

CONFERENCE PROCEEDINGS



Irreversible Times?

Interdisciplinary Dialogues

XII Simpósio em Ciência e
Tecnologia Ambiental

II International Conference
on Environmental Science
and Technology



PPGCTA

Programa de Pós-Graduação em
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MESTRADO E DOUTORADO

**NOVEMBER 12 TO 14, 2025
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II INTERNATIONAL CONFERENCE ON ENVIRONMENTAL SCIENCE AND
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**Graduate Program in Environmental Science and Technology – PPGCTA
Federal University of Fronteira Sul – Campus Erechim**

ERS 15 – KM 72, 200, Cx. Postal 764

Postal Code 99700-970

Phone: +55 (54) 3321-7050

www.uffs.edu.br

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PREFACE

Marking another successful edition under the theme “Irreversible Times? Interdisciplinary Dialogues”, the XII Simpósio em Ciência e Tecnologia Ambiental and the II International Conference on Environmental Science and Technology were events organized by the Graduate Program in Environmental Science and Technology (PPGCTA) of the Federal University of Fronteira Sul (UFFS), Erechim Campus, RS. The event's theme highlighted the urgency of environmental issues and the importance of interdisciplinary dialogue, reflecting on Science and Graduate Studies in the field of Environmental Sciences, and it marked the second international edition of the Symposium and Conference.

The II International Conference on Environmental Science and Technology reaffirms our commitment to the production, integration, and dissemination of knowledge aimed at sustainability. The event brought together researchers, students, and professionals from different fields, promoting an environment of scientific cooperation, interdisciplinary dialogue, and critical reflection on contemporary environmental challenges.

By fostering the exchange of experiences, research results, and innovative practices, the conference contributes to strengthening research networks, thereby amplifying the impact of scientific solutions on society. Furthermore, the meeting emphasized the importance of training qualified professionals to act conscientiously and ethically, addressing complex socio-environmental issues based on evidence and sustainable technologies.

The proceedings of this edition contain 43 abstracts in the project category and 90 abstracts in the results category, totaling 133 abstracts presented. The texts compiled in this document are the work of more than 350 researchers from 34 different institutions across 15 Brazilian states (RS, MA, AP, BA, SC, AL, MT, MS, SP, PE, PR, GO, PB, MG, and RJ). The presentation is organized in alphabetical order by the title of the research within two categories: project abstracts and result abstracts.

The event organization thanks all the professionals who entrusted their studies to the Simpósio em Ciência e Tecnologia Ambiental and the Conference on Environmental Science and Technology. We wish you a pleasant read!

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ALLELOPATHIC POTENTIAL OF COVER CROP EXTRACTS ON THE GERMINATION OF DIFFERENT PLANT SPECIES

Paulo José dos Santos^{1*}, Leandro Galon², Maico André Bagnara³, Juan Christopher Onesko¹, Felipe Bittencourt Ortiz¹, Rodrigo José Tonin³

¹Master's student in Environmental Science and Technology, University of Federal Fronteira Sul, campus Erechim;

²PhD in Agronomy, Teacher, PPGCTA, University of Federal Fronteira Sul, campus Erechim;

³PhD student in Environmental Science and Technology, University of Federal Fronteira Sul, campus Erechim.

*Contact: paulojosesantos@estudante.uffs.edu.br

Cover crops are important tools that contribute to soil structure and weed management, primarily through allelopathic activities. This project, therefore, aims to evaluate the allelopathic properties of cover crops - such as common vetch, rye, turnip, ryegrass, canola, wheat, jack bean, velvet bean, sunn hemp, and brachiaria - on the germination and growth of the weed species horseweed and pigweed. The experimental design will be a randomized complete block with four replications. Aqueous extracts will be obtained from the aerial biomass of the cover crops. Fifty seeds of wheat, common bean, soybean, maize, pigweed, and horseweed will be sown on blotting paper and moistened with aqueous extracts at concentrations of 0, 25, 50, 75, and 100% for analyses of the germination process. The experiments will be conducted in a BOD-type germination chamber, with temperature and photoperiod adjusted for each species. The variables to be evaluated will be germination percentage, germination speed index (GSI), shoot and root length, fresh and dry shoot and root biomass, number of dead seeds, and number of abnormal seedlings. The project's hypothesis is that the cover crop extracts will affect the germination of the tested weeds while being selective for crop seeds. This project intends to evaluate the allelopathic effect of cover crops for a more sustainable management of weeds, such as horseweed and pigweed, thereby reducing the amount of herbicides applied in the food production environment.

Keywords: *Glycine max*, Sustainable management, *Triticum aestivum*, *Zea mays*.

BIOREMEDIATION WITH MICROALGAE: TREATMENT OF AGROINDUSTRIAL EFFLUENTS

Eduarda Perazzoli^{1*}, Maira Rodrigues Lima¹, Ludmilla Lopes Angelo¹, Maycon Tavares Morete¹, Rafaela Correa Varandas¹, Thiago da Silva Matos¹, Lohengrin Dias de Almeida Fenandes¹

¹Programa de Pós-Graduação em Biotecnologia Marinha, Instituto de Estudos do Mar Almirante Paulo Moreira, Arraial do Cabo, RJ, Brasil.

*Contact: eduardaperazzoli29@gmail.com

The growth of agro-industrial activities in Brazil has intensified the generation of effluents with high concentrations of nitrogen and phosphorus. When discharged without adequate treatment, these effluents lead to the degradation of aquatic ecosystems and the loss of biodiversity. Based on this, this project proposes the use of microalgae for the bioremediation of nutrient-rich effluents. The main objective is to employ microalgae to absorb pollutants while generating algal biomass with added value. The recovered biomass can serve different sectors: in bioenergy, as a renewable feedstock; in agriculture, as biofertilizers or soil conditioners; and in the biotechnological industry, as a source of high-value compounds. The study will be conducted through laboratory experiments, using microalgae cultures grown in agro-industrial effluents. Physicochemical parameters will be monitored, including pH, temperature, nutrient concentrations, and algal growth. Water quality will be assessed through analyses of total nitrogen, total phosphorus, chemical oxygen demand (COD), and other relevant indicators. In addition, the biochemical composition of the produced biomass will be evaluated to define potential applications in the bioenergy, agriculture, or other biotechnological sectors. This method is expected to be highly efficient in nutrient removal, thereby reducing the environmental impact of effluents. Furthermore, the results will attest to the feasibility and advantages of employing microalgae-based systems either as a substitute for, or as a complement to, conventional wastewater treatment methods. The evaluation will also take cost factors into account in order to identify points of economic unfeasibility, thus providing a realistic and applicable cost model that can serve as a reliable reference for decision-making by investors and public managers.

Keywords: Biotechnology, Eutrophication, Sustainable technologies, Wastewater treatment.

BIRD DIVERSITY IN AREAS WITH AND WITHOUT THE INFLUENCE OF ROADS IN THE ATLANTIC FOREST IN SOUTHERN BRAZIL

Caio Eduardo Messora Bagnolo^{1*}, Marília Hartmann², Paulo Afonso Hartmann²

¹PhD Candidate, Universidade Federal da Fronteira Sul, Erechim, CAPES Fellow;

²PhD, Universidade Federal da Fronteira Sul, Erechim.

*Contact: caiombagnolo@gmail.com

In Brazil, the road transport system is responsible for the largest movement of products and people. Roads cause various environmental impacts on the landscape and wildlife. Birds around roads suffer a reduction in species richness, abundance, density, and reproduction rate, leading to decreased activity and consequently vocalizations. Therefore, monitoring fauna near roads is essential to understand how the dynamics of species interactions are affected by the negative effects of the roads. The objective of this study is to evaluate the impacts of road proximity on bird species richness, composition, and diversity. For this purpose, the study will assess the sound activity patterns of birds and abiotic parameters such as humidity and temperature. The study will be conducted along the RS135 highway in the northern part of the State of Rio Grande do Sul, Brazil. Sampling points will be selected based on their proximity to the highway (areas influenced by the road - CI and areas not influenced by the road - SI), with CI being a maximum distance of 100 meters from the highway, and SI being a minimum distance of 700 meters and a maximum of 1500 meters. The data will be collected from September 2026 to September 2028. Once a week during this period, temperature and humidity will be measured using a YSI Professional Plus portable multiparameter probe. To quantify noise and acoustics, an AudioMoth v1.2.0 autonomous recorder will be used, which remains on for 24 hours and is checked once a week to save data and recharge batteries. We hope that the results will provide qualified information for decision-making about the impacts of roads on the surrounding landscape.

Keywords: Activity pattern, Conservation, Fauna, Highway effects.

CAPACITY FOR IMPLEMENTATION OF ENVIRONMENTAL PUBLIC POLICIES IN THE COREDE NORTH REGION

Tanaua da Rosa Hlavac^{1*}, Darlan Christiano Kroth²

¹Master's student in Environmental Science and Technology, Federal University of Fronteira Sul, campus Erechim;

²Teacher Postgraduate program in Environmental Science and Technology, Federal University of Fronteira Sul, campus Erechim.

*Contact: tanaua@estudante.uffs.edu.br.

The National Environmental Policy, established by Law No. 6,938 of 1981, set forth principles and guidelines for environmental management in Brazil, consolidating environmental protection as a fundamental right in the Federal Constitution of 1988. The decentralization of environmental responsibilities, reinforced by Complementary Law 140/2011, assigned municipalities a crucial role in implementing and monitoring environmental policies. However, this decentralization presents significant challenges, especially concerning the municipal capacity to manage and execute such policies autonomously and efficiently, due to limited resources, infrastructure, and qualified technical staff. Thus, this study aims to analyze the capacity for implementing environmental public policies in the municipalities of the COREDE North region, in Rio Grande do Sul, considering Brazilian environmental legislation and the decentralization of responsibilities. To achieve this goal, the research will identify the administrative, technical, fiscal, financial, political-relational, and institutional capacities required to implement Brazilian environmental policy and evaluate whether the municipalities of COREDE North possess adequate state capacities for this purpose. The methodology will combine in-depth bibliographic research, documentary analysis of master plans, local environmental laws, and management reports, and, if feasible, interviews with public managers and environmental technicians. The research is expected to provide an in-depth understanding of the challenges and existing capacities in the municipalities of the COREDE North region, contributing to improving environmental public policies and strengthening local environmental management.

Keywords: Decentralization, Environment, Municipalities, Public policies.

CARBON SEQUESTRATION ASSESSMENT AND SUSTAINABILITY INDICATORS IN BIODIVERSE AGROFORESTRY SYSTEMS IN THE ATLANTIC FOREST AND PAMPA BIOMES OF SOUTHERN BRAZIL

Alexandre Hüller^{1*}, Geraldo Ceni Coelho²

¹Postgraduate Program in Environmental Science and Technology, University of Federal Fronteira Sul, campus Erechim;

²Professor of the Postgraduate Program in Environmental Science and Technology, Federal University of Fronteira Sul, campus Erechim.

*Contact: alexandre.huller@gmail.com

Climate change and growing pressure for sustainable production have driven the search for alternatives to balance environmental conservation and food production. Among these, biodiverse agroforestry systems (AFS) stand out for integrating tree species and agricultural crops in arrangements that enhance both ecological resilience and food security. This study aims to investigate the carbon sequestration potential of different AFS located in the Atlantic Forest and Pampa biomes of Southern Brazil, as well as to identify sustainability indicators that reflect their role in strengthening family farming and mitigating climate change. The methodology involves evaluation of small rural properties through soil analyses focused on organic carbon, utilizing high-resolution satellite imagery, and field immersions to directly observe management practices, floristic composition, and relevant technical aspects. Sustainability indicators will also be considered across environmental, social, and economic dimensions, emphasizing the multiple benefits AFS generate for farmers and local communities. Agroforestry systems are expected to exhibit higher carbon storage than conventional agricultural areas, contributing to soil restoration, biodiversity protection, and the provision of ecosystem services. Additionally, the analysis of sustainability indicators may provide insights to support public policies that encourage the broader adoption of these systems, expanding their strategic role in family farming. In summary, the research aims to demonstrate how biodiverse agroforestry systems address climate challenges and serve as tools for ecological restoration and agroecological transition, thereby combining mitigation, adaptation, and income generation for smallholder farmers.

Keywords: Biodiversity, Climate change, Family farming, Global warming, Soil organic carbon.

CLIMATE CHANGE AND CYANOBACTERIAL BLOOMS: ECOLOGICAL AND HEALTH IMPLICATIONS IN AQUATIC ECOSYSTEMS

Maira Rodrigues Lima^{1*}, Ludmilla Lopes Angelo¹, Maycon Tavares Morete¹, Eduarda Perazzoli¹, Rafaela Correa Varandas¹, Thiago da Silva Matos¹, Lohengrin Dias de Almeida Fenandes¹

¹Postgraduate Program in Marine Biotechnology, Admiral Paulo Moreira Institute of Marine Studies, Arraial do Cabo, Rio de Janeiro, Brazil.

*Contact: mairalima64@gmail.com

Cyanobacterial blooms are among the most pressing challenges for aquatic ecosystems, threatening water quality, biodiversity, and human health. Although nutrient enrichment is recognized as a primary driver of these events, growing evidence suggests that climate variability may also influence their frequency, persistence, and toxicity. Rising temperatures, altered rainfall regimes, and changes in hydrological cycles are frequently associated with conditions that favor bloom development. Yet, the strength and consistency of these relationships remain uncertain across different ecosystems. This project aims to explore how climatic factors interact with nutrient dynamics to shape cyanobacterial ecology and to evaluate the potential consequences for ecosystem functioning and public health. The methodological approach involves summarizing studies that examine links between climatic drivers and bloom occurrence, while also assessing ecological indicators that could serve as early signals of bloom risk. The expected outcomes include a clearer understanding of the mechanisms through which climate-related stressors may intensify cyanobacterial proliferation and toxin release, as well as insights into the cascading effects on aquatic biodiversity, trophic interactions, and water safety. By addressing these knowledge gaps, the study seeks to contribute to a more nuanced perspective on the role of climate change in shaping bloom dynamics, highlighting the importance of adaptive monitoring and management strategies in increasingly variable environmental scenarios.

