marcos Piedade (UFRA), professor Alexandre Bragio Bonaldo (MPEG), professor Leonardo Sena (UFPA), Domingos Campos (Head of HSE - Hydro B&A) and Fridtjof Mehlum (Senior Researcher - UiO). Leonardo Sena (UFPA) exercised the function as chair of the board.

The Board had its annual meeting on 7th March 2020 in Belém – Pará (MPEG). The possibility of an extension of the Consortium agreement beyond 2023, as well the role of BRC in social media for improving dissemination of BRC activities and products, were amongst the topics discussed during the meeting. In addition, the secretariat presented the first sketch of a strategic plan proposed to BRC and the Board contributed to comments and suggestions. They were important to the preparation of an ultimate version of a long-term strategic plan for the Consortium, which was adopted by the Board through email consultation in October – November 2020. The plan is ready to be implemented in the current year (2021).

## 4. The BRC Scientific Committee

The BRC Scientific Committee takes all the overall scientific and operational decisions. It consists of two representatives from each member institution and normally meets two times every year. In 2020, the members of the committee have been: professors Gracialda Ferreira and Norberto Cornejo Noronha (UFRA), researchers Alberto Akama and Rogerio Rosas Silva (MPEG), professors Ana Cristina Mendes de Oliveira and Leandro Juen (UFPA), Patrick Brading (Environmental Manager – Norsk Hydro), Domingos Campos (head of HSE, Hydro B&A), and senior researcher Fridtjof Mehlum and professor Øystein Wiig (UiO). Fridtjof Mehlum (UiO) exercised the function as chair of the committee.

BRC had two meetings of its Scientific Committee in 2020. The first of the annual BRC SC meeting took place in Belém – Pará (MPEG), on March 4th. Fridtjof Mehlum (UiO) chaired the meeting. The following members attended this meeting: Rafael Assis (UiO/BRC) Øystein Wiig (UiO), Fridtjof Mehlum (UiO), Ana Cristina Oliveira (UFPA), Patrick Brading (Hydro), Norberto Noronha (UFRA), Alberto Akama (MPEG), Leandro Juen (UFPA), Rogerio Rosas Silva (MPEG). Several other persons from the BRC partners participated as observers. The main discussions focused in the status of the new and the ongoing projects, potential new calls for projects support, activities related to the Project Management Group, delays in starting new projects, issues involving the rental cars for conducting the BRC projects at Hydro, status on the

Biodiversity Indicators initiative, the publication of the book between BRC and Hydro, among others.

The second meeting occurred on September 24th and took place virtually (via web conference) due to restriction on travelling caused by the pandemic. Participants were: Rafael Assis (UiO/BRC), Fridtjof Mehlum (UiO), Øystein Wiig (UiO), Leandro Juen (UFPA), Ana Cristina Oliveira (UFPA), Patrick Brading (Hydro), Domingos Campos (Hydro), Gracialda Ferreira (UFRA), Norberto Noronha (UFRA), Alberto Akama (MPEG), Rogerio Rosas Silva (MPEG). Several other persons from the BRC partners participated as observers. Fridtjof Mehlum (UiO) chaired this meeting. The main topics discussed in the meeting involved the challenges faced by the group caused by the pandemic. Among them, Hydro updated the team about how the Company has been proceeding with their operations in order to avoid further dissemination of the virus, the status of all projects in times of the pandemic, possibility of the extension of projects and changes in project budgets due to delays, and perspectives of when the projects may restart their field activities. The members of the SC were also updated about the status on the Biodiversity Indicators initiative, the progress of the planned BRC book, and discussed how the results of the studies from BRC could be conveyed and applied to the Hydro's plan for ecologically sustainable mining practices.

## 5. The BRC Secretariat

The BRC Secretariat is responsible for coordinating the consortium's activities and for preparing and planning the meetings of the Board and the Scientific Committee. It is also responsible for coordinating internal application processes, external funding initiatives as well as internal and external communication. It is hosted by the Natural History Museum, UiO, and leaded by Dr. Rafael Leandro de Assis.

A second member of Secretariat, the environmental engineer André Carvalho, has been based in Belém left position in October 1st October, 2019. He started working for Hydro in July 2019 and is no longer part of the BRC's Secretariat. The need of a second member in the Secretariat to conduct activities in Brazil (mainly Belém) was discussed during the Board meeting (March 2020). The board agreed that the Secretariat sees no immediate need to fill a position in Belém, and decided that currently there is no need to hire an extra person in Belém.

## 6. New research projects

In 2018, BRC opened a new call for research projects based on the revised BRC Research Program (2018-2023). From all the 22 proposals received, the Scientific Committee recommended 11 research projects to Hydro for funding. During the year of 2019, the coordinators of the approved proposals have been dealing with bureaucratic arrangements in order to have their projects implemented. Despite some delays regarding signatures and agreements between the parts involved (e.g. Universities, Hydro and FADESP), most of these projects had their budget released and are ready to start or are already ongoing (Annex 1).

The exception is the project BRC 17/19 – "Metabarcoding and metagenomics of terrestrial arthropods", in which the delay is caused by delay in the preparation of the

contract between the partner in Norway and Hydro. The Secretariat is in discussions with the project leaders and the contracts are likely to be prepared and signed in the first semester of 2021.

Although most of the new projects are ready to start (Annex 1), unfortunately few of them have made substantial progress. This was caused by the termination of field activities in early March due to the pandemic. Project leaders were able to assemble their teams for the projects (students, post-doctorates, etc.), as well acquire equipment for the experiments/field work, among other activities related to the research project. However, since they were not able to access the study site, all these projects are behind the schedule and are waiting for permission to get access to the study sites.

## 7. Research project activities

Most of the projects that have been approved in previous years are now fully operational (Annex 2), and great progress has been made. Progress reports have been presented twice a year to the BRC Scientific Committee.

Only one of the projects listed on Annex 2, however, has not started yet - BRC 15/17 (The topsoil project). The reason is that it has been a change in relation to the funding designated to support the proposal. There was a possibility of this project to be supported by external founds, but in the end this possibility did not work out. However, discussions between the project coordinators and Hydro for finding a solution were very productive, and a new budget is now in preparation. It is likely that this project will have all contracts prepared and potentially signed in the first semester of 2021.

Another case is the BRC 09/15 (Wood-decay fungi), which has not had the expected progress because of administrative problems. The problems seem now to have been solved: Karl-Henrik Larsson, who headed the proposal, has retired from his position at UiO and Professor Hugo de Boer (UiO) has taken over as new coordinator of the project. The contracts between UiO and Hydro have already been signed and the budget is about to be released, and the project will be ready to start.

Some projects have reached the end and have delivered the final reports. This is the case of the project BRC 03/14 – “Biodiversity, proliferation of plant species and restoration of degraded areas from bauxite mining”, BRC 06/15 – “Evaluation of chemical compounds”, BRC 07/15 – “Impact study of a biodiversity recovery program on populations of insect vectors”, and BRC 08/15 – “Bird diversity”. Results from these projects so far include at least five publications in scientific journals, and many others are in preparation for submission. Moreover, tens of under-graduate and post-graduate students, technicians, professors and other researchers have been involved in these projects, which highlights the importance of the BRC-supported studies for university education and the professional competence building.