Keywords: Aquatic ecosystems, Climate change, Cyanobacterial blooms, Eutrophication.

**ECOTOXICOLOGICAL ASSESSMENT OF A SYNTHETIC INSECTICIDE AND A
MICROBIAL AGENT ON THE EARLY LIFE STAGES OF NON-TARGET SPECIES:
Physalaemus cuvieri AND *Danio rerio***

Gabriel Henrique Klein^{1*}, Aline Pompermaier², Marilia Hartmann³

¹Master's student in Postgraduate Program in Environmental Science and Technology, University of Federal Fronteira Sul, campus Erechim;

²Ecology and Conservation Laboratory, Federal University of Fronteira Sul, campus Erechim;

³Dra, Professor in Postgraduate Program in Environmental Science and Technology, University of Federal Fronteira Sul, campus Erechim.

*Contact: gabrielklein518@gmail.com

The widespread use of chemical pesticides in modern agriculture, although effective in controlling pests and diseases, has increasingly been linked to negative impacts on non-target organisms, particularly amphibians and fish, which are highly sensitive to aquatic contaminants. This has emphasized the need for safer alternatives, such as microorganism-based bioinsecticides, which are considered less persistent and more selective. In this context, the present study aims to evaluate and compare the ecotoxicological effects of the synthetic insecticide Methomyl, a carbamate that inhibits acetylcholinesterase activity, and the bioinsecticide Acera®, formulated with *Bacillus thuringiensis*, on embryos of *Physalaemus cuvieri* and *Danio rerio*. These species were chosen for their biological traits, which make them suitable and widely recognized models for toxicological studies, including high sensitivity, ecological importance, and ease of laboratory maintenance. The methodology involves controlled collection of *P. cuvieri* spawn from natural environments and laboratory reproduction of *D. rerio*, followed by exposure to a range of concentrations of both compounds, reflecting environmentally realistic scenarios. Endpoints to be analyzed include mortality, malformations, morphological changes, behavioral responses such as risk perception in aversive tests, and oxidative stress biomarkers assessed through antioxidant enzymes like superoxide dismutase and catalase. Statistical analyses will determine significant differences between treatments and controls, applying parametric or non-parametric tests depending on data distribution. Expected results include identifying lethal and sublethal effects of Methomyl on both species, as well as a comprehensive evaluation of the safety and limits of Acera®. By generating comparative data, this study seeks to address scientific gaps regarding the toxicity of synthetic and natural-origin pesticides in aquatic vertebrates, ultimately supporting more sustainable agricultural practices that reconcile pest control efficiency with biodiversity conservation.

Keywords: Bioinsecticide, Methomyl, Non-target organisms.

ECOTOXICOLOGICAL ASSESSMENT OF PHARMACEUTICAL BLISTER EXTRACTS ON THE EMBRYONIC AND LARVAL DEVELOPMENT OF *Rhamdia quelen* (Silfvergrip, 1996)

João Fernando Medeiros Cardoso^{1*}, Bruna Amaral da Costa¹, Gabriela Claudia Cangahuala-Inocente¹, Roberta Daniele Klein², David Augusto Reynalte-Tataje³

¹ Master's Student, Federal University of Fronteira Sul, campus Cerro Largo;

² Federal University of Fronteira Sul, campus Cerro Largo;

³ Postgraduate Program in Environment and Sustainable Technologies, Federal University of Fronteira Sul, campus Cerro Largo.

*Contact: joaocardosomedeiros2016@gmail.com

The increasing presence of emerging contaminants in aquatic ecosystems, such as pharmaceuticals and their residues, has raised concerns due to the potential risks to biota and human health. Among these, pharmaceutical blister packaging stands out, mainly composed of PVC and aluminum, which, when improperly discarded, can release harmful compounds into the environment. Despite their widespread use, there is a lack of studies on the ecotoxicological effects of this packaging on aquatic organisms. Therefore, this project aims to assess the ecotoxicological effects of extracts from different types of pharmaceutical blisters (colored, uncolored, and aluminum) at various concentrations and exposure times on the embryonic and larval development of *Rhamdia quelen*. This species is widely used in ecotoxicological studies due to its sensitivity to contaminants. *R. quelen* eggs will be obtained from the UFFS Fish Farming Station and exposed to solutions prepared from 50 g of blisters in 1 L of water, diluted to 50%, 25%, and 1%, with different preparation times (24 hours, 15 days, and 30 days). The assays will follow the OECD 236 protocol (Fish Embryo Acute Toxicity Test), adapted to the embryonic development of the species, using Elisa plates with one egg per well. Parameters such as survival, hatching, and morphological normality will be evaluated, as well as oxidative stress biomarkers, including lipid peroxidation (TBARS), catalase activity (CAT), acetylcholinesterase (AChE), and reduced glutathione (GSH). The data obtained will be statistically analyzed using ANOVA/Tukey or Kruskal-Wallis/SNK, depending on the distribution. It is expected to identify deformities, edema, larval mortality, and biochemical changes indicative of oxidative stress, as well as differences in toxicity related to blister type, solution concentration, and exposure time, providing relevant information to better understand the environmental risks associated with this waste.

Keywords: Ecotoxicology, Emerging pollutants, Pharmaceutical waste.

ECOTOXICOLOGICAL EFFECTS OF ACEPHATE EXPOSURE IN FISH AND AMPHIBIANS

Jenifer Eduarda Luterek^{1*}, Aline Pompermaier², Paulo A. Hartmann², Marília Hartmann²

¹Biological Science Student, Federal University of Fronteira Sul, Campus Erechim;

²Laboratory of Ecology and Conservation, Federal University of Fronteira Sul, Erechim, RS.

*Contact: luterekjenifer@gmail.com

Acephate is an organophosphorus insecticide, belonging to a class of pesticides widely recognized for their neurotoxic properties, primarily through the inhibition of acetylcholinesterase (AChE). Although it presents moderate environmental persistence, its low soil adsorption raises concerns about leaching and subsequent contamination of aquatic ecosystems. Despite being banned in several countries, including those of the European Union, Acephate remains extensively used in Brazilian agriculture as a pest control agent. The ecological risks of this compound are particularly concerning, given the scarcity of studies addressing its impacts on non-target organisms. Amphibians and fish are especially vulnerable, as their life cycles and physiological characteristics make them sensitive indicators of environmental contamination. In this context, the present study aims to assess the ecotoxicological effects of Acephate exposure in zebrafish (*Danio rerio*), a widely established model species in toxicological research, and in tadpoles of *Physalaemus*, a native South American genus of ecological relevance. Parameters to be evaluated include mortality, cardiac frequency, developmental and morphological abnormalities, immune responses, cellular alterations, growth patterns, and behavioral outcomes. Furthermore, biochemical responses will be investigated by analyzing enzymes associated with the cholinergic system (AChE) and antioxidant defenses. By integrating organismal, physiological, and biochemical parameters, this research seeks to establish safe concentration thresholds for Acephate and to elucidate its potential sublethal effects, thereby contributing to a better understanding of the risks posed by this compound to aquatic vertebrates and to freshwater ecosystems more broadly.

Keywords: Acephate; Anurans, *Danio rerio*; Ecotoxicology; Organophosphate.

EFFECT OF MICROPLASTIC PRESENCE IN SEDIMENT AND IN THE MACROINVERTEBRATE COMMUNITY OF TWO NEOTROPICAL SUB-BASINS

**Bruna Amaral da Costa^{1*}, Isabela Alves dos Santos¹, João Fernando Medeiros Cardoso¹,
Milton Norberto Strieder², David Augusto Reynalte-Tataje²**

¹Master's Student, Federal University of Fronteira Sul, campus Cerro Largo;

²Postgraduate Program in Environment and Sustainable Technologies, Federal University of Fronteira Sul (UFFS), campus Cerro Largo.

*Contact: bruna.amaral@estudante.uffs.edu.br

Plastics are becoming increasingly prevalent in our daily lives, as they are produced in large quantities due to their properties and are widely found in all regions of the planet. These materials are improperly disposed of and, as a result, can end up in the environment, especially in aquatic ecosystems. When exposed to environmental conditions, they degrade and break down into small fragments (<5mm) known as microplastics (MPs). Furthermore, MP particles settle on the bottom along with the sediment, and the combination of these factors creates an environmental problem for aquatic environments and the organisms within them. Based on this, the objective is to assess the relationship between MP loads in the aquatic macroinvertebrate community and in the sediments. The study will be conducted in the Piratinim and Comandá sub-basins, where 36 sites were evaluated, divided into 18 sampling points for each sub-basin. At each sampling point, sediment samples will be collected using a garden trowel at a depth of 5–10 cm, and macroinvertebrates will be collected using active sampling methods (dipnet and kick-net), and will subsequently be identified to the family level. The extraction of MPs from sediment samples will be carried out using density separation with Zinc Chloride (ZnCl₂) and chemical digestion with 10% potassium hydroxide (KOH). For macroinvertebrates, 10% KOH will be used for chemical digestion in batches by family. The samples will be quantified and classified using a Raman spectrometer and identified in the OpenSpacy spectral library. Based on this, we expect to identify the macroinvertebrate families most affected by the presence of MPs and assume that the MP load in sediments may be directly related to that found in macroinvertebrates, as well as to quantify and classify the MPs found.

Keywords: Aquatic organisms, Freshwater, Plastic pollution.

ENVIRONMENTAL CHALLENGES AND THE SAEB: PLAYFUL ACTIVITY FOR EARLY ELEMENTARY STUDENTS

Dayana Monique Rodrigues Lima Araujo^{1*}

¹Master's student, Federal University of Alagoas, campus Arapiraca.

*Contact: educacaoambiental.smeapiraca@gmail.com

The project “Environmental SAEB Validation” aims to assess the understanding and perceptions of early elementary students regarding environmental education topics, using questions adapted from the Basic Education Assessment System (SAEB) and incorporating context-based challenges related to socio-environmental issues. The study seeks to identify students’ knowledge levels as well as their critical thinking skills about sustainability, biodiversity, responsible consumption, climate change, and environmental risks, allowing an understanding of how these topics are perceived and assimilated by young learners. The methodology included applying questionnaires and pedagogical challenges in playful and interactive formats, adapted to the students’ age group, along with classroom observations and documentation of their responses and strategies used to solve the proposed challenges. Collected data were analyzed descriptively to identify knowledge patterns, common difficulties, and areas requiring pedagogical reinforcement. The main expected outcome is the production of a detailed diagnosis regarding students’ comprehension and engagement in environmental education, supporting the development of more effective pedagogical interventions and promoting the integration of socio-environmental topics transversally across curricular components, thereby strengthening citizenship education and environmental awareness from the early years of formal education.

Keywords: Biodiversity, Climate change, Responsible consumption, Sustainability.

ENVIRONMENTAL EDUCATION IN GEOGRAPHY TEXTBOOKS: PROPOSAL FOR ANALYSIS OF *ARARIBÁ CONECTA* COLLECTION

Gilmar José Schons^{1*}

¹Master's student in Geography, Federal University of Fronteira Sul, campus Chapecó and Erechim.

*Contact: gilmar.schons@estudante.uffs.edu.br

This research, currently underway in the Master's program in Geography at UFFS, involves a study of Environmental Education in Geography textbooks from the *Araribá Conecta* collection for the Final Years of Elementary School. This topic is raised by the possibility of problematizing how Environmental Education is addressed in these textbooks. Based on the general objective of analyzing this approach, the specific aims are: to relate the theoretical contributions of Geographic Education, Critical Geography and Paulo Freire's Pedagogy to Environmental Education; to identify the implications of *Programa Nacional do Livro e do Material Didático* (PNLD) 2024 on the historical aspects of Geography textbooks; and to discuss the references to Environmental Education in the textbooks that make up *Araribá Conecta – Geografia* collection for the Final Years of Elementary School. The research works with authors from Critical Environmental Education and Critical Geography, especially Milton Santos – in dialogue with Geographic Education, textbook theorists, and the concept of liberating education grounded in Paulo Freire. The project is developed based on a qualitative and descriptive approach, initially consisting of a bibliographic phase that will involve a literature review of academic and scientific works by leading authors and new studies that encompass the scope of the study. Subsequently, the documentary phase will focus on references to Environmental Education in the textbooks that compose the *Araribá Conecta – Geografia* for the Final Years of Elementary School collection, published by Editora Moderna. Thus, it begins with the demand for “ideas to postpone the end of the world”, as announced by Ailton Krenak, and, as one of the expected results, identifies Environmental Education as one of them.

Keywords: Educational public policies, Elementary education, Interdisciplinarity, Nature, PNLD.

ENVIRONMENTAL IMPACTS OF THE FOOD INDUSTRIES: A PROPOSAL FOR A LEVEL ONE IN THE TRAINING OF CHEMISTRY STUDENTS

Simone Rocha Leoncio^{1*}, Silvia Zamberlan Costa Beber²

¹Master's student in Chemistry, Unioeste, campus Toledo;

²PhD in Science Education, Teacher at Unioeste, Chemistry Degree Course, Postgraduate Program in Science Education and Mathematics Education, Postgraduate Program in Chemistry.

*Contact: simone.leoncio@unioeste.br

The initial training of Chemistry teachers requires undergraduates to experience situations in which theory and practice coexist, and these experiences must be linked to the social contexts of these future teachers. In this sense, the topic "animal food industries in Toledo, Paraná" constitutes a relevant axis for problematizing environmental impacts, including the emission of unpleasant odors resulting from the processing of these industries, which directly affect the population's quality of life. The objective of this study is to develop, with undergraduate Chemistry students, Potentially Significant Teaching Units (UEPS) that integrate chemical concepts with socio-environmental issues, fostering the development of a reflective and critical stance on the relationship between science, technology, society, and the environment. The methodology involves the development of teaching sequences called UEPS (Moreira, 2011), based on Ausubel's Theory of Meaningful Learning (TAS) (2003) and Moreira's Theory of Critical Meaningful Learning (TASC) (2005), these sequences take the undergraduate students' prior knowledge as a starting point and focus on the issue of industrial odors as a guiding theme. Investigative activities, analysis of local news, study of industrial processes, and environmental chemistry experiments will be developed with undergraduate students participating in the PIBID Chemistry program at a public state university in Paraná, aiming to articulate conceptual, procedural, and attitudinal content. We hope that the research will contribute to broadening undergraduate students' understanding of the complexity of industrial environmental impacts, stimulate reflection on the role of the teacher as a mediator of critical learning, and strengthen their capacity to develop contextualized, critical, and socially committed pedagogical practices, solidifying food as a guiding theme in chemistry teaching.

Keywords: Critical meaningful learning, Dialogue, Odors, Socio-environmental issues, Teacher training.

ENVIRONMENTAL SAFETY OF MICROBIAL BIOHERBICIDES: CHRONIC AND GENOTOXIC EFFECTS OF AN ENZYMATIC EXTRACT ON TADPOLES OF *Lithobates catesbeianus* FROM THE PERSPECTIVE OF THE CIRCULAR ECONOMY

Maria Rita Conde Simone^{1*}, Guilherme Felicioni¹, Helen Treichel², Claudia Maris Ferreira³

¹Master's degree graduate student, Instituto de Pesca, Divisão de Pesquisa em Aquicultura, São Paulo, Scholarship CNPq;

²Doctor, Universidade Federal da Fronteira Sul – campus Erechim;

³Doctor, Instituto de Pesca, Divisão de Pesquisa em Aquicultura, São Paulo.

*Contact: mariaritaconde@gmail.com

Growing concern about the impacts of commercial pesticides on health and the environment has driven the sector to develop and produce agricultural bio-inputs, emphasizing microbial bioherbicides. These bioherbicides are developed from microorganisms, such as fungi and bacteria, and work by degrading the cell walls of weeds. The use of bioherbicides instead of herbicides is becoming increasingly common and essential for more sustainable agriculture. Rich in enzymes with herbicidal potential, these bio-inputs can be used alone or in synergy with the microorganisms themselves. In line with the concept of circular economy, their production uses waste as substrates, reducing costs and minimizing environmental impacts. The different ways these products are spread in production sectors can lead to accidental contact with animals. Although they're already classified as sustainable, the ecological reliability of these products needs scientific proof since there's still uncertainty about their toxic impact on non-target organisms, especially vertebrates. This project aims to evaluate the toxicity of a microbial bioinput (Enzymatic Extract - EZ) by investigating possible chronic and genotoxic effects on amphibian larvae. To this end, *in vivo* tests will be conducted with sublethal exposure of *Lithobates catesbeianus* tadpoles to different concentrations of EZ, followed by assessments of oxidative stress and analysis of genotoxic damage measured through the micronucleus test. The results are expected to contribute to the development of safe and sustainable bio-inputs, promoting agricultural innovations aligned with the circular economy, offering natural and viable solutions for the food production sector, and ensuring the safe use of this new product for aquatic ecosystems.

Keywords: Aquatic organisms, Bioherbicides, Ecotoxicology, Genotoxicity, Sustainability.

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EVALUATION OF THE MANAGEMENT OF APPLE TREES WITH LOW COLD REQUIREMENTS IN THE CLIMATIC CONDITIONS OF WESTERN SANTA CATARINA

Vanderlei Smaniotto^{1*}, Gerônimo Rodrigues Prado¹, Marco Aurelio Godoi², Edson da Silva², Thiago Vinicius Rech², Daniele Gomiero Polli Sartori³, Jhonatan Antônio Marcante⁴, Moisés de Abreu Barbosa⁴, Clevison Luiz Giacobbo⁵

¹Doctoral student in Environmental Science and Technology, University of Federal Fronteira Sul, campus Erechim;

²Master's student in Environmental Science and Technology, University of Federal Fronteira Sul, campus Erechim;

³Graduated in Environmental Chemistry Technology; Degree in Chemistry, UTFPR;

⁴Undergraduate student in Agronomy, University of Fronteira Sul, campus Chapecó;

⁵Dr. in Agronomy, Teacher in Environmental Science and Technology, University of Federal Fronteira Sul, campus Erechim.

*Contact: vanderlei.smaniotto@uffs.edu.br

This project, to be implemented from 2025 to 2028, considers climatic and environmental variations that can impact the performance of apple trees (*Malus domestica* Borkh). It has economic, academic, social, and environmental relevance. Fruit growing contributes to healthy eating, food security, environmental preservation, and sustainable rural development. Brazil has evolved from an apple importer to an exporter of apple production, especially in Santa Catarina State, reaching an average productivity of over 35 tons ha⁻¹ in 2023 and generating almost R\$3 billion. The objective of the study is to evaluate the vegetative and productive behavior of apple trees with low cold requirements for western Santa Catarina. The experiment will be conducted on the Chapecó campus of the UFFS, in an apple orchard in its second year of implementation, in a humid subtropical climate (Cfa), and on Red Oxisols soil. The plants will follow a central leader training system, with spacing of 5.0 x 1.0 m and drip irrigation, managed according to agronomic recommendations. Two experiments will be conducted: (1) cultivar Eva Seleta, grafted onto Marubakaido rootstock, with and without M9 interstock, evaluating the use of a dormancy regulator and branch arching; (2) cultivar Anna, on Marubakaido rootstock with an M9 interstock, with similar treatments. The variables analyzed include vegetative growth (trunk area, growth rate, height, branch mass), production (fruit set, number of fruits, average mass, estimated yield), physical (fruit size, firmness, and color), and chemical (total soluble solids, pH, flavonoids and anthocyanins, phenolic compounds, and vitamin C) analyses. Statistical analysis will be performed in the R program, with ANOVA and comparisons of means by Tukey's test or regression at 5% significance level. The aim is to identify the best apple tree architecture and management techniques for training Eva and Anna cultivars in the western region of Santa Catarina State.

Keywords: Agronomy, Apple tree productivity, Fruit growing, *Malus domestica*, Training.

FLOOD EVENT SUSCEPTIBILITY ASSESSMENT USING REMOTE SENSING TECHNIQUES AND GEOGRAPHICAL INFORMATION SYSTEMS (GIS)

Lucas Kovaleski^{1*}, João Felipe Freitag¹, Cleomar Reginatto¹

¹Civil and Environment Post-Graduate Program, University of Passo Fundo, Campus I.

*Contact: 158666@upf.br

Climate change currently poses a major challenge due to its influence on extreme weather events, with perceived signs of intensification and an increase in frequency of these phenomena, with increasingly severe and catastrophic consequences. In this sense, the use of remote sensing tools is a key ally in understanding impacts, predicting, and monitoring the occurrence of these extreme situations. The availability of a large database enables integration with Geographic Coordinate Systems (GIS) programs and computer models. Floods, being one of the most recurrent natural events on the planet, have significant destructive capacity for infrastructure and widespread impacts. Identifying areas susceptible to the recurrence of these events becomes an important planning tool for urban expansion and land use planning, in addition to having a powerful potential as an early warning system for environmental disasters. Based on this idea, this project's methodology focuses on identifying areas vulnerable to flooding in the Guaíba hydrographic basin, as well as understanding the physiographic parameters of its component basins. Topographic, land use and cover, and geological data sources, as well as data related to the social context of the areas, will be used to measure the different risk levels that contribute to flood occurrence. For that, a geoprocessing technique will be used, aided by QGIS software and the Google Earth Engine platform, in which spatial data are overlaid through a multicriteria process, generating a single map that measures susceptibility to these events. Through this study, an enhancement of understanding of the risk zones of flooding across the basin is expected, as well as the influence of its contributing watercourses on events.

Keywords: Climate change, Remote sensing, Flooding, Susceptibility, GIS.

HUMPBACK WHALES (*Megaptera novaeangliae*) AS REGULATORS OF PLANKTON PRODUCTIVITY AND THE OCEANIC CARBON CYCLE: IMPLICATIONS FOR CONSERVATION AND CLIMATE CHANGE

Rafaela Correa Varandas¹, Ludmilla Lopes Angelo^{1*}, Maira Rodrigues Lima¹, Maycon Tavares Morete¹, Eduarda Perazzoli¹, Thiago da Silva Matos¹, Lohengrin Dias de Almeida Fenandes¹

¹Programa de Pós-Graduação em Biotecnologia Marinha, Instituto do Mar Almirante Paulo Moreira, Arraial do Cabo, RJ, Brasil.

*Contact: luferangelo@gmail.com

Humpback whales (*Megaptera novaeangliae*) play a strategic ecological role in maintaining the health of marine ecosystems, acting as natural regulators of ocean balance. Through the so-called “whale pump,” these cetaceans transport nutrients from deep layers to the surface, enriching the euphotic zone and stimulating phytoplankton productivity, the primary driver of atmospheric carbon sequestration in the oceans. The increase in phytoplankton biomass directly influences marine food webs, sustaining zooplankton and numerous other species. In addition, the process known as *whale fall*, when whale carcasses sink after death, promotes carbon sequestration in deep waters, where it can remain stored for centuries, highlighting the connection between these organisms and the biogeochemical carbon cycle. This study aims to evaluate the contribution of humpback whales to plankton productivity and carbon sequestration, emphasizing their importance as natural allies in mitigating climate change. The methodology consists of a bibliographic review in international scientific databases, prioritizing studies that address the relationship between whale presence and phytoplankton and zooplankton dynamics, as well as their role in population recovery and the maintenance of marine ecosystem services. It is expected to demonstrate that the presence of humpback whales contributes to the increase of oceanic primary productivity, directly benefiting planktonic communities, and that their natural death favors large-scale carbon sequestration. In this context, the population recovery observed along the Brazilian coast from approximately 1,000 individuals in 1988 to over 30,000 today stands out as a remarkable example of successful conservation. This reinforces the importance of effective species protection in maintaining ecological interactions with plankton and, consequently, in addressing climate change.

Keywords: Carbon sequestration, Climate change, Humpback whales, Marine conservation, Plankton productivity.

IMPACTS OF MASS MOVEMENTS ON WATER QUALITY IN PROTECTED AREAS OF SERRA GERAL, RS, BRAZIL

Eleonai Garcia da Silva^{1*}, Delio Endres Júnior², Leonardo Airton Ressel Simões³, Annette Droste⁴

¹Master's Student in Environmental Quality, Graduate Program in Environmental Quality, Universidade Feevale;

²PhD in Environmental Quality, Participant in the Program for Scientific Advancement, Universidade Feevale;

³PhD in Biological Sciences: Physiology, Federal University of Rio Grande do Sul, postdoctoral researcher in the Graduate Program in Environmental Quality, Universidade Feevale, FAPERGS Fellow;

⁴PhD in Genetics and Molecular Biology, Full Professor in the Graduate Program in Environmental Quality, Universidade Feevale.

*Contact: eleonaigs@gmail.com

Changes in land use, particularly the replacement of native vegetation with agricultural or urban areas, significantly alter local climatic and ecological processes, increasing vulnerability to mass movements. The municipality of Veranópolis, Rio Grande do Sul (Brazil), experienced extreme rainfall in May 2024, triggering numerous landslides that affected soil, vegetation, and surface and groundwater bodies. This project aims to evaluate the water quality and potential genotoxic effects in areas impacted by these events, focusing on four sampling points: three surface water points along the Jaboticaba river – within the Serra Parque Jaboticaba (P02), upstream (P01) and downstream (P03), near the mouth by the Taquari-Antas river – and one groundwater point (P04) at the Sítio Árvore Mãe. Surface water will be sampled monthly between July 2025 and June 2026, totaling 12 samplings, while groundwater will be sampled seasonally starting in September 2025, totaling four samplings. All samples will undergo physicochemical analysis, following the standards established by Brazilian environmental legislation (CONAMA Resolution 357/2005 and CONAMA Resolution 396/2008). In parallel, the Trad-MCN test will be applied to detect the effects of water on the induction of genetic damage in reproductive cells of *Tradescantia pallida* var. *purpurea*. Climatic data and historical precipitation records will be collected using local monitoring equipment and integrated to contextualize observed patterns, while multivariate statistical analyses will explore correlations among genotoxicity, water quality parameters, and environmental factors. The expected results include identifying potential genotoxic risks to aquatic biota, detecting areas of water quality degradation, and providing a framework for integrating biomonitoring with conventional physicochemical assessments. This approach aims to support preventive environmental management and mitigation strategies in regions prone to mass movements, contributing to preserving ecosystem services and water resources in the Serra Geral region.

Keywords: Biomonitoring, Environmental management, Genotoxicity, Landslides, Water resources.

IN VITRO APPROACH IN CELLS OF AQUATIC ORGANISMS FOR THE ASSESSMENT OF CYTOTOXICITY OF A MICROBIAL BIOINPUT WITH HERBICIDAL POTENTIAL

Guilherme Felicioni^{1*}, Maria Rita Conde Simone¹, Helen Treichel², Claudia Maris Ferreira³

^{1*}Master's student, Fisheries Institute, São Paulo;

²Doctor, University of Federal Fronteira Sul, campus Erechim;

³Doctor, Fisheries Institute, São Paulo.

*Contact: guifelicioni@gmail.com

The growing concern about the environmental impacts of agrochemicals has driven the production of microbial bioherbicides, which are rich in enzymes with herbicidal potential. Aligned with the concept of a circular economy, their production utilizes waste as substrates, reducing costs and minimizing environmental impacts. However, uncertainties remain regarding their possible toxic effects on non-target organisms. The present project aims to identify potential cytotoxic effects of the microbial bioinput on cell cultures from fish and amphibians as a preliminary step for environmental safety assessment. For this purpose, an enzymatic extract (EZ) with herbicidal potential will be used at five dilutions: 100%, 75%, 50%, 25%, and 0%. 24-well culture plates will be filled with 100 μ L of fibroblastic or epithelial cells from fish and amphibians, plus 1 mL of culture medium. The cells will be incubated in a CO₂ incubator for 24 hours to promote adherence to the plate. Then, 100 μ L of the EZ, previously dissolved in DMSO at the concentrations described above, will be added to each well in triplicate, and the plates will be incubated with the EZ for 72 hours in a CO₂ incubator at 23°C. At the end of the exposure, cells from each group will be subjected to membrane integrity tests (neutral red uptake and trypan blue exclusion) to evaluate possible cellular membrane degradation; viability and cell mass assays (MTT and SRB reduction) to quantify active cells in the wells; cellular metabolism assessment (XTT); and nucleic acid quantification via crystal violet assay. We expect to determine chronic safe concentrations for future exposures with live aquatic organisms, thereby avoiding the need for the conventional acute (LC50) test. It is anticipated that the results will contribute to the development of safe and sustainable bioinputs, providing natural and viable solutions for the food production sector.