The year of 2020 was a very successful year in regard to publications in scientific journals: nearly 20 papers were published or accepted for publication. This is by far the most productive year in terms of number of published papers since the beginning of the consortium. These publications covered a large number of research themes – mammals, aquatic insects, fishes, seedling production, aquatic plants, and many others.

Thanks to the researches supported by BRC, we have obtained a better understanding of the impacts of degraded habitats for the life of different species of mammals ("Environmental factors influencing the abundance of four species of threatened mammals in degraded habitats in the eastern Brazilian Amazon", Teixeira-Santos et al. 2020 – *PlosOne*) (Figure 1). Another paper presented the first time registration of an invasive species of macrophyte in the Eastern Amazon ("New records of the invasive macrophyte, Urochloa arrecta extend its range to eastern Brazilian Amazon altered freshwater ecosystems", Fares et al. 2020 – *Acta Amazonica*). Another highlight was the description of a new species of litter bug ("*Voragocoris weirauchae* sp. n. (Heteroptera: Schizopteridae: Schizopterinae), a further minute litter bug species from Brazil", Almeida et al. 2020 – *Zootaxa*) (Figure 2). A list of all the publications along the year are shown on Annex 3.

These studies, among all the others, are very important to increase the knowledge of the most diverse biome in the globe, and reveal that still there is a lot to know about the flora and fauna from Amazonia, as well to better understand how to minimize the impact on the environment caused by the exploitation of the natural resources. The results are very relevant as scientific support for new and more green practices to guarantee a more sustainable exploration in the region. In addition, the high number of publications reveals that some of the most important goals of the consortium, which is the development of research activities and the strengthening of the university - industry partnership, is being reached.

Figure 1. Researchers from BRC evaluated the adaptive plasticity of threatened mammal species. Among the four studied species, the peccary presented the least ability to survive in more altered environments. (Photo: Hydro).

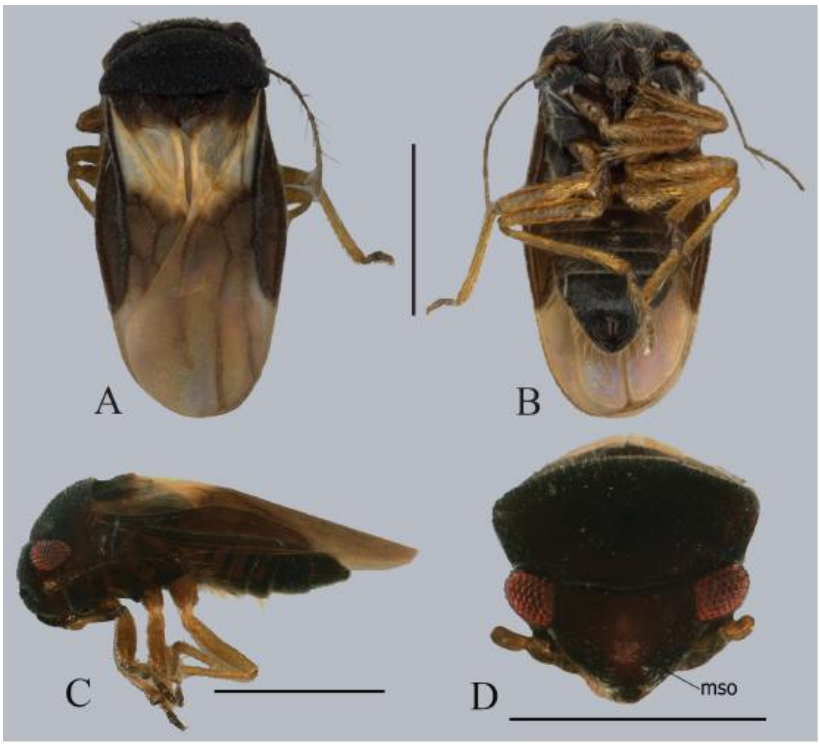



Figure 2. A new species, *Voragocoris weirauchae*, is described based on specimens collected in the Brazilian Amazon, representing the first record of the genus from Brazil. (Photo: Jose Antonio Marin Fernandes).

## 8. Brazilian newspapers and TV highlights BRC's researches

One of the most important Brazilian newspapers, with broad relevance in the country, published on November 11th a report highlighting the Jaguar project (BRC 05/15) (Figure 3). According to the report, the study leaded by researchers from UFPA (Federal University of Pará) and UiO (University of Oslo) have been monitoring large cats over the past six years in the Paragominas region - an area that is extremely degraded by deforestation for livestock, logging, large monocultures, legal mining and illegal mining – and revealed that jaguars are adapting to the degradation of their habitat and may be ceasing to be a parameter for the level of preservation of a territory. The report also highlights the role of BRC in the region, stating that the consortium "began in 2013, with the creation of the Brazil-Norway Biodiversity Research Consortium, with researchers from UFPA, the Goeldi Museum, UFRA (Federal Rural University of the Amazon) and the University of Oslo, in Norway".

In August, BRC was also the theme of a report in a Brazilian TV channel, from the Pará State (Figure 4). The report highlighted the role of BRC in developing researches on Eastern Amazon, showing some of the studies that are conducted in the area – from mammals to plants and insects. Also, the report showed that the Jaguar project successfully captured a jaguar in the Hydro's mining area and tagged the animal with a GPS satellite collar, in order to monitor the movement, habitat use, and living area of the largest feline in the Americas. It was also informed that this was the first radio-monitored jaguar in the Pará State. Another report about the Jaguar Project was released in July by a local newspaper from Belém, also highlighting the fact that this was the first jaguar to be monitored by radio collar in the State.

The web links to these reports and videos can be accessed through the BRC's official

website (https://www.brcbn.com/news).


Figure 3. One of the most important Brazilian Newspapers highlighted the study with Jaguars performed by the researchers from BRC (Source: internet). (Source: internet).


Figure 4. Local news channel in Pará presented some of the studies ongoing on Paragominas supported by the collaboration Hydro – BRC. Among the highlights in the report, there were mentioned the studies with interaction plant-insects, projects on forest restauration and the jaguar project. (Source: internet).

# 9. BRC researchers in the Highlight

Two of the researchers associated with BRC, both female, were highlighted in the field of science this year. One of them, Prof. Thaísa Michelan, represented UFPA and BRC at the 5th BRICS Young Scientists Forum (YSF) (Figure 5). She was one of the 19 Brazilians invited to the Forum 2020 in the area of Ecology. The event, which took place in September (via online), is part of the Summit of BRICS countries (Brazil, Russia, India, China and South Africa). It aims to strength the cooperation between young scientists from these countries and the creation of intercultural talent groups from BRICS for cooperation in Science, Technology & Innovation. Thaísa Sala Michelan, from the Primary Producers Ecology Laboratory and the Post-Graduate Program in Ecology (PPGECO - UFPA) is the coordinator of the BRC project "BRC 26/19: Effects of soil use on diversity and ecophysiology on the riparian vegetation, aquatic macrophytes and plankton in streams and lagoons in mining areas", and has been collaborating with BRC since 2016.