Keywords: Ecotoxicology, Environmental safety, Microbial herbicides.

INNOVATION LABORATORIES AT TRADE FAIRS: OPPORTUNITIES AND CHALLENGES

Josinete Alves Fonseca^{1*}, Débora Regina Schneider Locatelli²

¹Undergraduate student in Agronomy, University of Federal Fronteira Sul, campus Erechim;

²Teacher at University of Fronteira Sul, campus Erechim.

*Contact: josinete.fonseca@estudante.uffs.edu.br

Trade fairs appear to be ideal environments for implementing innovation labs, as they encompass a sector's entire production chain, as well as various stakeholders involved in the processes. This project aims to analyze the opportunities and challenges of implementing innovation labs at trade fairs. The specific objectives are: to describe the ecosystem surrounding a trade show; to present the needs that trade shows would have for implementing innovation labs; and to diagnose the opportunities and challenges of implementing innovation labs at trade shows. The research is characterized by a qualitative and quantitative approach, with an exploratory and descriptive approach. Data will be collected through bibliographic research, observation of trade shows, analysis of websites and social media, and documents presenting sectoral, economic, and social studies. The study also includes questionnaires and semi-structured interviews with various stakeholders in the trade show ecosystem: exhibitors, organizers, and representatives of public entities, aiming to obtain information on their understanding, interest, and conditions for establishing these labs. The data analysis will utilize open-source software tools such as Iramuteq and R, with content analysis and descriptive statistics. The results are expected to inform trade show organizers and support public policymakers in promoting innovative activities, strengthening the role of trade shows as environments conducive to collaborative innovation. If viability is confirmed, the research will provide guidance for the implementation and operation of innovation labs, enhancing the added value of events and encouraging the participation of diverse social and economic actors in the region.

Keywords: Ecosystem, Innovation, Stakeholders.

MITIGATION OF HERBICIDE DAMAGE IN SOYBEANS USING PHOSPHATE SOLUBILIZER

Maico André Michelin Bagnara^{1*}, Leandro Galon², Renata Paula Zicatto³, Eduardo Henrique Santin Cechet³

¹PhD student in the Graduate Program in Environmental Science and Technology, Federal University of Fronteira Sul, campus Erechim;

²Professor D. Sc. at the Federal University of Fronteira Sul, campus Erechim;

³Student in the Agronomy program at the Federal University of Fronteira Sul, campus Erechim.

*Contact: maicobagnara10@gmail.com

Soybeans are of great economic importance to Brazilian agribusiness, but they face limitations related to weed interference and low soil phosphorus (P) availability, factors that impact crop development. Therefore, the project aimed to evaluate the effect of seed treatment with phosphate solubilizer (PS) to mitigate phytotoxicity caused by herbicides applied pre- and post-emergence to soybeans. The experiment will be conducted in the field for two agricultural seasons (2024/25 and 2025/26) at the experimental area of the Federal University of the Southern Frontier, Erechim Campus, Rio Grande do Sul. The experimental design will be randomized blocks, arranged in a 2 x 12 factorial scheme, with four replicates. Factor A will test the presence or absence of the PS, and factor B will test the herbicides. sulfentrazone + diuron 245 + 490 g ha⁻¹, S-metolachlor + metribuzim 1295 + 285 g ha⁻¹, S-metolachlor + metribuzim (1570 + 372 g ha⁻¹), sulfentrazone + imazethapyr (360 + 96 g ha⁻¹), flumioxazin + imazethapyr (60 + 120 g ha⁻¹), sulfentrazone + S-metolachlor (300 + 2100 g ha⁻¹), sulfentrazone (600 g ha⁻¹), flumioxazine (75 g ha⁻¹), S-metolachlor (1920 g ha⁻¹), metribuzim (100 g ha⁻¹). Additionally, a weed control will be used, without the application of herbicides. Herbicide phytotoxicity will be evaluated at 7, 14, 21, 28, 35, and 42 days after treatment application (DAT), gas exchange at 21 DAT, and soybean grain yield components at harvest. The study hypothesis is that the use of a phosphate solubilizer increases the availability of soluble phosphorus to plants, thus promoting greater plant vigor and reducing the toxic effects of herbicides. Expected results include reduced phytotoxicity, nutrient uptake, and increased grain yield when using a phosphate solubilizer. The integration of selective herbicides and a phosphate solubilizer could be an innovative strategy for weed management and increased productivity of key agricultural crops.

Keywords: *Glycine max*, Herbicide injury, Phosphate solubilizer.

OPTIMIZATION OF THE ELECTRO-OXIDATION PROCESS FOR LANDFILL LEACHATE TREATMENT

Taynara Aparecida Xavier Gomes de Oliveira^{1*}, Mariáh Vitória de Oliveira Cortes¹, Luísa Peruchi Morandini¹, Rafael Celuppi¹

¹Kemia Effluent Treatment.

*Contact: pesquisa@kemia.com.br

The complexity of effluents such as landfill leachate represents a major challenge for defining effective treatment routes, since this effluent is composed of dissolved organic pollutants, inorganic compounds, heavy metals, and xenobiotic substances. Conventional treatments generally show low efficiency when dealing with this composition, which justifies the growing interest in advanced oxidation processes (AOPs), capable of degrading highly complex compounds. Among these technologies, electro-oxidation stands out as a promising alternative, as it promotes the oxidation of a wide range of pollutants through the application of electric current in the reaction medium. Despite its potential, the process still faces limitations related to high energy consumption, which creates an important gap for the development of studies focused on its optimization. In this context, this work aims to optimize an electro-oxidation reactor with a focus on reducing energy consumption, thereby improving process efficiency and the feasibility of real-scale application. The methodology consists of the initial characterization of the leachate, the development of a high-rate reactor, and the evaluation of different cathodic and anodic electrode materials, seeking to correlate the efficiency of recalcitrant COD removal with the system's energy performance. The project is currently under development, with preliminary tests in progress, and the next steps include the consolidation of energy efficiency indicators, estimation of operational costs, and scale-up analysis for a pilot unit. It is expected that the results will provide support for the most appropriate selection of electrode materials and more suitable reactor configurations, contributing to landfill leachate treatment through an innovative technological solution applicable at real scale.

Keywords: Advanced oxidative processes, Electrochemical oxidation, Energy, Reactor.

PARASITES AS ECOLOGICAL LENSES: CHARACTERIZATION OF THE HELMINTHOFAUNA OF ANURANS AND TADPOLES IN NATURAL PARKS OF GOIÁS, BRAZIL

Emerson Wilson Wachtel^{1*}

¹Master's degree from the Federal University of Minas Gerais, Samambaia.

*Contact: wachtelemerson58@gmail.com

The interaction between anurans and their helminth parasites is a crucial component of Neotropical biodiversity, but remains understudied in the Brazilian Cerrado, where these organisms can function as "ecological lenses" for assessing environmental health. This project's main objective is to characterize the diversity and ecological patterns of helminth communities in anurans and tadpoles from three conservation units in Goiás, testing the hypothesis that parasite structure is shaped by host ecology and environmental factors. The methodology will involve seasonal collections (dry and rainy seasons) in Chapada dos Veadeiros National Park, Emas National Park, and Serra dos Pirineus State Park. Collected specimens will undergo necropsy for the search, collection, and identification of helminths using morphological and, when necessary, molecular techniques. Parasitological data (prevalence, intensity, richness) will be correlated with host variables (species, life stage, size) and environmental variables (water quality, climate) using robust statistical models. As a result, we hope to generate a detailed inventory of the local helminth fauna, including the discovery of new occurrence records and potentially new species. Furthermore, we aim to elucidate the key factors that structure these parasite-host communities, establishing an essential baseline for monitoring ecological integrity and informing conservation strategies in the Cerrado.

Keywords: Amphibians, Bioindicators, Cerrado.

PATHS TO FOOD SOVEREIGNTY AND SECURITY IN THE TOLDO GUARANI INDIGENOUS TERRITORY

**Eluando Tonatto Mariano^{1*}, Altemir José Mossi², Márcio Freitas Eduardo², Nycollas
Stefanello Vianna¹**

¹Doutorando no Programa de Pós-Graduação em Ciência e Tecnologia Ambiental, Universidade Federal da
Fronteira Sul (UFFS), bolsista CAPES;

²Professor Dr. do Departamento de Agronomia da Universidade Federal da Fronteira Sul (UFFS);

²Professor Dr. do Departamento de Geografia da Universidade Federal da Fronteira Sul (UFFS).

*Contact: eluandomariano21@gmail.com

The contemporary environmental crisis is directly related to the transformations caused by human action and the concentration of wealth in the hands of large corporations and the state, widening inequalities that severely affect Indigenous peoples. In this scenario, alternatives emerge that propose new forms of existence in which the relationship between humans and nature transcends capitalist logic. Indigenous peoples play a central role in defending their rights and preserving their traditional territories. The relevance of this research lies in its scientific and social contribution, as it enables the recognition of traditional Indigenous knowledge, much of which is at risk of disappearance. It is justified by the challenges historically faced by the Toldo Guarani Indigenous community, especially the expansion of the conventional production model, which compromises food sovereignty in traditional territories. The central objective is to understand the transformations in the community's food systems, analyzing their impacts on food sovereignty and security. It also seeks to investigate the role of partner institutions in strengthening productive autonomy and sustainable practices, in addition to evaluating the Basic Environmental Plan (PBA). The research will be conducted through a case study, complemented by documentary and participatory research. The study will take place in the Toldo Guarani community in Benjamin Constant do Sul, Rio Grande do Sul, and will involve interviews with representatives of organizations working on environmental preservation and food security. The researcher, a community member, brings a technical and cultural perspective to the analysis. The results are expected to deepen understanding of transformations in food systems, inform agroecological transition strategies, and strengthen the territory's food sovereignty, promoting greater autonomy for Indigenous families, the appreciation of traditional knowledge, and the preservation of natural resources.

Keywords: Indigenous agroecology, Knowledge, Sovereignty, Territory.

PERFORMANCE OF MICROFILTRATION MEMBRANE IN POULTRY SLAUGHTERHOUSE WASTEWATER TREATMENT AT LABORATORY SCALE

**Verônica Baldon Fusinato^{1*}, Ana Lauren Foza¹, Clarice Steffens¹, Eduarda Alves da
Fonseca¹, Gabriela Bruel Mesquita¹, Giovana Feltes¹, Itiana Lauer¹, Laiane Racoski¹,
Rogério Marcos Dallago¹, Juliana Steffens¹**

¹PhD Program in Environmental Engineering, Integrated Regional University of Alto Uruguai and the Missions,
campus Erechim.

*Contact: verobaldon@gmail.com

Poultry slaughterhouses consume large volumes of water in their processes and generate effluents that are highly polluting to the environment. One alternative for these wastewaters is reuse for potable or non-potable purposes. Currently, the technologies employed use environmentally aggressive chemicals and require large infrastructure. Therefore, the objective of this study was to apply membrane separation technology, which is more sustainable and compact, in addition to providing high-quality permeates. The membrane used was a 0.2 μm flat-type polymeric microfiltration membrane, operated in crossflow mode, for the treatment of stabilization pond effluent from a poultry slaughterhouse. The permeate fluxes of the membrane and the quality of the treated water were evaluated. The system was operated at 1.0 bar and a constant flow rate of 1 L/min, incorporating activated carbon in the effluent pre-treatment. The results obtained under these process conditions indicated a 100% reduction in turbidity, 22% reduction in hardness, 19% reduction in alkalinity, and 13% reduction in chlorides. A slight increase in pH was observed, and microbiological analyses did not show significant reductions. Therefore, it can be concluded that further process steps involving ultrafiltration and/or reverse osmosis membranes, or disinfection systems, will still be necessary to make the reuse of these waters feasible.

Keywords: Effluents, Membranes, Microfiltration.

PLANKTON AS A BIOTECHNOLOGICAL TOOL FOR ENVIRONMENTAL MONITORING

Maycon Tavares Morete^{1,2*}, Maira Rodrigues Lima¹, Ludmilla Lopes Angelo¹, Eduarda Perazzoli¹, Rafaela Correa Varandas¹, Thiago da Silva Matos¹, Vanessa Trindade Bittar^{1,2}, Lohengrin Dias de Almeida Fernandes¹, Sávio Henrique Calazans Campos¹

¹Programa de Pós-Graduação em Biotecnologia Marinha, Instituto de Estudos do Mar Almirante Paulo Moreira, Arraial do Cabo, RJ, Brasil;

²Rede de Estudos Ambientais Costeiros do Brasil (REAC Brasil), Cabo Frio, Rio de Janeiro, Brasil.

*Contact: maycon.morete21@gmail.com

Plankton consists of organisms that lack sufficient mobility to overcome water currents. They play a crucial role in oxygen production and form the foundation of the marine food chain. Moreover, because of their sensitivity to environmental changes, plankton can serve as bioindicators of alterations in the ecosystems they inhabit. This characteristic highlights their potential for monitoring activities, contributing to assessments of ecosystem health. This project aims to identify and evaluate biotechnological tools applied to plankton analysis in order to select the most suitable option for environmental monitoring studies. A systematic literature review will be carried out to support the selection of the most appropriate tool and to describe its characteristics, strengths, and limitations. The expected outcomes include a comprehensive comparison of the different methods applicable to environmental monitoring that use plankton as a reference. This analysis is also expected to establish criteria for selecting and applying the most suitable tool, considering factors such as cost, practical applicability in the field or laboratory, and the ability to detect environmental impacts across different temporal and spatial scales. Planktonic organisms are important indicators of ecosystem health and are useful in studies involving the understanding of emerging environmental problems, such as marine pollution by microplastics and other contaminants.

Keywords: Environmental quality, Marine biotechnology, Marine ecosystems, Marine pollution, Plankton.

PURIFICATION AND APPLICATION OF ENZYMES OBTAINED FROM *Trichoderma koningiopsis* BIOCOMPOSITE

**Marcelli Powzum Amorim^{1,4*}, Vitória Dassoler Longo^{2,4}, Isabely Sandi Baldasso^{2,4},
Emanuely Fagundes da Silva^{2,4}, Nair Mirely Freire Pinheiro Silveira^{2,4}, Helen Treichel^{3,4}**

¹PhD student in the Postgraduate Program in Environmental Science and Technology, Federal University of Fronteira Sul, campus Erechim;

²Graduate Program in Environmental and Sanitary Engineering, Federal University of Fronteira Sul, campus Erechim;

³PhD in Food Engineering;

⁴Laboratory of Microbiology and Bioprocess, Federal University of Fronteira Sul, Erechim.

*Contact: marcellipowzum@gmail.com

Filamentous fungi, such as *Trichoderma koningiopsis*, are extensively studied for their capacity to secrete enzymes (cellulases, xylanases, proteases, etc.) and metabolites with biotechnological applications. These enzymes play a crucial role in plant biomass degradation and have potential for use in bioremediation, biofuel production, and agriculture. However, efficient and low-cost purification methods are required to enable their application on an industrial scale. This project aims to purify and characterize enzymes obtained from a biocomposite produced by *T. koningiopsis* in an Airlift bioreactor, in addition to exploring their potential applications. The biocomposite will be obtained by submerged fermentation in a chemically defined medium, utilizing optimized conditions of pH, temperature, and aeration. The crude enzymatic extract will be subjected to various purification methods, including salt precipitation, aqueous two-phase systems (ATPS), and three-phase partitioning (TPP), with the aim of maximizing the yield and activity of the enzymes. The activities of amylase, cellulase, laccase, lipase, protease, peroxidase, catalase, ascorbate peroxidase, and superoxide dismutase will be assessed using standardized spectrophotometric methodologies. The efficiency of the purification methods will be determined through analysis of variance (ANOVA) and central composite design (CCD). The most efficient purification method for enzymatic recovery is expected to be obtained. In addition to characterizing the purified enzymes for applications in bioremediation and industrial processes, this study will contribute to developing sustainable and economically viable processes for obtaining fungal enzymes, with potential application in sectors such as waste treatment and bioenergy, for example.

Keywords: Enzyme purification, Precipitation, Submerged fermentation, Three-phase partitioning, Two-phase systems.

PyGIS ALLIED TO THE DEVELOPMENT OF ENVIRONMENTAL DISASTER PREDICTION MODELS

João Felipe Freitag^{1*}, Lucas Kovaleski¹, Cleomar Reginatto¹

¹Civil and Environment Post-Graduate Program, University of Passo Fundo, Campus I.

*Contact: 158662@upf.br

The increasing frequency and intensity of extreme weather events, such as floods, landslides, and droughts, have heightened the need for technological tools capable of monitoring and forecasting risk scenarios. In this context, the use of geoprocessing systems emerges as a strategic alternative for geospatial analysis, enabling the integration of environmental and temporal variables into predictive models. Python, recognized for its versatility and widespread application in data science, provides specific libraries for geoprocessing, such as GeoPandas, which offer advanced resources for the manipulation, analysis, and visualization of georeferenced data—the so-called PyGIS tools. This research project is part of a doctoral study within the Graduate Program in Civil and Environmental Engineering at the University of Passo Fundo (PPGEng – UPF). Therefore, the aim is to explore the potential of PyGIS tools in the development of predictive models for environmental disasters, considering climatic, hydrological, and land-use data. The research proposes the integration of information from historical weather station records, remote sensors, and satellite imagery, with the aim of identifying vulnerable areas and estimating the probability of critical events. Furthermore, spatial analysis techniques and machine learning methods will be tested, enabling the generation of dynamic risk maps and decision-support reports. Overall, the expected results should demonstrate the applicability of PyGIS as a robust tool for environmental management, fostering the creation of systems with greater precision and efficiency. In this way, the study contributes to innovation in territorial monitoring and strengthens strategies for the prevention and mitigation of environmental disasters, aligning with global demands for climate resilience.

Keywords: Climate change, Geoprocessing, Python.

RELATIONSHIP BETWEEN WATER FLOW AND PARASITISM IN *Melanorivulus pictus* (COSTA, 1989) FISHES (*Osteichthyes*, *Cyprinodontiformes*, *Rivulidae*) IN THE CERRADO

Emerson Wilson Wachtel^{1*}, Thainara Aparecida D. Arruda de Paula², Marcus Vinicius Nunes Martins²

¹PhD student at the Federal University of Goiás, campus Samambaia;

² Graduate.

*Contact: wachtelemerson58@gmail.com

Hydrological dynamics are a crucial factor in structuring host-parasite interactions in freshwater ecosystems, but their influence on annual Cerrado fishes, such as *Melanorivulus pictus*, remains largely unexplored. Lentic environments (still water) can favor parasite transmission by concentrating infective stages and intermediate hosts, while lotic environments (running water) tend to disperse them. This project aims to test the hypothesis that the prevalence and intensity of endoparasite infection in *M. pictus* are significantly higher in lentic than in lotic environments. To this end, a comparative study will be conducted in Emas National Park, where 30 fish will be sampled at five lentic and five lotic sites. In the laboratory, the specimens will be necropsied to search for, count, and taxonomically identify endoparasites in internal organs such as the intestine, liver, and musculature. Abiotic water parameters (pH, temperature, conductivity) will be measured at all sites to control for potential confounding variables. Significantly higher prevalence and mean infection intensity are expected in fish from lentic environments, highlighting the role of water flow as a modulator of parasite dynamics. The results will deepen our understanding of disease ecology in Neotropical fish and generate important data for the conservation of aquatic environments in the Cerrado.

Keywords: Annual fish, Fish diseases, Lentic environments, Parasite ecology, Protected areas.

REMOVAL OF PHARMACEUTICALS FROM WASTEWATER USING OZONATION: EVALUATION OF THE APPLICATION OF PYRITE AS A CATALYST

Bianca Trindade Oldoni^{1*}, Gabriela Cristina Perusin Flores², Bruna da Conceição Marques², Kauê Câmara Leal de Oliveira², Vitória Bôaventura Midon³, Aluizio Araújo Passos³, Yago Vitório Colares Pinto⁴, Danieli Brandler⁴, Rogério Marcos Dallago⁵, Gean Delise Leal Pasquali⁶

¹PhD student, Postgraduate Program in Environmental Science and Technology, Federal University of Fronteira Sul;

²Undergraduate student, Environmental and Sanitary Engineering, Federal University of Fronteira Sul;

³Undergraduate student, Biological Sciences, Federal University of Fronteira Sul;

⁴Master's student, Postgraduate Program in Environmental Science and Technology, Federal University of Fronteira Sul;

⁵PhD teacher, Postgraduate Program in Food Engineering, Regional and Integrated University of Alto Uruguai and Missões;

⁶PhD teacher, Postgraduate Program in Environmental Science and Technology, Federal University of Fronteira Sul.

*Contact: bianca.oldoni@gmail.com

The growing presence of pharmaceutical residues in water and wastewater represents serious risks to the environment and human health. This poses a challenge to conventional treatment methods, leading to the search for alternatives such as advanced oxidation processes (AOPs). Ozonation stands out as an effective technique, thanks to the high oxidative potential of ozone, which can act directly or indirectly, generating hydrogen peroxide and hydroxyl radicals capable of degrading emerging pollutants. The project aims to evaluate the effectiveness of ozonation as an AOP in removing pharmaceuticals from real wastewater samples, using pyrite as an alternative catalyst, mainly when obtained as a waste product from coal mining, and its combination with ozone promotes stability, good hydroxyl radical generation, and efficient degradation of organic compounds. The methodology includes characterizing the effluent before and after the treatment, in terms of physical-chemical and microbiological parameters; assembling the bench-top ozonation reactor at a rate of 600 mg h⁻¹ and treating wastewater samples contaminated with bromazepam (anxiolytic) through a kinetic degradation study, with recirculation of this effluent in pyrite, with and without the application of ozone; determine the operating parameters where 3 pHs will be evaluated as a function of time and the use of fixed variables; evaluate toxicity through tests on aquatic microcrustaceans (*Artemia salina*), COD and total organic carbon (TOC) to verify the percentage of mineralization, as well as analyze the economic and technical feasibility of these methods and compare their efficiency in degrading the drug. The results will help identify whether the process is promising in removing bromazepam, whether there was complete mineralization of its by-products, and obtain parameters that enable upscaling, providing a basis for the development of better technologies in wastewater treatment.

Keywords: Ozonation, Pharmaceuticals, Removal, Wastewater/effluent.

ROADS AND CHANGES IN FOREST COVER: ASSESSMENT OVER TIME AND SPACE

Marcel Leonel Jorge¹, Paulo Afonso Hartmann²

¹ Master's in Environmental Science and Technology, UFFS, Campus Erechim;

² PhD, Federal University of Fronteira Sul, UFFS, Campus Erechim.

*Contact: marcelpf@gmail.com

Roads and their associated structures promote physical and biological changes in the landscapes around them, known as the Road Effect Zone. These impacts occur not only during construction but also persist over time, particularly affecting forest cover. Understanding how roads influence land use and land cover is therefore crucial for assessing their broader environmental impacts. In southern Brazil's Atlantic Forest, particularly in Mixed Ombrophilous and Deciduous Seasonal Forests, agriculture, urbanization, and road infrastructure exert significant pressure on forest cover. Despite advances in remote sensing and geospatial analysis, gaps persist in understanding the comparative effects of paved and unpaved roads on forest cover. This study aims to compare the influence of different road structures on landscape dynamics in a subtropical forest region of southern Brazil. We selected road segments that differ in lane and shoulder width, pavement type, and traffic volume. The study area includes paved highways (RS-135, 71 km between Passo Fundo and Erechim; RS-324, 31 km between Pontão and Passo Fundo; and BR-153, 38 km between Passo Fundo and Tio Hugo) and unpaved roads (BR-153, 72 km between Erechim and Passo Fundo; RS-221, 23 km between Ronda Alta and Campinas do Sul; and BR-470, 62 km between Lagoa Vermelha and Nova Prata). The methodology combines geoprocessing tools and MapBiomas data to generate spatiotemporal maps using 5 km buffers from the highways for the years 1985 and 2023. Forest fragment metrics will be calculated in QGIS, considering fragment area, distance to the highway centroid, and circularity index. Statistical comparisons will be performed through analysis of variance (ANOVA). The expected outcomes include estimating the extent to which different road characteristics influence surrounding landscapes. Overall, areas adjacent to these roads are expected to exhibit higher fragmentation, reduced forest cover, and consequently, greater environmental impacts.

Keywords: Atlantic forest (Southern Brazil), Forest fragmentation, Geospatial analysis, Land use and land cover change, Road effect zone.

SMALL MAMMAL SURVEY: DIVERSITY AND ANTHROPIZATION IN THE ALTO URUGUAI REGION

Teodoro Companhoni Pasquali^{1,2*}, Ellen Cristina Brönstrup², Aluizio Araújo Passos², Daniel Galiano²

¹Biological Science Student, Universidade of Federal Fronteira Sul, campus Erechim;

²Laboratory Ecology and Conservation, University of Federal Fronteira Sul, campus Erechim.

*Contact: teodoro.pasquali@estudante.uffs.edu.br

The Alto Uruguai region is located in the northern part of the state of Rio Grande do Sul, and hosts a rich mammalian fauna, especially small mammals, defined as those weighing less than one kilogram. This project aims to survey the small mammal species occurring at the Campus Erechim of the University of Federal Fronteira Sul (UFFS), Rio Grande do Sul, southern Brazil, in order to understand the composition of the local fauna, species diversity, and their relationship with landscape anthropization. Tomahawk and Sherman traps with attractive baits will be used to sample the widest possible diversity of terrestrial small mammals. Sampling sites will be categorized according to their level of human disturbance: high activity (around built structures), medium activity (experimental area), and low activity (valley). For terrestrial species, sampling points will be spaced at least 20 meters apart, and collections will be conducted over the course of one year, on a weekly basis. For volant mammals, active capture will be conducted using mist nets and acoustic monitoring. Acoustic data will be analyzed and identified using Raven Pro 1.6 software. Subsequently, statistical analyses of species richness and distribution will be carried out using the R software. A significant diversity of small mammals is expected to be recorded, with species composition varying according to the degree of anthropogenic disturbance. It is anticipated that areas with lower human activity will present greater richness of sensitive species, while more urbanized areas will be dominated by generalist species. The combined use of physical and acoustic survey methods should allow identification of individuals at least to the genus level, contributing to a comparative analysis between environments. This study will contribute to the knowledge of the small mammal fauna in the Alto Uruguai region and provide insights into the impacts of human activity on local biodiversity.

Keywords: *Chiroptera*, *Didelphimorphia*, Neotropical region, *Rodentia*.

SMUGGLING OF AGROCHEMICALS IN NORTHWEST RIO GRANDE DO SUL: DYNAMICS, IMPACTS, AND ENFORCEMENT STRATEGIES

Daniele de Oliveira Lima^{1*}, Altemir José Mossi², Helen Treichel³

¹Undergraduate student in Environmental Science and Technology, Federal University of Fronteira Sul, Campus Erechim;

²Postgraduate program Environmental Science and Technology, Federal University of Fronteira Sul;

³Laboratory of Microbiology and Bioprocesses, Federal University of Fronteira Sul, Environmental Science and Technology.