The second one was Prof. Ana Cristina M. de Oliveira from UFPA, one of the coordinators of the project "BRC 05/15: Camera trap survey of ground-living mammals in the Hydro bauxite mine area in Paragominas, Brazil". She was amongst the researchers that described a new species of marsupial (Figure 6), named in honor of Brazilian woman environmental activist. *Marmosops marina* is the name given to the tiny marsupial of a new species identified by the researchers Claudilívia Ferreira, Ana Cristina Mendes de Oliveira (UFPA – BRC), Luan Gabriel Lima-Silva and Rogério Vieira Rossi. The scientific name of the animal was a tribute to Marina Silva, former Brazilian member of Senate and worldwide recognized for being an activist for the protection and conservation of the Amazon.

Figure 5. Prof. Thaísa Michelan represented UFPA and BRC at the 5th BRICS Young Scientists Forum, an online event that took place in September. (Source: UFPA).

Figure 6. *Marmosops marina*, new species of marsupial named in honor of Brazilian woman environmental activist Marina Silva. (Source: internet).

## 10. Fundraising activities

BRC is actively seeking other funding sources for new projects. In 2018 BRC was successful in obtaining a new bi-lateral project funded by CAPES and The Norwegian Centre for International Cooperation in Education (SIU). The project entitled "Transnational training in environmental DNA for biodiversity assessments and restoration ecology" is a collaboration between UFPA and UiO. This project is now ongoing, and even made it possible for exchange of students from Norwegian Institutions to take part of their master thesis in Brazil.

In 2020 however, due to limitations on field work and lab activities, several projects had to stop their planned activities. Hence, most of their allocated funds for being used during the year were not accessed, and most project leaders did not see the need to apply for complementary funds. In addition to that, few calls were released by the funding agencies worldwide, mainly because of the uncertainty scenario that the entire planet is dealing with due to the pandemic.

## 11. Challenges Faced by Pandemic Covid 19

The year of 2020 will be forever remembered as the year of the Covid 19 pandemic. Several sectors of the society were deeply impacted by the pandemic, from industries to the segments that embrace the travel agencies, services and businesses in general. Not different of them, the sector involving academic institutions also suffers its consequences. In what regards the BRC projects, all had to stop their field work in mid-March, as well the lab activities.

Despite the difficulties that the research groups have confronted due to the pandemic,

BRC managed to let several research activities proceed. This was possible mainly thanks to the virtual platforms: they hosted the meetings between members of the consortium, allowing them to work from home and avoid further exposition to the virus. Thus, important events that are crucial for the maintenance of the dialogue between partners and for important decision within the consortium's scope were performed according to previously schedule. They included, for example, the second meeting of the Scientific Committee, taking place in September 2020 as a virtual meeting. The virtual format of the meeting was quite acceptable to the participants, but a physical meeting would be preferred, if possible.

In addition to the fulfilling the schedule of the important meetings for the consortium, BRC also adopted strategies to approach the research leaders in order to give them the assistance needed. One example was the monthly meetings, which started to be performed in June and occurred every month during the rest of the year. For these meetings, all the project leaders, as well staff from Hydro and collaborators were invited, and most of them attended the meetings regularly. These meetings were highly important to update the participants on the situation of and the challenges caused by the pandemic, including health concerns, modifications on schedule for field work, support for students and other staff, safety protocols, among others.

Apart of the issues concerning the pandemic, the meetings were highly important also to discuss other topics that are of major importance for the consortium, such as the progress of the Biodiversity Indicator's initiative, BRC book, and others. Moreover, through the monthly meetings the participants could be updated about new publications, events and opportunities. Finally, these meetings were also important for the participants to share experiences and other concerns that they were facing due to the pandemic, and seek for suitable solutions.

The progress of all projects in general were impacted, and consequently all BRC projects are currently behind the schedule. However, the main funding support of the consortium – Hydro - has shown to be highly supportive for all project leaders in order to avoid that these delays impact the quality of their studies. In this context, Hydro has indicated to be flexible in order to solve problems encountered by the projects, and is considering to adjust their schedules and budgets. This confirm the solid partnership that has been built between Hydro and the research groups, and the willingness of supporting the studies in order for them to achieve the objectives initially proposed. In addition to that, it was noted a high concern on protective measures regarding the students' health situation, as well for the staff and other collaborators from BRC. Since the beginning of pandemic, the welfare of all participants was considered as the first priority, and all the partners were very transparent in communicating the measures to contain the spreading of the virus. It was very important to show to all the BRC members that healthy is a major concern, and that only when the adequate conditions for everyone are guaranteed, the activities will resume.

## 12. Promoting Web Seminars and Online Events

Despite the fact that the pandemic hampered most of the scientific activities scheduled for the year, the researchers associated to BRC promoted several online events for dissemination of results, initiate discussions related to the most varied themes, integration of students & professors, and also to stimulate the dissemination of science during the times of the pandemic. These web seminars took place of all different forms, mainly social media.

Due to the need for social distancing, and with several different professionals working

from home, this platform was extremely important throughout the year. Researchers, scientists and professors used this manner of communication to get closer to students and the general public. Similarly, researchers associated with BRC promoted web seminars and other online events and were together able to reach hundreds of listeners and watchers.

The most diverse topics were addressed during these events, such as “Revegetation of degraded areas by mining” – promoted by Gracialda Ferreira (UFRA) (Figure 7A); “Diversity, information gaps and changes caused by land use in the state of Pará” – sponsored by associate researchers from UFPA (Luciano Juen, Luciano Montag, Marcos Persio), MPEG (Rogério Rosa da Silva) and EMBRAPA (Joice Nunes Ferreira) (Figure 7B); debate about the challenges on the coexistence between Humans and Great Felines worldwide – organized by researchers from UFPA and experts from other organizations.

Also, some of these events counted on Brazilian celebrities, such as a famous actor which is also an activist for environmental causes (Victor Fasano and Ana Cristina de Oliveira – UFPA, talk on “Amazon, Biodiversity and Climate”; figure 8A), and one of the most famous singers from Pará State: Fafá de Belém (Figure 8B). In this talk, the participants discussed among other things, the importance of training the local communities for developing sustainable practices in the acai berry production.

These events were highly important in order to disseminate science, gather students and other interested people for discussing the scientific topics developed in BRC, as well for increasing the relevance of the studies from the consortium. During the pandemic, such events helped the students to be kept updated about topics related to the most diverse subjects in science. They were important also for helping students to stay at home and still access source of important information for their education and development as researchers.


Figure 7. Online events performed by BRC associated researchers from UFRA (*left* – 7A), and from MPEG, UFPA and EMBRAPA (*right* – 7B).


Figure 8. Online events that accounted on celebrities from Brazil, organized by Ana Cristina Oliveira - UFPA (*left* – 8A), and Prof. Gracialda Ferreira - UFRA (*right* – 8B).