*Contact: danielle.dol@estudante.uffs.edu.br

The seizure of illegal pesticides is crucial in combating environmental pollution and protecting public health. The study will be conducted in the northwestern region of the state of Rio Grande do Sul, encompassing microregions grouped into mesoregions, with a focus on the area surrounding the Turvo State Park, a conservation unit situated along the Uruguay River, on the border with Santa Catarina and the Argentine province of Misiones. The focus is on pesticide smuggling, a complex problem that utilizes strategic border routes, particularly the Uruguay River, where inspections are hindered. On these routes, products mainly originate from the Argentine provinces of Misiones, Corrientes, and Entre Ríos, where pesticides and fertilizers are sold at lower prices, favoring illegal trade. In Brazil, the routes pass through municipalities such as Tiradentes do Sul, Três Passos, Santo Ângelo, Sarandi, Ijuí, and Passo Fundo, areas of large agricultural production and high demand for inputs, which facilitates illicit circulation. The joint actions of the Federal Highway Police and the Federal Police will be analyzed, considering the importance of highways such as BR-386 and BR-285, which function as transportation axes for clandestine distribution. Data will be collected from the Regional Superintendence of the Federal Police and the Federal Highway Police, covering the period from 2016 to 2024. The research will record seizures per year and per municipality, as well as the origin and active ingredients most frequently smuggled. It will also examine the impacts of the ban on Paraquat, the final destination of the products, and the penalties applied. Additionally, the study will incorporate bibliographic, documentary, and jurisprudential research, drawing on information from environmental agencies such as IBAMA and SEMA. The research aims to demonstrate that strengthening inspection can reduce environmental and public health impacts, contributing to greater food security and the adoption of safer and more sustainable agricultural practices.

Keywords: Border, Environmental inspection, Food security, Pesticide smuggling.

SOLID WASTE MANAGEMENT AT FARMERS' MARKETS IN THE MUNICIPALITY OF ERECHIM, RS

**Larissa Pandolfo Rodrigues de Lima^{1*}, Eduardo Pavan Korf², Debora Regina Schneider
Locatelli³**

¹High School Student, José Bonifácio State Normal School;

²Doctor, University of Federal Fronteira Sul - campus Erechim, Co-advisor;

³Doctor, University of Federal Fronteira Sul - campus Erechim, Advisor.

*Contact: laril@gmail.com

Currently, farmers' markets benefit many families who depend on farm work, but they produce solid waste, about which there is little information, making proper waste management difficult. Considering this, this project's overall objective is to describe the situation at Erechim's farmers' markets regarding solid waste. The specific objectives are: to quantify the number of consumers who visit farmers' markets; to characterize the solid waste generated at farmers' markets; and to verify how waste is packaged/stored during farmers' markets. Research data will be obtained by quantifying consumers using a manual counter; quantifying waste in compliance with NBR 10007/2004 through waste segregation and weighing; and observing the fair environment. Data organization and analysis will be performed in different ways depending on their characteristics, using spreadsheets to perform descriptive statistics and content analysis. After analysis, the information will be presented through text, tables, maps, or diagrams to better understand and present it to interested parties. The study will take place at Erechim's market locations, which, according to the Municipal Department of Agriculture, Supply, and Food Security, are: Feira Centro, Feira Nossa Terra, Feira Três Vendas, Feira São Cristóvão, Feira Progresso, Feira Entre Paíóis, Feira Parques Longines, Feira Atlântico, and Feira do IFRS. As a result, the materials produced are expected to contribute to the basis of more sustainable solid waste management plans, thus achieving better organization of waste disposal and characterization, aiming for the medium-term adoption of the zero-waste concept.

Keywords: Fairs, Management, Quantification, Solid waste.

STREAMS UNDER THE INFLUENCE OF DIFFERENT MANAGEMENT SYSTEMS: BENTHIC MACROINVERTEBRATES AS BIOINDICATORS IN SOUTHERN BRAZIL

Caciane Larissa Rauch^{1*}, Bruna Luisa Pastore², Silvia Vendruscolo Milesi³, Rozane Maria Restello²

¹Postgraduate Program in Ecology, Integrated Regional University of Alto Uruguai and Missões, campus Erechim;

²Postgraduate Program in Ecology, Integrated Regional University of Alto Uruguai and Missões, campus Erechim;

³Federal University of Mato Grosso do Sul.

*Contact: cacianerauch@yahoo.com.br

Global population growth has increased food demand and driven agricultural expansion, particularly of soybeans, one of Brazil's main crops. Although economically important, this expansion is a major contributor to the degradation of aquatic ecosystems due to intensive agrochemical use and management practices that promote erosion and the leaching of nutrients and contaminants. In contrast, alternative practices, such as organic farming and preserved natural areas, play a key role in biodiversity conservation, water resource protection, and sustainability. This study aims to evaluate the influence of different agricultural management systems (conventional and organic) on stream water quality in rural properties in southern Brazil, comparing them to streams in natural reference areas, using benthic macroinvertebrates as bioindicators. Seventeen streams will be studied, including conventional farms, certified organic farms, and preserved natural areas. Macroinvertebrates will be collected using a Surber sampler in standardized stream sections and identified to the family level in the laboratory. Simultaneously, physical and chemical limnological variables, including temperature, turbidity, pH, dissolved oxygen, carbon, and nitrogen, will be measured for integrated water quality analysis. Data will be analyzed using univariate and multivariate statistics in R. Streams in natural areas and under organic management are expected to show higher benthic macroinvertebrate richness, including sensitive groups, and better limnological conditions than conventionally managed streams. The expected results aim to improve understanding of the relationship between agricultural practices and aquatic ecosystem integrity, supporting sustainable management and water resource conservation strategies.

Keywords: Bioindicators, Freshwater ecosystems, Organic farming, Water quality.

STRUCTURAL ECOLOGICAL INTEGRITY AND BIODIVERSITY VALUATION IN ATLANTIC FOREST REMNANTS

Roberta Malinowski^{1*}, Daniel Galiano²

¹PhD Student, Graduate Program in Environmental Science and Technology, Federal University of Fronteira Sul (UFFS), Erechim, RS, Brazil. CAPES Scholarship holder;

²Faculty Member, Graduate Program in Environmental Science and Technology, Federal University of Fronteira Sul (UFFS), Erechim, RS, Brazil.

*Contact: malinowski.rbrt@gmail.com

The Atlantic Forest, globally recognised for its exceptional biodiversity and ecological importance, is among the most threatened tropical biomes, exhibiting severe habitat loss and fragmentation. In southern Brazil, particularly in the state of Rio Grande do Sul, only a small fraction of its original cover remains. The combined impacts of anthropogenic pressures and climate change have heightened the vulnerability of these ecosystems, undermining their resilience and the provision of essential ecosystem services. This project aims to assess the integrity and structural complexity of vegetation remnants within the Atlantic Forest over the past four decades by analysing the spatio-temporal dynamics of habitat loss, fragmentation, and regeneration. Ultimately, the study seeks to develop a Model for Biodiversity Valuation in Fragmented Landscapes to support strategic conservation planning in southern Brazil. Specifically, it will (i) identify spatio-temporal patterns of landscape change, (ii) validate the Index of Structural Ecological Integrity of Habitats (ISEIH) using updated datasets, (iii) integrate ecological, biodiversity, and socio-environmental indicators based on ecosystem services, and (iv) propose public policy applications for the model as a tool for environmental and climate mitigation. Methodologically, the research will employ land-use and land-cover time series (1985–2023) from the MapBiomas platform, spatial analysis using QGIS software, and landscape metrics derived from Fragstats. These will be complemented by statistical and multivariate analyses conducted in R software. The ISEIH will be refined and validated through field surveys and by establishing correlations among spatial, ecological, and socio-environmental indicators, including biodiversity records. The expected outcomes include the formulation of a comprehensive methodological framework integrating ecological, socio-environmental, and economic dimensions. This framework aims to provide a robust scientific basis for conservation, restoration, and evidence-based policy-making across the Atlantic Forest region.

Keywords: Conservation planning, Ecosystem services, Habitat complexity.

STRUVITE PRODUCTION FROM DIGESTATES CONTAINING HIGH CARBON CONCENTRATIONS

Gerônimo Rodrigues Prado^{1*}, Airton Kunz²

¹Doctoral student in Environmental Science and Technology, UFFS, Erechim, RS;

²Dr, Teacher permanent, in Environmental Science and Technology, UFFS, Erechim, RS.

*Contact: geronimo-prado@uergs.edu.br

The growing demand for phosphorus (P), an essential element for life and agriculture, has raised concerns about its future availability, as natural reserves of phosphate rocks are finite and concentrated in a few countries. In addition to scarcity, the intensive use of phosphate fertilizers causes environmental impacts, such as eutrophication of water bodies and imbalances in soil fertility. Therefore, phosphorus recovery from agricultural waste, especially digestates from anaerobic digestion, emerges as a strategic alternative. Among the recovery routes, struvite precipitation ($\text{MgNH}_4\text{PO}_4 \cdot 6\text{H}_2\text{O}$) stands out, a slow-release crystalline fertilizer that reduces dependence on mineral sources and promotes sustainable practices aligned with the circular economy. The project aims to evaluate struvite production from anaerobic digestion effluents with high carbon concentrations. Specifically, the project seeks to: (i) evaluate the efficiency of phosphorus recovery in swine and bovine digestates; (ii) determine the available phosphorus in the precipitated material; and (iii) analyze the influence of carbon content on crystallization. The study's methodology will include the collection of raw waste from the anaerobic digestion of the UASB and CSTR reactors. Samples collected during the summer and winter seasons (2026-2027) will be analyzed by physicochemical methods and ICP-OES to quantify P, Mg, Ca, K, Na, Fe, Zn, Mn, and Cu. The samples will be evaluated for struvite concentration and purity, and recovered phosphorus. Statistical analysis will assess the influence of experimental factors on the recuperation of phosphorus. The expected results include identifying the most favorable conditions for struvite precipitation from digestates with a high carbon load, as well as evaluating the influence of variables such as pH, the presence of competing ions, and organic matter. Demonstrate the technical feasibility of phosphorus recovery through struvite, reducing the environmental impacts of manure management and offering a sustainable fertilizer alternative for the agricultural sector.

Keywords: Digestate, Nutrient recovery, Phosphorus, Struvite, Sustainable fertilizers.

SYNERGISTIC USE OF PHOTOCATALYSIS AND OZONATION WITH DIFFERENT CATALYSTS IN THE REMOVAL OF PHARMACEUTICALS FROM EFFLUENTS

Bianca Trindade Oldoni^{1*}, Gabriela Cristina Perusin Flores², Bruna da Conceição Marques², Kauê Câmara Leal de Oliveira², Vitória Bôaventura Midon³, Aluizio Araújo Passos³, Yago Vitório Colares Pinto⁴, Danieli Brandler⁴, Rogério Marcos Dallago⁵, Gean Delise Leal Pasquali⁶

¹PhD student, Postgraduate Program in Environmental Science and Technology, Federal University of Fronteira Sul;

²Undergraduate student, Environmental and Sanitary Engineering, Federal University of Fronteira Sul;

³Undergraduate student, Biological Sciences, Federal University of Fronteira Sul;

⁴Master's student, Postgraduate Program in Environmental Science and Technology, Federal University of Fronteira Sul;

⁵PhD teacher, Postgraduate Program in Food Engineering, Regional and Integrated University of Alto Uruguai and Missões;

⁶PhD teacher, Postgraduate Program in Environmental Science and Technology, Federal University of Fronteira Sul.

*Contact: bianca.oldoni@gmail.com

The identification of pharmaceutical compounds in wastewater and more advanced treatment technologies for their removal are the focus of current investigations. The most popular advanced oxidation processes (AOPs) are photocatalysis and ozonation, and combining them in the presence of new catalysts can increase process performance by generating more hydroxyl free radicals, which are capable of removing these emerging pollutants. Given the above, the project aims to evaluate the synergistic effect of photocatalysis and ozonation in removing the pharmaceutical bromazepam (anxiolytic), added to domestic wastewater, using different catalysts. The methodology will involve physical-chemical, microbiological, and toxicological characterization of the initial effluent contaminated with the drug and after the treatment; operational parameters will be determined, such as photocatalytic reaction and ozonation time, as well as the amount of catalyst. For the photocatalysis, the catalysts used will be HDL (anionic clays or hydrotalcites) and TiO₂ (titanium dioxide) in a benchtop UV lamp reactor, while for ozonation, pyrite will be used in a benchtop ozone reactor. The wastewater will be conducted through the two processes in sequence, and the results will be analyzed at the end. It is expected that the drug bromazepam will be effectively removed, and parameters such as Chemical Oxygen Demand (COD), Total Organic Carbon (TOC), and toxicity will be reduced. The study may contribute to the development of a new technology for wastewater treatment.

Keywords: Catalysts, Drug, Ozonation, Photocatalysis, Synergistic.

TREATMENT OF PHARMACEUTICAL-CONTAINING EFFLUENTS USING HYDROGEL PRODUCED FROM SUGARCANE BAGASSE ASH: A SUSTAINABLE APPROACH

Yago Vitório Colares Pinto^{1*}, Vitória Bôaventura Midon², Bruna da Conceição Marques³, Kauê Câmara Leal de Oliveira³, Gabriela Cristina Perusin Flores³, Aluizio Araújo Passos², Bianca Trindade Oldoni⁴, Danieli Brandler⁵, Eduardo Pavan Korf⁶, Gean Delise Leal Pasquali⁷

¹Master's student, Postgraduate Program in Environmental Science and Technology, Federal University of Fronteira Sul;

²Undergraduate student, Biological Sciences, Federal University of Fronteira Sul;

³Undergraduate student, Environmental and Sanitary Engineering, Federal University of Fronteira Sul;

⁴PhD student, Postgraduate Program in Environmental Science and Technology, Federal University of Fronteira Sul;

⁵Master's student, Postgraduate Program in Environmental Science and Technology, Federal University of Fronteira Sul;

⁶PhD teacher, Postgraduate Program in Civil Engineering/Geotechnics from the Federal University of Rio Grande do Sul;

⁷PhD teacher, Postgraduate Program in Food Engineering from the Regional Integrated University of Alto Uruguai.