## 13. Field Course in Tropical Rainforest Ecology and Biodiversity

The Field course is conducted by the BRC partner institutions and it is part of the post-graduation programs of the participating institutions. Specific funding for the course was obtained from the Norwegian Centre for International Cooperation in Education (DIKU), throughout the UTFORSK call, and will finance the course for four years (2018-2021). The course includes two parts: one in Brazil, and another in Norway. In the first part, eight students from Norway (NMBU and UiO) travel to Brazil and join eight students from Brazilian Institutions (UFRA, UFPA and MPEG) for field-work in the Amazon forest. For the second part, they take the opposite direction: students from Brazil travel to Norway and work together with students from Norwegian Institutions.

Until now, the field course has been held two times: 2018 and 2019. However, due to restrictions and concerns caused by the pandemic, the course for 2020 was canceled. Fortunately, the agency that is responsible for funding the course (DIKU – UTFORSK) accepted the justification of postponing the course for one year. As consequence, we will be able to offer another two courses: 2021 and 2022. According to the initial plans, the last field course would have been held in 2021.

The situation hopefully will be better in the coming year, and the conditions adequate to offer another field course in August-September 2021. This initiative is highly important for our objectives regarding the exchange of students and professors between the two countries, as well to strengthen the collaboration among institutions and research groups.

## 14. Special Issue of the MPEG Bulletim on “Biodiversity and Ecological Restoration Processes Related to Mining Areas”

In December 2020, the BRC together with the MPEG, launched the process of planning a special issue of The Bulletin of the Museu Paraense Emílio Goeldi - Natural Sciences on the theme “Biodiversity and Ecological Restoration Processes Related to Mining Areas”. The idea is to assemble research articles worldwide focusing on the biological diversity in areas under the influence of mining, their conservation, recovery and sustainable use. The mission of this special issue is to promote and disseminate knowledge not only about the concept of sustainable development in mining, but also specialized knowledge based on ecological research results related to biodiversity restoration, as well as scientific methods for mitigating impacts and recovering ecosystems under the effects of mining.

For the dissemination of the issue and call for manuscripts, platforms of social media and websites (MPEG, BRC, etc.) were used (Figure 9). Manuscripts can be submitted until June 2021, and the publication of the issue is expected for December 2021.


Figure 9. Folder for dissemination of the special issue of the MPEG Bulletin on “Biodiversity and Ecological Restoration Processes Related to Mining Areas”, initiative between the MPEG and BRC.

## 15. Course on Recovery of Degraded Areas

BRC and the Tutorial Education Program in Forest Engineering from UFRA start the promotion of the “International Course on Recovery of Degraded Areas: (Re)Building the Past”. The course aims to provide theoretical and practical training on concepts, legislation and application of methods for planning and carrying out forest restoration activities, provoking a wide debate on

the theme. Its goal is to expand knowledge on the subject, collaborating with actions under development in the Amazon region and, with that, contributing to the technical training of professionals in the area. For this, the course has assembled teachers from different areas who work in the field of forest recovery, especially in the Amazon. It consists of two and a half weeks of remote classes, and is offered totally via a virtual platform (Figure 10).

Since the course is conducted via internet (online), it opened the possibility of people from different regions of the country to attend. By the end of the registration period, more than 50 people had signed up for the course, from more than twenty different institutions and cities, embracing six different states in the country. The attendants were very diverse, with background on biological sciences, forest and environmental engineering, agronomy, and others.

The course was prepared between October and December 2020, and the registration for the course opened in December 2020. It will start in Mid-January 2021, and will last three weeks. At the end of the course, it is expected that the students will be able to understand all the steps involved in the processes of forest restoration, such as the most applicable methods, legislation, techniques for promoting the return of natural elements and environmental services and, thus, recovering the previously degraded area.


Figure 10. Students and professors during a class of the virtual course on Recovery of Degraded Areas, organized by UFRA and BRC.

## 16. Seminar on “Coexistence: expanding the scale of analysis and management of relationships between humans and wildlife”

On March 5th, the BRC project “Coexistence plan for human and carnivores” organized an event to discuss the importance of the coexistence between humans and fauna. For this seminar, the researcher from University of São Paulo – Professor Silvio Marchini – was invited (Figure 11). The talk discussed aspects of conservation of fauna through human–wildlife coexistence policies, such

as urban-dwelling people.

This topic is highly relevant for the context that embraces some projects ongoing in the Paragominas region, in special those with mammals. The Jaguar project, for example, revealed that individuals of this feline species expand their territory much beyond the limits of the mining area, advancing also along the farmers and other properties in the surroundings. Therefore, this seminar allowed relevant discussions on awareness of local people in relation to the carnivores present on their properties, and that the animals were not necessarily a threat (but instead that coexistence was totally possible).

The event took place at the Federal University of Pará, and about 40 people attended the seminar.


Figure 11: Professor Silvio Marchini, from USP – São Paulo, conducted a seminar on human-fauna coexistence at the UFPA. Photo: Iara Ramos.

## 17. Student Involvement and Exchange

One of BRC's main aims is to integrate students in research projects. With research activities expanding, so is the number of students involved. By the end of 2020, a total number of 71 students were involved in BRC research projects: 32 on bachelor level, 8 on master level, 18 on PhD level and 13 Postdoc (Figure 12). Based on this numbers, we observed a continuation of the high number of students associated to BRC projects compared to the previous year, despite the pandemic. The number of undergraduate students increased more than three times after a dip in numbers the previous year. The number of PhD students and post-doctoral fellows kept stable in relation to the previous year, while the number of master students decreased.

Another thing to mention is the fact that, despite several projects are now concluded, the number of students linked to BRC is still high. Probably this is a consequence of students recruited to the new projects that are ready to start as soon as the pandemic situation allows. .

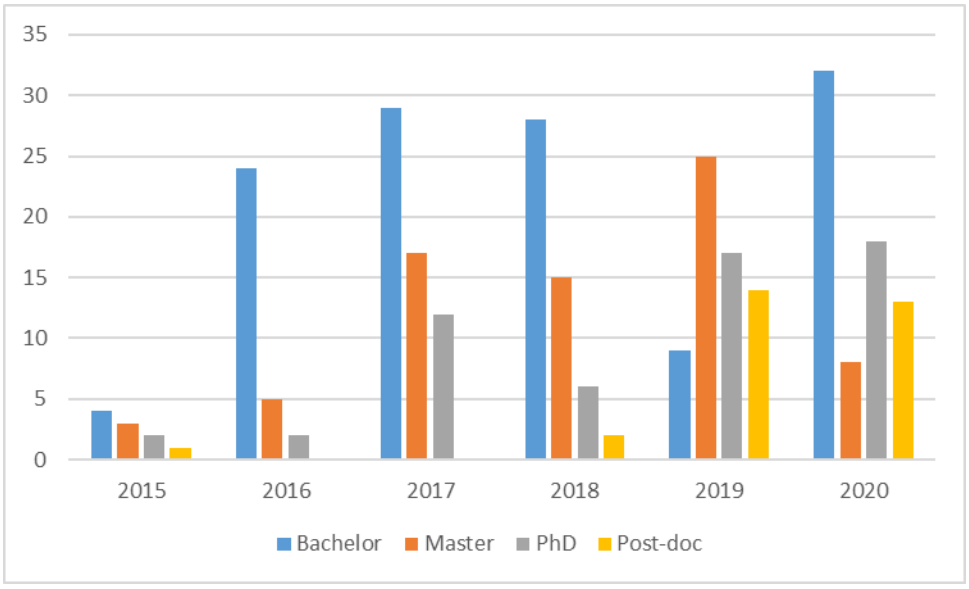



Figure 12: Number of students involved in BRC research projects from 2015 to 2020.

In the previous years, some of these students had the opportunity to experience part of their studies abroad, participating in the exchange program of the institutions involved in the Consortium. For example, a few Norwegian students that participated in the rainforest field course extended their stay in Brazil in order to develop their master thesis. In all the cases they recognized that the exchange was a very rich experience, both professional and the personal, despite of the language barrier.

In 2020 however, the physical exchange of students was not possible due to limitations on travelling caused by the pandemic. Still, students managed to participate and interact with other students in virtual meetings and forums promoted by researchers from the different BRC. Partner institution. These events were important to strengthen the relation between the research groups, and to open possibilities for the future in a scenario where the exchange of students is again possible.

## 18. BRC's Website and Social Media

The BRC's official website has been under constant update in 2020. News, reports, events, and other relevant information concerning the consortium's activities have been regularly posted in the website (brcbn.com). This is an important tool for students and the general public to get to know what BRC is about, and to be informed about upcoming events, such as courses, seminars, opportunities, research teams and others. Also, a new link with information on the researchers associated to BRC was included in the website (https://www.brcbn.com/associate-researchers), containing their research interests and professional profile. The aim is to facilitate the contact for those interested in BRC project with the project leaders, and thus help increasing the range of the studies performed by BRC (Figure 13).

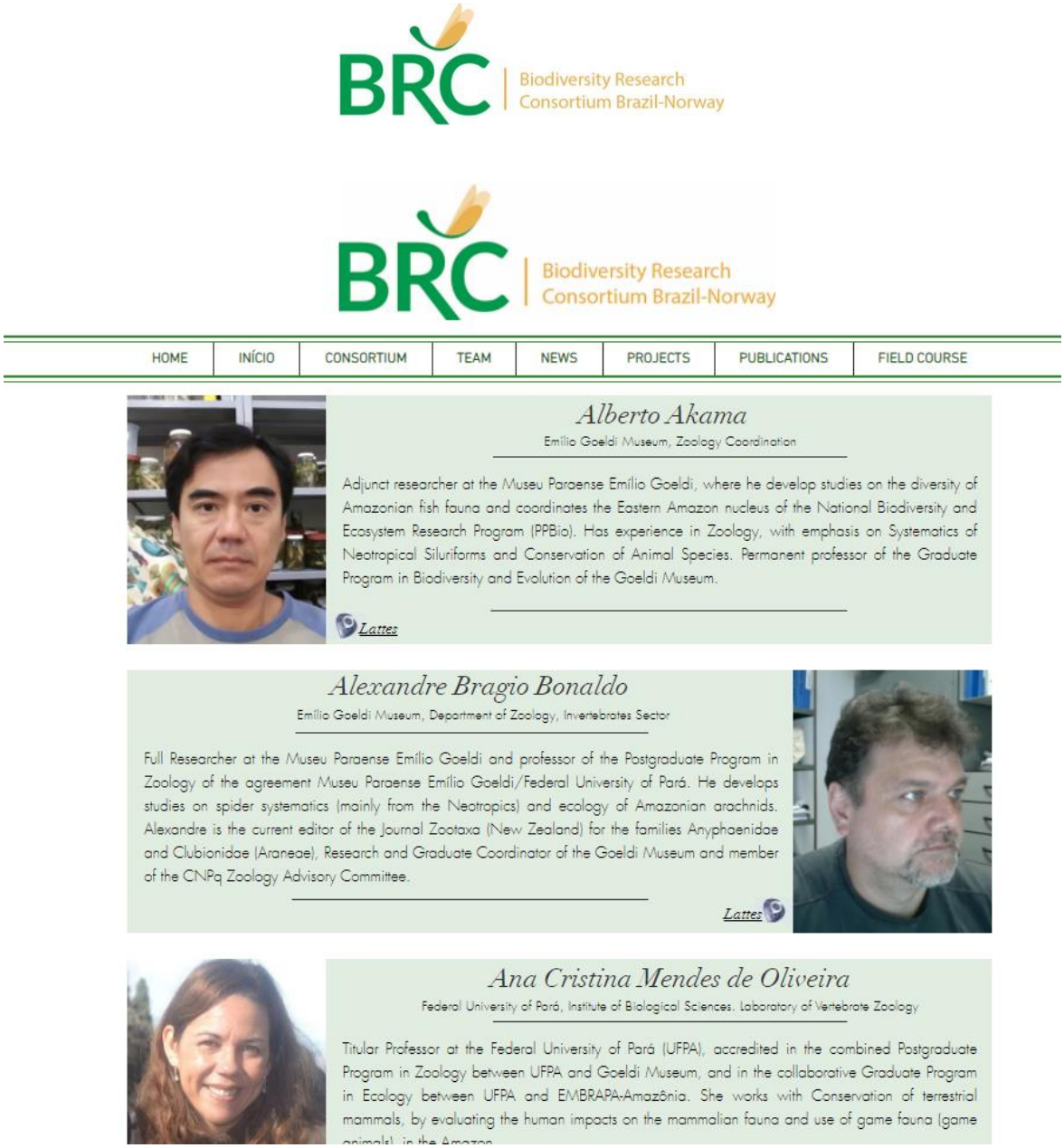



Figure 13. Image of the BRC's website, showing page with the bio of the researchers associated to BRC.

In addition to the website, BRC has been very active on social media. The consortium had recently created its page on Twitter (@BRCAmazon), which already has more than 30 followers. In this channel, most of the information is posted in English, in the attempt to reach a public more international. BRC has also an account on Facebook, created in 2018 (@BRCAmazon). This account has been repeatedly updated with posts related to updates of the BRC (e.g. publications, achievements, etc.), opportunities, events, and news regarding forest sciences, environment, among others. These media channels are extremely important to disseminate the science that is made by the BRC team, and also relevant to attract more people that might be interested in collaborate or integrate some of the research projects – especially students. Posts on the Facebook pages are written mainly in Portuguese, focusing on the public from Brazil. Today, our Facebook page has more than 400 followers, and this number has significantly increased during the year 2020 (Figure 14).