*Contact: yagocolaresvp@gmail.com

The increasing presence of pharmaceuticals in water bodies, resulting from human consumption and improper disposal, represents an emerging environmental issue, impacting aquatic biota, public health, and contributing to antimicrobial resistance. In this context, developing technologies that combine contaminant removal efficiency with sustainable practices, aligned with circular economy principles, becomes essential. This research proposes the production of an adsorbent hydrogel using sugarcane bagasse ash, a byproduct of the alcohol industry, in combination with sodium alginate. The use of this agro-industrial residue not only provides a valuable destination for an abundant and frequently discarded material but also adds environmental and economic value by transforming byproducts into inputs for decontamination technologies. This approach integrates technological innovation with sustainable waste management, emphasizing the importance of the bioeconomy in the environmental field. The study aligns with the United Nations Sustainable Development Goal (SDG) 6 – Clean Water and Sanitation, by promoting innovative and sustainable strategies for water quality improvement and pollution reduction. The methodology involves synthesizing a porous hydrogel with high water retention capacity and potential for interaction with organic molecules. Physicochemical characterization will be performed using techniques such as FTIR, BET, BJH, and SEM, enabling the understanding of the material's surface and structural properties. Batch adsorption tests, using synthetic effluent contaminated with bromazepam, will assess the hydrogel's efficiency under different operational conditions, as well as provide data for isotherm modeling and regeneration studies. The expected impact goes beyond contaminant removal efficiency: the aim is to develop a low-cost treatment system, scalable for industrial application, and environmentally responsible. Valorizing residues as raw materials strengthens pollution mitigation strategies, reduces pressure on industrial landfills, and aligns with global sustainable development goals. Ultimately, the project seeks to contribute to the preservation of water resources and the creation of innovative solutions that integrate science, technology, and environmental sustainability.

Keywords: Agro-industrial residues, Circular economy, Hydrogel, Pharmaceuticals, Sustainability.

VALORIZATION OF TEXTILE WASTE IN INTERLOCKING CONCRETE BLOCKS: A CONTRIBUTION TO THE CIRCULAR ECONOMY IN THE TEXTILE AND APPAREL INDUSTRIES

Alessandra Tonin Incerti^{1*}, Eduardo Pavan Korf²

¹Master's student, Graduate Program in Environmental Science and Technology, Federal University of Fronteira Sul
– Campus Erechim;

²Environmental Engineer, Doctor in Civil Engineer, Professor/Researcher, Graduate Program in Environmental
Science and Technology, Federal University of Fronteira Sul – Campus Erechim.

*Contact: aleincerti@gmail.com

The textile and apparel industry is one of the most important sectors of the global economy, but it also stands out for the environmental impacts resulting from its linear model of production and disposal. The high volume of textile waste, often destined for landfills, highlights the need for solutions that promote the circular economy. In this context, civil construction presents itself as a promising alternative for the use of this waste, with the potential to reduce the extraction of natural resources and add value to discarded materials. The overall objective of this research is to develop interlocking concrete blocks incorporating post-consumer textiles as non-structural reinforcement. The methodology provides for the characterization and classification of discarded waste that will be incorporated as partial substitutes for fine aggregate in the production of interlocking concrete blocks, molded with Portland cement, sand, gravel, and stone powder. The study will consider variations in flat and mesh waste, natural and synthetic origin, and curing times of 7 and 28 days. The samples will be subjected to compressive strength and water absorption tests, complemented by microstructure and leaching tests to verify the interaction of the waste with the cementitious matrix and mobility of contaminants. It is expected to contribute to the valorization of textile waste, promoting sustainable alternatives for civil construction and encouraging practices aligned with the circular economy.

Keywords: Construction material, Environmental benefits, Fibre-based concrete, Mechanical Properties, Recycled textile.

WASTE MANAGEMENT AT FAIRS: PATHWAYS TO SUSTAINABILITY AND THE CIRCULAR ECONOMY IN THE GLOBAL CONTEXT

**Daniela Tonial Cattani^{1*}, Débora Regina Schneider Locatelli², João Paulo Peres Bezerra²,
Eduardo Pavan Korf²**

¹Graduate Student in Public Management, University of Federal Fronteira Sul, campus Erechim;

²PhD University of Federal Fronteira Sul, campus Erechim.

*Contact: danielacattani1975@gmail.com

There is a growing concern within the scientific and social communities regarding the recycling and recovery of waste generated on a large scale, such as that produced at fairs. The concentration of people in space has led to a significant increase in waste volume in a short period of time, representing a challenge for local collection and treatment systems. When not properly managed, the waste can overload urban infrastructure, cause environmental impacts, and result in the loss of recyclable materials. Fairs often take place in cities that do not have a consolidated structure to deal with this temporary waste. Questions such as: the waste sent to landfills or selectively collected? How can its generation be reduced at the source? Is the current bin system sufficient? What technological and organizational alternatives can lead to better results? In addition, it is essential to encourage user participation in proper waste separation through socio-environmental education and to assess whether pre-sorting at disposal points contributes to management efficiency. This study aims to identify and analyze international academic research on solid waste management at fairs. A systematic literature review will be conducted on the Web of Science and Scopus databases, using the search strings (“trade fair” OR “farmer market” OR “craft fair” OR “street market” OR “county fair”) AND (“waste”), in peer-reviewed articles without temporal limitation. The objective is to understand how this management is carried out in different contexts, enabling the exchange of more sustainable and efficient technologies and practices within the framework of the circular economy. The study intends to support the consolidation of public policies and environmental management strategies applicable to fairs and temporary events, contributing to the reduction of environmental impacts, the reuse, and the strengthening of socially and environmentally responsible practices.

Keywords: Environmental awareness, Public policies, Technologies.

YEASTS ASSOCIATED WITH HOMEOPATHIC PREPARATIONS AS BIOLOGICAL CONTROL AGENTS OF PRE AND POST-HARVEST DISEASES IN STRAWBERRY AND PEACH FRUITS

Egabrieli Garbin^{1*}, Sandra Denise Camargo Mendes², Pedro Boff², Mari Inês Carissimi Boff¹

¹Santa Catarina State University - Lages SC;

²Agricultural Research and Rural Extension Company of Santa Catarina.

*Contact: egabrielig@gmail.com

Biological control of plant diseases is a growing demand in agricultural research. Therefore, understanding the relationships between biocontrol microorganisms and phytopathogens in pathosystems of agricultural and economic importance is of public interest, as it involves a low-environmental-impact technology. This study aims to evaluate the efficacy of yeasts in the biocontrol of gray mold (*Botrytis cinerea*) in strawberries and brown rot (*Monilinia fructicola*) in peaches. The study will be conducted at the Laboratory of Homeopathy and Plant Health and the Laboratory of Biotechnology, both at the Lages Experimental Station of the Agricultural Research and Rural Extension Corporation of the State of Santa Catarina (EPAGRI). The initial strains of phytopathogens will be acquired from collections, and the yeasts will be acquired from isolates from EPAGRI-Lages. Assays will be conducted twice, under controlled conditions and in a greenhouse, in a completely randomized design. The bioprospecting of yeast isolates and their ability to induce resistance to the phytopathogen *B. cinerea* in strawberry plants will be studied. Additionally, the homeopathic preparation *Pulsatilla nigricans* 30CH will be associated with the yeast growth medium to assess its potential for increased biocontrol, according to the aforementioned parameters. The evaluations that comprise this project: (a) in vitro antagonism; (b) spore germination; (c) biocontrol of brown rot in peach fruits; yeasts - (d) killer factor, (e) siderophores, (f) amylase, (g) protease, (h) volatile compounds; (i) peroxidase, catalase, β -1,3 glucanase, and chitinase in strawberry plants; (j) severity and incidence of *B. cinerea* in strawberry plants; and (k) strawberry yield. All experiments will be conducted in a double-blind design, and the data will be subjected to statistical analysis (ANOVA) followed by Tukey's test ($p < 0.05$). The isolates are expected to control the tested phytopathogens and induce resistance in strawberry plants. The combination with the homeopathic preparation will also enhance the biocontrol performance of these yeasts.

Keywords: Bioinputs, Fruit diseases, Microbiological control, Resistance induction.

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ABUNDANCE-BIOMASS CURVE AS A TOOL FOR ASSESSING THE ECOLOGICAL INTEGRITY OF THE FISH FAUNA IN ESTREITO DOS COQUEIROS, SÃO LUÍS, MA

Filipe França dos Santos Silva^{1*}, Danielle Viana Mendes¹, Scarlleth Patricia Salomão da Silva¹, Alcione Sousa da Silva¹, Larissa Gabrielle Pinheiro Ferreira¹, Cecília Mendes Póvoas Netta², Ingryd Lorena Batista de Oliveira², Nívea Fernanda Maria Ferreira Costa², Yasmim Gomes Medeiros³, Daniella Patrícia Brandão Silveira⁴, Marcelo Henrique Lopes Silva⁵, James Werllen de Jesus Azevedo⁵, Antonio Carlos Leal de Castro⁵

¹Program in Development and Environment, Federal University of Maranhão (UFMA);

²Undergraduate Program, Oceanography, Federal University of Maranhão (UFMA);

³Undergraduate Program, Veterinary Medicine, Anhanguera College;

⁴PhD, Biotechnology Doctoral Program – RENORBIO, Federal University of Maranhão (UFMA);

⁵Teacher, Department of Oceanography, Federal University of Maranhão (UFMA).

*Contact: filipe.franca@discente.ufma.br

Estuaries are among the ecosystems most sensitive to anthropogenic pressures due to intense unplanned occupation and changes associated with population growth without sustainable planning. In addition to being fundamental for maintaining biodiversity, these areas are frequently impacted by industrial and port activities, as occurs in the region influenced by the ALUMAR Private Use Terminal (TUP) in São Luís, Maranhão. In this context, it is essential to assess fish communities as bioindicators, since they respond directly to changes in environmental quality and provide insights into the effects of degradation on aquatic ecosystems. Six quarterly sampling campaigns were conducted between February 2022 and June 2023, with the support of artisanal fishers using gill nets. Captured specimens were preserved, transported, and identified to the species level in the laboratory. Data analysis was conducted using PRIMER and STATISTICA 7.0 software to calculate the ABC curve (Abundance Biomass Comparison) to evaluate ecosystem quality. A total of 8,063 individuals belonging to 47 species from 28 families were captured, with predominance of the orders Siluriformes (28.79%) and Perciformes (22.68%). The application of the ABC curve revealed more structured communities at points P1 ($W = 0.06$) and P4 ($W = 0.106$), indicating relatively balanced environments. In contrast, points P2 ($W = -0.017$) and P3 ($W = -0.001$) showed negative values, reflecting the dominance of opportunistic and juvenile species in the sampled area, not directly reflecting the port influence on the study area. Thus, the results confirm that fish communities are an effective tool for diagnosing environmental pressures in estuaries, allowing differentiation between more impacted areas and areas with greater ecological stability.

Keywords: Bioindicators, Ecological integrity, Estuaries.

AGROCHEMICALS IN BRAZIL: BETWEEN REGULATION, ILLEGALITY, AND THE CHALLENGES OF CONTROL

Daniele de Oliveira Lima^{1*}, Altemir José Mossi², Helen Treichel³

¹Undergraduate student in Environmental Science and Technology, Federal University of Fronteira Sul, Campus Erechim;

²Postgraduate program Environmental Science and Technology, Federal University of Fronteira Sul;

³Laboratory of Microbiology and Bioprocesses, Federal University of Fronteira Sul, Environmental Science and Technology.

*Contact: daniele.dol@estudante.uffs.edu.br

Brazil has consolidated itself as the world's largest consumer of pesticides, driven by the expansion of intensive agriculture since the Green Revolution. This production model, which relies on chemical inputs, has generated productivity gains but also negative consequences, including environmental contamination, risks to human health, and the expansion of the illegal pesticide market, characterized by smuggling, counterfeiting, and irregular use. Historically, regulation evolved from scattered norms, such as Decree No. 24,643/1934, to establishing milestones, including Law No. 7,802/1989 (Pesticide Law) and its subsequent regulation, Decree No. 4,074/2002, which defined the joint role of MAPA, ANVISA, and IBAMA. The 1988 Constitution, by recognizing the fundamental right to an ecologically balanced environment, strengthened the legal basis for controlling these substances. However, recent changes, such as Law No. 14,785/2023, have been criticized for relaxing restrictions, transferring competencies to the Ministry of Agriculture, and reducing the role of environmental and health agencies. Pesticide smuggling represents one of the main current challenges, with consolidated routes along the borders with Paraguay, Uruguay, and Argentina, coordinated by criminal organizations. Despite operations by the Federal Police, Federal Highway Police, and Military Brigade, limitations in personnel, resources, and interinstitutional integration undermine the effectiveness of enforcement. There is also evidence of penal selectivity: small farmers and intermediaries face harsher punishments, while major financiers and beneficiaries often remain unpunished. Given this scenario, it is urgent to rethink the Brazilian agricultural model, encouraging sustainable alternatives such as agroecology, ecological pest management, and the use of bio-inputs. At the same time, it is necessary to strengthen public policies on inspection, invest in intelligence and international cooperation, and promote equitable accountability of the different actors. Only through the integration of technical rigor, social justice, and environmental responsibility will it be possible to mitigate the negative impacts of pesticides and advance toward sustainable agriculture for present and future generations.

Keywords: Environmental legislation, Pesticides, Public policies, Smuggling.

ALKALI-ACTIVATED CEMENT USING AGRO-INDUSTRIAL WASTE: A NEW APPROACH ON THE PRODUCTION OF SUSTAINABLE BINDERS

Arthur Paim Cescon^{1*}, Eduardo Pavan Korf²

¹Architect and urbanist, Master's student in Environmental Science and Technology, University of Federal Fronteira Sul, campus Erechim;

²Environmental Engineer, Doctor in Civil Engineer, University of Federal da Fronteira Sul, campus Erechim, CNPq productivity fellow.