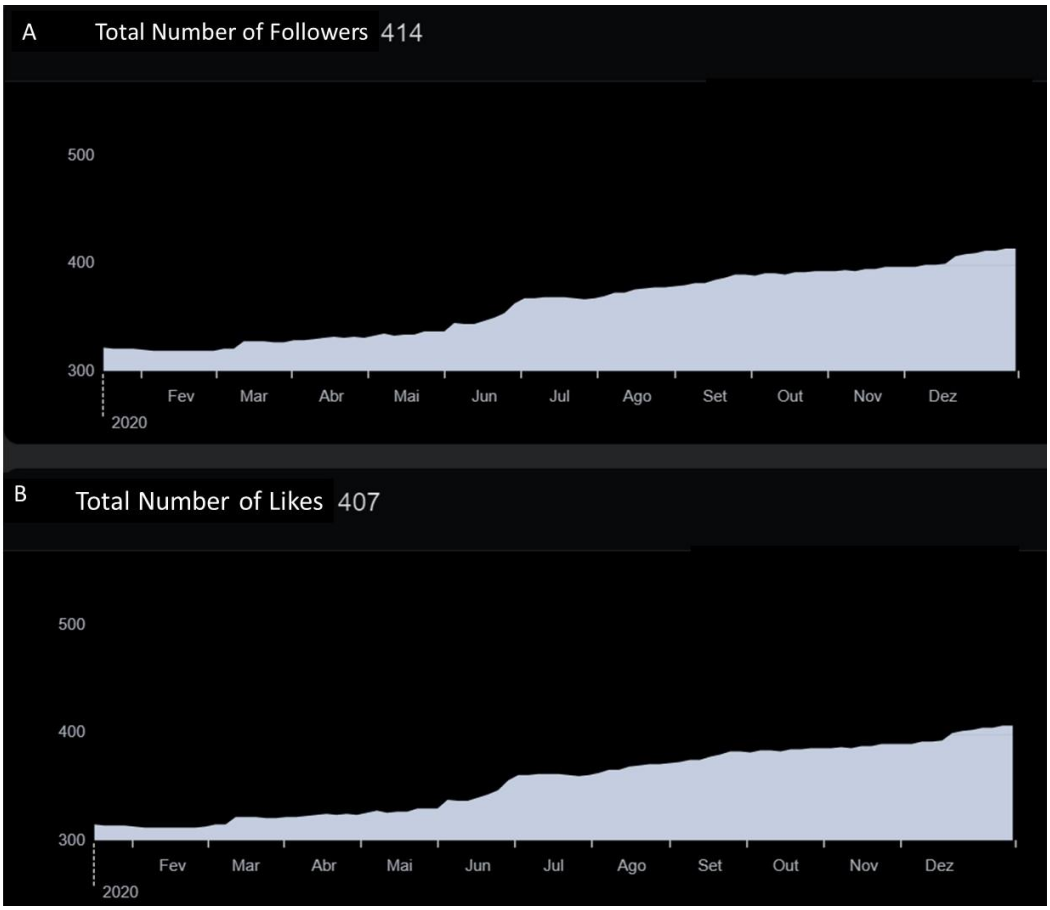



Figure 14. Stats of the BRC's Facebook page showing Total Number of Followers (*top* – A), and Total Number of Likes (*bottom* – B) across the year 2020.

## 19. Lessons Learned

The year of 2020 was another year of progress for BRC, in spite of all the restrictions and challenges caused by the pandemic. The consortium advanced on the defined main aims of the cooperation, namely to develop research activities, to improve university – industry partnership, increase its relevance through its publications and social media, and finally in the integration of the students and professors/researchers among the different institutions. Below, some of the achievements and challenges faced:

- *The Consortium can be seen as more solid than never, since all the prejudices caused by the pandemic did not affected the union and integrity of its members. The pandemic has caused large difficulties for progress of the research activities, especially for field work. However, it did not affect necessarily the interaction between the partners, as well the programs for training and for publication of scientific results from projects that have completed the field work or have collected significant data in previous years. This in fact reinforce that BRC is a very well established Consortium with a concrete structure suitable for its long-term existence;*
- *More frequent meetings (e.g. monthly) can be highly productive for updating the members of the Consortium, share information on challenges and experiences, and find solutions to problems. These meetings have also been shown as highly important to*

*keep important topics of the consortium in the radar and speeding up processes relevant for the progress of then research projects.*

- *BRC has been very successful in producing publications of the ongoing and completed studies. Despite the fact that the production was relatively low in the previous years, now that some projects are concluded or well advanced we noticed a substantial increase in the number of publications. This shows that we are fulfilling our objective in increasing the relevance in the scope related to forest restoration and biodiversity in areas affected by mining by contributing to the world literature in the field of restoration ecology and adjacent disciplines;*
- *Despite the fact that the publication rate was high throughout the year and this trend is expected to last for the next few years, it is still a challenge to incorporate these results in the restoration practices of the mining company. Hydro aims at being a leading company in conducting ecologically sustainable mining operations, and BRC is highly fundamental for this achievement. Thus, efforts need to be made on how the results from the projects can be converted into better operational practices of the mining company;*
- *Online platforms for meetings, teaching and talks worked very well during the period of pandemic and can be used as channels of communication between the BRC members. It was a challenge for some to get used to the new tools, but everyone performed well on the learning of the new method. Certainly, this platform can be used also in the future, and will be highly relevant to interested external institutions, especially from the different countries.*

Oslo, 27th January 2021

Rafael Assis and Fridtjof Mehlum

# Annex 1: BRC – Status of new research projects 25.01.2021

| Code | Coordinator | Proposal | Institution | Status |
|---|---|---|---|---|
| BRC 16/19 | Jonathan Stuart Ready | Measuring biodiversity dynamics using environmental DNA and metabarcoding | UFPA | Documents signed and budget available. Started. |
| BRC 17/19 | Vladimir Gusarov | Metabarcoding and metagenomics for high throughput inventory and monitoring of terrestrial arthropods | UiO | Budget is fine. Missing documents from FADESP. Need to line up with team in Norway. Permits for DNA extract is an issue. |
| BRC 18/19 | Leonardo Sena | Metagenomic and metabarcoding as a tool for developing One Health In Hydro Area, Paragominas | UFPA | Documents signed and budget available. Started. |
| BRC 19/19 | Lilian Lund Amado | Use of native species from different trophic levels and occurring in bauxite mining area to evaluate the toxicity of residues | UFPA | Documents signed. Budget available. Started. |
| BRC 20/19 | Luciano Montag | Aquatic biota monitoring and assessment upstream and downstream of bauxite pipeline Hydro Paragominas – Barcarena | UFPA | Documents signed. Budget available. Started. |
| BRC 21/19 | Marcos Persio | Bird telemetry monitoring to evaluate loss of habitat in mining area in the northeastern Amazon. | UFPA | Documents signed. Budget available. Started. |
| BRC 22/19 | Maria Aparecida Lopes | Effect of large herbivorous mammals on forest regeneration in post-mined areas, in Paragominas | UFPA | Documents signed. Budget available. Started. |
| BRC 23/19 | Rossineide Martins da Rocha | The use of physical, chemical and biological tools to evaluate the water resources under the influence of the Norsk Hydro Mining Company | UFPA | Documents signed. Budget available. Started. |
| BRC 24/19 | Leonardo dos Santos Sena | Coexistence plan for human and carnivores | UFPA | Documents signed. Budget available. Started. |
| BRC 25/19 | Raphael Ligeiro | Assessing the integrity of aquatic ecosystems by implementing a next generation DNA sequencing-based method for biomonitoring | UFPA | Documents signed. Budget available. Started. |
| BRC 26/19 | Thaísa Sala Michelan | Effects of soil use on diversity and ecophysiology on the riparian vegetation, aquatic macrophytes and plankton in streams and lagoons in mining areas | UFPA | Documents signed. Budget available. Started. |

# Annex 2: BRC – Overview of all research projects 25.01.2021

| Project title | Institution / Coordinator | Contract signed | Did it start already? |
|---|---|---|---|
| BRC 01/14: Arbuscular mycorrhizal fungi in natural areas and areas in restoration after bauxite mining in Pará | UFPA Altamira/Magali Goncalves Garcia UNIFESSPA/Ulisses Albino | YES | YES |
| BRC 02/14: Measuring the emissions of trace gases in chrono-sequence of reforestation in areas influenced by bauxite mining in Paragominas | UFPA Braganca/Hudson Cleber Pereira da Silva | YES | YES |
| BRC 03/14: Biodiversity, proliferation of plant species and restoration of degraded areas from bauxite mining | UFRA/Marcos André Piedade Gama | YES | YES * |
| BRC 04/15: Entomology Survey and Bioindicators for Biodiversity Monitoring | MPEG/Rogerio Rosas | YES | YES |
| BRC 05/15: Camera trap survey of ground-living mammals in the Hydro bauxite mine area | UiO/Øystein Wiig, UFPA/Ana Cristina de Oliveira | YES | YES |
| BRC 06/15: Evaluation of chemical compounds of different forest species stored, susceptible to contamination in the soil. | UFRA/Gracialda Costa Ferreira | YES | YES * |
| BRC 07/15: Impact study of a biodiversity recovery program in a bauxite mining area on populations of insect vectors | UFPA/Ivoneide Maria da Silva | YES | YES * |
| BRC 08/15: Bird diversity in three areas in different states of conservation in the Eastern Amazon. | UFPA/Marcos Persio Dantas Santos | YES | YES * |
| BRC 09/15: Wood-decay fungi in Paragominas and Trombetas: baseline information, monitoring priorities, and how to achieve the “no net loss” target? | UiO/Hugo de Boer | YES | NO |
| BRC 10/15:Aquatic biota monitoring of streams in mining areas of Paragominas SA, Pará, Brazil | UFPA - MPEG/Akama, Juen and Montag | YES | YES |
| BRC 11/15: Diversity of the herbivorous insects in four areas of the Hydro mining company | UFPA/José Antonio M. Fernandes | YES | YES |
| BRC 12/16: How ecological interactions are influenced by mining activities and efforts for environmental restoration after exploration | MPEG/Marlucia Martins | YES | YES |
| BRC 13/16 Tracking jaguars in the Hydro bauxite mine area in Paragominas, Brazil | UiO/UFPA Øystein Wiig /Leonardo Sena | YES | YES |
| BRC 14/17 Monitoring Amphibians and Squamata Reptiles in Reforestation Areas in the Hydro Bauxite Mine Area in Paragominas, Brazil. | UFPA/Maria Cristina dos Santos Costa | YES | YES |
| BRC 15/17 Rehabilitation techniques in bauxite mining areas - A topsoil study | UFRA/Gracialda Ferreira | NO | NO |
| BRC 16/19 - Measuring biodiversity dynamics using environmental DNA and metabarcoding | UiO - Jonathan Stuart Ready | YES | YES |
| BRC 17/19 - Metabarcoding and metagenomics for high throughput inventory and monitoring of terrestrial arthropod biodiversity | UFPA/Gustavo Ruiz UiO/ Vladimir Gusarov | NO | NO |
| BRC 18/19 – Metagenomic and metabarcoding as a tool for developing One Health In Hydro Area | UFPA/Leonardo Sena | YES | YES |
| BRC 19/19 - Use of native species from different trophic levels and occurring in bauxite mining area to evaluate the toxicity of residues | UFPA/Lilian Lund Amado | YES | YES |

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|---|---|---|---|
| BRC 20/19 - Aquatic biota monitoring and assessment upstream and downstream of bauxite pipeline Norsk Hydro Paragominas - Barcarena | UFPA/Luciano Montag | YES | YES |
| BRC 21/19 - Bird telemetry monitoring to evaluate loss of habitat in mining area | UFPA/Marcos Persio Dantas Santos | Yes | NO |
| BRC 22/19 - Effect of large herbivorous mammals on forest regeneration in post-mined areas | UFPA/Maria Aparecida Lopes | YES | YES |
| BRC 23/19 - The use of physical, chemical and biological tools to evaluate the water resources under the influence of the Norsk Hydro | UFPA/Rossineide Martins da Rocha | YES | NO |
| BRC 24/19 - Coexistence plan for human and carnivores | UFPA/Leonardo dos Santos Sena | YES | YES |
| BRC 25/19 - Assessing the integrity of aquatic ecosystems by implementing a next generation DNA sequencing-based method for biomonitoring | UFPA/Raphael Ligeiro | YES | YES |
| BRC 26/19 - Effects of soil use on diversity and ecophysiology on the riparian vegetation, aquatic macrophytes and plankton in streams and lagoons | UFPA/Thaísa Sala Michelan | YES | YES |

* Project concluded

# Annex 3: BRC – List of all published articles from the BRC series number 25.01.2021

| Publication label | Title | Journal/book | Authors | Affiliation | Vol. | Issue n. | Pages | Year |
|---|---|---|---|---|---|---|---|---|
| BRC0001 | *Imantodes lentiferus* - Geographic Distribution | Herpetological Review | Axandre C. Ascenso; Alexandre F.R. Missassi | MPEG | 46 | 3 | 386 | 2015 |
| BRC0002 | Deposição de serapilheira e nutrientes em áreas de mineração submetidas a métodos de restauracão florestal em Paragominas, Pará | FLORESTA | Martins, Walmer B.R.; Ferreira, Gracialda C., Souza, Fernanda P.; Dionísio, Luiz Fernandes S.; Oliveira, Francisco de Assis | UFRA | 48 | 1 | 37-48 | 2018 |
| BRC0003 | Forest Restoration Evaluation Through Indicators in Areas of Bauxite Mining | Floresta e Ambiente | Ribeiro, Sabrina S.; Oliveira, Francisco de Assis; Ferreira, Gracialda C.; Santos, Daniel E.; Cruz, Denis C. | UFRA | 26 | 3 | online | 2019 |
| BRC0004 | Litterfall, litter stock and water holding capacity in post-mining forest restoration ecosystems, Eastern Amazon | Revista Brasileira de Ciências Agrárias | Martins, Walmer B.R.; Vale, Raquel L.; Ferreira, Gracialda C.; Andrade, Vanda M.S.; Dionísio, Luiz Fernandes S.; Rodrigues, Richard P.; Oliveira, Francisco de Assis; Souza, Giuliana M.P. | UFRA | 13 | 3 | online | 2018 |
| BRC0005 | After 10 years the myth *of Crotalaria* spp. and dragonflies remains alive | Biota Netropica | Joás Brito; Nayara Louback-Franco; Cristian Mendoza; Flávia Nonato; Leandro Juen; Thaisa Michelan | UFPA | | | | 2020 |
| BRC0006 | Environmental factors influencing the abundance of four species of threatened mammals in degraded habitats in the eastern Brazilian Amazon | PlosOne | Juliana Teixeira-Santos, Ana Carolina da Cunha Ribeiro, Øystein Wiig, Nelson Silva Pinto, Lorrane Gabrielle Cantanhede, Leonardo Sena, Ana Cristina Mendes Oliveira | UFPA, UiO | *online* | *online* | *online* | 2020 |
| BRC0007 | Environmental factors affect macrophyte diversity on Amazonian aquatic ecosystems inserted in an anthropogenic landscape | Ecological Indicators | Ana Luísa B. Fares, Lenize Batista Calvão, Naiara Raiol Torres, Ely Simone C.Gurgel, Thaísa Sala Michelan | UFPA | 113 | *online* | *online* | 2020 |
| BRC0008 | New records of the invasive macrophyte, *Urochloa arrecta* extend its range to eastern Brazilian Amazon altered freshwater ecosystems. | Acta Amazonica | Ana Luisa Biondi Fares; Flávia Alessandra da Silva Nonato; Thaísa Sala Michelan | UFPA | | | | 2020 |
| BRC0009 | *Voragocoris weirauchae* sp. n. (Heteroptera: Schizopteridae: Schizopterinae), a further minute litter bug species from Brazil | Zootaxa | Flavio Roberto de Albuquerque Almeida, Fernando da Silva Carvalho-Filho, Jose Antonio Marin Fernandes | UFPA, MPEG | 4729 | 1 | 138-144 | 2020 |
| BRC0010 | Tree communities in 3-yr-old post-mining sites under different forest | Forests | Denis Conrado da Cruz, José María Rey Benaya, Gracialda Costa Ferreira, Sabrina Santos Ribeiro | UFRA | 527 | 11 | | 2020 |

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|---|---|---|---|---|---|---|---|---|
| | restoration techniques in the Brazilian Amazon | | | | | | | |
| BRC0011 | The Habitat Integrity Index and aquatic insect communities in tropical streams: A meta-analysis | Ecological Indicators | Leandro Schlemmer Brasil, Edgar Luiz de Lima, Zander Augusto Spigoloni, Danielle Regina Gomes Ribeiro-Brasil, Leandro Juen | UFPA | 116 | *online* | | 2020 |
| BRC0012 | Morphological and allometric variation due to percentage of cover in *Eichhornia azurea* (Swart) Kunth (Pontederiaceae) | Brazilian Journal of Botany | Cintia Oliveira Carvalho, Kelsey Archer Barnhill, Alexandre Cordeiro Ascenso, Barbara Dunck, Grazielle Sales Teodoro, Thaisa Sala Michelan | UFPA, MPEG, NMBU | | *online* | | 2020 |
| BRC0013 | Survival, growth and regeneration of forest species in mining areas in the Eastern Amazonia | Scientia Plena | W. B. R. Martins; W. dos S. Barros; L. F. S. Dionisio; T. G. Bezerra; M. L. dos Santos; Gracialda. C. Ferreira; V. M. Barbosa; F. de A. Oliveira | UFRA | 6 | *online* | | 2020 |
| BRC0014 | Caracterização biométrica de sementes de *Solanum paniculatum* L. e desempenho germinativo após superação de dormência | Revista Colloquium Agrariae | Elson Junior Souza da Silva, Lorene Bianca Araújo Tadaiesky, Jéssy Anni Vilhena Senado, Dênmora Gomes de Araujo | UFRA | 6 | 4 | 29-37 | 2020 |
| BRC0015 | Assessing sodium limitation as a resource for ground-dwelling ants (Hymenoptera:Formicidae) in an area of the Amazonian Terra Firme Forest | Bol. Mus. Para. Emílio Goeldi. Cienc. Nat. | Cristian Camilo Mendoza-Penagos, Knut Olav Vadla Hessen , Rony Peterson Santos Almeida | UFPA, MPEG, UiO | 15 | 1 | 135-143 | 2020 |
| BRC0018 | Contamination of stream fish by plastic waste in the Brazilian Amazon | Environmental Pollution | Danielle Regina Gomes Ribeiro-Brasil, Naiara Raiol Torres, Ana Beatriz Picanço, David Silva Sousa, Vanessa Serrao Ribeiro, Leandro Schlemmer Brasil, Luciano Fogaça de Assis Montag | UFPA | 266 | *online* | | 2020 |
| BRC0019 | Diversity of macrophytes in the Amazon deforestation arc: information on their distribution, life-forms and habits (*accepted*). | Rodriguesia | Thaisa Michelan et al. | UFPA | | | | 2020 |
| BRC0020 | Metals in different environmental compartments and biomarkers of oxidative stress in the fish *Bryconops caudomaculatus* (Osteichthyes: Characiformes) from a bauxite mining area in the Brazilian Eastern Amazon (*in prep.)* | Chemosphere | Lilian Amado et al. | UFPA | | | | 2020 |
| BRC0021 | Growth and Quality of *Inga heterophylla* Wild Seedlings According | Journal of Agricultural Science | Elson J. S. da Silva, Jéssy A. V. Senado, Ádson E. da Silva, Marcos A. P. Gama, Selma T. Ohashi, Giuliana | UFRA | 11 | 5 | 479-484 | 2019 |

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|---|---|---|---|---|---|---|---|---|
| | to the Slow Release Fertilizer | | M. P. de Souza, Gracialda C. Ferreira, Norberto C. Noronha, Gilson S. B. de Matos, Dênmora G. de Araujo | | | | | |
| BRC0022 | Collecting arboreal arthropods: a technique for sampling plant-inhabiting arthropod communities in a tropical forest understory (*accepted)* | Entomologia Experimentalis et Applicata | Viana-Junior AB, Quijano-Cuervo L, Ferreira JC, Reis RRN, Santos IA, Martins MB | MPEG | | | | 2020 |
| BRC0023 | Effects of landscape and local habitat on Odonata larvae (Insecta) communities in eastern Amazon streams (*in submission*) | Marine and Freshwater Research | Rodrigo Arison Barbosa Ribeiro[1, 2*], Leandro Juen[1, 2] & Leandro Schlemmer Brasil[1, 2] | UFPA | | | | 2020 |
| BRC0024 | Mudanças no uso da terra alteram os riachos e afetam os grupos funcionais alimentares de insetos aquáticos na amazônia (*in submission*) | Ecological Indicator | Myllena Suzi Lima Silva, Viviane Caetano Firmino, Carina Kaory Sasahara de Paiva, Leandro Juen, Leandro Schlemmer Brasil | UFPA | | | | 2020 |
| BRC0025 | Seed viability changes during fruit ripening of *Tapirira guianensis*: Implications for collection (*accepted*) | Research, Society and Development | Denmora et al. | UFRA | | | | 2020 |
| BRC0026 | Morphological and phylogenetic factors structure the distribution of damselfly and dragonfly species (Odonata) along an environmental gradient in Amazonian streams | Ecological Indicators | Rafael Costa Bastosa, LeandroSchlemmer Brasil, José Max Barbosa Oliveira-Juniora, Fernando Geraldo Carvalho, Gareth D. Lennox, Jos Barlow, Leandro Juen | UFPA | 122 | | | 2021 |
| BRC0027 | The role of macrophyte architecture in driving periphytic algal communities in a lowland river in the Brazilian Amazon | Brazilian Journal of Botany | Híngara Leão; Louise Cathrine Rolstad Esdar; Bárbara Dunck | UFPA, MPEG, NMBU | online | | | 2021 |