*Contact: arthurpcescon@gmail.com

The construction industry has generated significant environmental impacts, primarily due to the intense exploitation of natural resources and the high CO₂ emissions resulting from the burning of clay and limestone to produce traditional Portland cement (OPC). Furthermore, poor management and improper disposal of solid waste contribute to increased water, soil, and air pollution. In this context, alkali-activated cements (AACs) emerge as an alternative to mitigate the environmental impacts caused by both the OPC manufacturing process and improper waste disposal, by reusing agro-industrial byproducts to produce more sustainable cements. For this work, an alkali-activated cement with a high calcium content system was developed from two agro-industrial residues: Rice Husk Ash (RHA), as a source of aluminosilicate, and Hydrated Oyster Shell Lime (HOSL), as a source of calcium. The selected alkaline activator was sodium hydroxide (NaOH). An experimental program using controllable variables that considered different curing times, RHA/HOSL ratios, and molarities produced alkali-activated binders with good mechanical properties suitable for use as non-structural building blocks, mortars, and coatings. Therefore, this study presented the discovery of a new combination of waste applied to alkali activation, resulting in an alkali-activated cement with potential applications in society and that contributes to sustainable development, promoting the valorization of byproducts and reducing the environmental impacts associated with civil construction.

Keywords: Alkali-Activated Cements, Hydrated Oyster Shell Lime, Portland cement, Rice Husk Ash.

ALTERNATIVE BINDER SYSTEM: PERFORMANCE AND MICROSTRUCTURAL EVOLUTION AFTER SHORT-TERM CURING

William Mateus Kubiaki Levandoski^{1*}, Maria Alice Piovesan², Eduardo Pavan Korf³

¹Environmental and Sanitary Engineer, Master and PhD student in Environmental Science and Technology, Federal University of Fronteira Sul, campus Erechim;

²Environmental and Sanitary Engineer, Master's student in Environmental Science and Technology, Federal University of Fronteira Sul, campus Erechim;

³Doctor in Civil Engineer, Professor/Researcher, Federal University of Fronteira Sul, campus Erechim.

*Contact: williankubi@gmail.com

The environmental impact of Portland cement has driven growing interest in developing sustainable binders with lower carbon footprints. Portland cement production is energy-intensive, emits large amounts of CO₂, and shows durability limitations under aggressive chemical exposure. As a response, alternative binders based on reactive magnesium oxide (MgO) and silica-rich precursors have gained attention due to their ability to form magnesium silicate hydrate (M–S–H) gels, which provide mechanical strength, lower alkalinity, and improved immobilization of heavy metals and sulfates. Rice husk ash (RHA), an abundant agro-industrial waste rich in amorphous silica, represents a promising low-cost source for sustainable binder production while contributing to waste valorization and circular economy practices. In this study, a binder was formulated using MgO, RHA, and sodium hexametaphosphate (SHMP) to evaluate its mechanical performance and microstructural characteristics. The mixture was prepared with an MgO/RHA ratio of 1.5, 2% SHMP, and cured for 7 days. Unconfined compressive strength values ranged between 5 and 6 MPa, considered satisfactory for low to medium demand applications such as filling materials, non-structural blocks, soil stabilization, and waste solidification. Scanning electron microscopy (SEM) revealed a heterogeneous matrix with evident porosity and unreacted particles, and possible early-stage formation of M–S–H gel was observed in localized regions of the matrix. Energy-dispersive spectroscopy (EDS) mapping indicated irregular magnesium, oxygen, and silicon distributions. Despite the lack of full densification, the results confirm the potential of this formulation for practical uses where mechanical resistance is not the primary requirement, but sustainability, waste reuse, and chemical stability are decisive. The MgO/RHA binder demonstrates viability for environmentally oriented applications and represents a relevant step toward reducing dependence on conventional Portland cement.

Keywords: Agro-industrial residues, Magnesium oxide, Rice husk ash, Sodium hexametaphosphate, Waste valorization.

AMINO ACID PROFILE OF TWO SPECIES OF TILAPIA AND POTENTIAL FOR FECAL TRANSMISSION OF *Megalocytivirus pagrus1* (ISKNV SUBTYPE)

Rafael Lopes Faria^{1*}, Gabriele Antunes Santos¹, Maria Rita Conde Simone¹, Erna Elisabeth Bach¹, Maria Letizia Petesse¹, Márcia Helena Braga Catroxo², Ricardo Harakava², Cláudia Maris Ferreira¹

¹Master's degree graduate student, Fisheries Institute, Aquaculture Research Division, São Paulo;

²PhD, Biological Institute - APTA – SAA, São Paulo.

Contact: rafalopesfariaa@gmail.com

Nile tilapia (*Oreochromis niloticus*) and Rendalli tilapia (*Coptodon rendalli*) are intensively farmed fish. In commercial hatcheries, high population densities facilitate the proliferation of pathogens. *Megalocytivirus pagrus1* (ISKNV genotype) is an icosahedral virus that presents clinical signs such as lethargy, melanosis, and ascites, which can lead to the death of animals. The ISKNV genotype represents the infectious spleen and kidney necrosis virus, and little is known about the differences in the metabolic responses of both tilapia species to infection with this pathogen and its potential transmission through feces. Thus, the objective of this study was to analyze both of the above issues. Two experiments were conducted: one to verify the amino acid profile between species when infected with ISKNV, and another to verify the potential for transmission of this virus through feces. Principal Component Analysis (PCA) was used to explain the variability of the observed data through linear combinations of the original variables, and qPCR was used to verify viral load in feces. The results showed changes in the concentrations of arginine and lysine, which were absent in infected species. This means this metabolic pathway is mobilized to combat this viral agent, explaining its decline. In contrast, there was an increase in valine in infected samples, which may be released from the degradation of muscle proteins in response to stress.

Keywords: *Infectious spleen and kidney necrosis virus*, Nile tilapia, Temperature changes.

ANALYSIS OF ASTHMA CARE IN THE YEARS 2023 AND 2024 IN THE MUNICIPALITY OF CAXIAS DO SUL

Eduarda da Rocha Grison^{1*}, Eloize Schütz¹, Manuela Gonçalves Rodrigues², Lennon Gabriel Ribas Severo³, Igor Silva do Amaral⁴, Daiane Bolzan Berlese⁵, Daniela Muller de Quevedo⁵

¹Chiropractic undergraduate student at Feevale University;

²Chemistry Technician, Liberato Salzano Vieira da Cunha Technical School Foundation;

³PhD in Environmental Quality, Feevale University;

⁴Undergraduate in Administration, Uniftec;

⁵Teacher at Feevale University.

*Contact: eduarda.r.grison@gmail.com

Asthma is a chronic inflammatory lung disease that causes the narrowing of the airways, resulting in breathing difficulties, coughing, wheezing, and chest tightness. It can be triggered by various factors such as weather, dust, and other environmental elements. Caxias do Sul is a Brazilian municipality located in the state of Rio Grande do Sul. Situated in the northeastern portion of the state at an altitude of 817 meters, it is the largest city in the Serra Gaúcha region and the second most populous municipality in Rio Grande do Sul, with a population density of 280.4 inhabitants per square kilometer, surpassed only by the state capital, Porto Alegre. This study aims to compare and analyze asthma-related medical visits in the municipality of Caxias do Sul, RS. Data was analyzed from DataSus, based on visits recorded between July and October of 2023 and 2024. In July 2023, there were 21 asthma-related visits; in August, 14; in September, 25; and in October, 26 visits. In 2024, the number of visits was as follows: 16 in July, 25 in August, 22 in September, and 26 in October. It was expected that, in 2024, due to the wildfires in the Amazon and the Cerrado, which were also observed in Rio Grande do Sul, asthma-related visits would increase. However, it is noted that a total of 89 visits occurred in 2024, compared to 86 visits in 2023. While this difference may not be statistically significant, it is important to emphasize the need for prevention and campaigns aimed at mitigating these numbers.

Keywords: Care, DataSus, Pulmonary disease.

ANALYSIS OF LANDSLIDE SUSCEPTIBILITY IN VERANÓPOLIS, RS: A GEOTECHNOLOGICAL APPROACH

Daiana Rodrigues^{1*}, Ana Paula da Cruz Santos¹, Júlio César Ramos¹, Andressa Bassani², Daniela Müller de Quevedo³, Roberta Plangg Riegel⁴, Victória Boes Bauerman⁵

¹Master's student in Environmental Quality, Feevale University, Campus II, FAPERGS scholarship holder;

²Bachelor in Architecture and Urbanism (Unisinos). Project Coordinator for Architecture Projects in municipal schools in the Vale do Sinos/RS region;

³PhD in Water Resources and Environmental Sanitation, Teacher in the Graduate Program in Environmental Quality (PPGQA), Feevale University;

⁴PhD and Master's in Environmental Quality and Bachelor's in Architecture and Urbanism from Feevale University. Faculty Member and Researcher in the Graduate Program in Environmental Quality (PPGQA) at Feevale University;

⁵Bachelor in Psychology (Unisinos), Postgraduate in Public Health with an Emphasis on Family Health (Uninter), and PACF Scholarship Holder (Feevale).

*Contact: daiadaianardg@gmail.com

In 2024, the municipality of Veranópolis, in Rio Grande do Sul, was severely affected by landslides resulting from intense rainfall in the Serra Gaúcha region. A total of 636 events were recorded, placing the city among the most impacted in the state. This study aims to map areas susceptible to mass movements in the municipality, using geotechnologies and spatial analysis. For this purpose, a database was structured with vector data, a digital elevation model (DEM), and thematic maps of land use, slope, geology, and pedology. Each map was reclassified with weights from 1 to 5, indicating degrees of susceptibility (Very Low to Very High). Subsequently, the vector files were converted into raster format, assigning classes directly to pixels. For the hierarchical weighting of variables, the following importance values were attributed: pedology (1), land use (2), geology (6), and slope (10). The overlay of thematic maps was performed using the "Raster Calculator" tool in QGIS, multiplying importance values by the weights of each pixel and the subsequent summation of the results. The results show that approximately 15% of the municipal territory falls into the High and Very High susceptibility classes, especially in areas with steep slopes and expanding urban occupation. These findings highlight the municipality's vulnerability and reinforce geoprocessing as an essential tool for urban planning and risk management. The validation of the model, based on landslide scars mapped in 2024, confirms the reliability of the susceptibility classes. This study aligns with SDGs 11 and 13 of the UN 2030 Agenda by proposing strategies for building safer and more resilient cities.

Keywords: Geoprocessing, Geotechnologies, Mass movements, Susceptibility.

ARE WATER QUALITY GUIDELINES SAFE FOR AQUATIC LIFE? A ZEBRAFISH EMBRYO-LARVAL STUDY WITH WIDELY USED PESTICIDES

Aline Pompermaier^{1*}, Flavia Bernardo Chagas², Paulo A. Hartmann³, Marilia Hartmann³

¹Postdoctoral researcher, Federal University of Fronteira Sul, Campus Erechim;

²PhD student, Federal University of Fronteira Sul, Campus Erechim;

³Professor at Federal University of Fronteira Sul, Campus Erechim.

*Contact: alinepompermaier@yahoo.com.br

The current agricultural model is focused on achieving high productivity to meet the growing global demand for food. To this end, protecting crops from organisms that could hinder their full development is essential. In this context, substances that combat so-called "agricultural pests"—such as insecticides, herbicides, and fungicides—have become allies of the agricultural sector and have been applied on a large scale in recent years. Consequently, residues of these substances are commonly found in surface and groundwater. Aiming to protect the environment and human health, specific regulations have been published both nationally and internationally to establish safe limits for residues of these substances in drinking water. For example, Canada allows 50 $\mu\text{g L}^{-1}$ for Diquat, and Brazil allows 180 $\mu\text{g L}^{-1}$ for tebuconazole. These values are considered safe for human consumption. However, are they safe for aquatic fauna? What about organisms developing under constant exposure to these concentrations? Therefore, we investigated the effects of exposure to two widely used pesticide classes: herbicides, using a commercial diquat-based herbicide, and fungicides, based on azoxystrobin and tebuconazole, on zebrafish embryos and larvae survival. Exposure was conducted for 120 hours, covering the entire period of organogenesis, and we assessed survival rates up to the 7th day of life. Our results demonstrate that the tested substances impaired animal survival. This finding indicates that, even though these concentrations are considered safe for human consumption, they can affect non-target aquatic organisms. This evidence reinforces that regulatory criteria should consider not only human health but also the protection of aquatic biota and the maintenance of ecosystem integrity.

Keywords: Environmental risk assessment, Fish, Pesticides, Survival.

ASSESSMENT OF PM₁₀ CONCENTRATIONS IN ESTEIO, SOUTHERN BRAZIL

Lennon Gabriel Ribas Severo^{1*}, Eduarda da Rocha Grison², Eloize Schütz², Manuela Gonçalves Rodrigues³, Igor Silva do Amaral⁴, Daiane Bolzan Berlese⁵, Daniela Muller de Quevedo⁵

¹PhD in Environmental Quality, Feevale University;

²Chiropractic undergraduate student at Feevale University;

³Chemistry Technician, Liberato Salzano Vieira da Cunha Technical School Foundation;

⁴Undergraduate in Administration, Uniftec;

⁵Professor at Feevale University.

*Contact: lennonribas_lg@hotmail.com

Inhalable particulate matter, known as PM₁₀, is one of the primary atmospheric pollutants impacting human health. Composed of particles with a diameter smaller than 10 micrometers, PM₁₀ can penetrate the respiratory tract and reach the lungs, triggering a range of respiratory and cardiovascular disorders. In municipalities such as Esteio, located in the Metropolitan Region of Porto Alegre, the presence of PM₁₀ in the atmosphere raises significant concern. The proximity to major urban centers, heavily trafficked highways, and industrial activities contributes to the emission of these pollutants. Environmental studies and measurements conducted by regulatory agencies indicate that, during certain periods, PM₁₀ concentrations may exceed the thresholds recommended by the World Health Organization (WHO), which are 15 µg/m³ for annual mean and 45 µg/m³ for 24-hour mean exposure. The objective of this study was to analyze PM₁₀ levels in Esteio from August to December 2024. Data were compiled from the database of FEPAM (State Foundation for Environmental Protection), with monthly averages calculated. In August, PM₁₀ reached 19.71 µg/m³; in September, 11.46 µg/m³; in October, 13.1 µg/m³; in November, 17.59 µg/m³; and in December, 11.75 µg/m³. The months of August and November exceeded WHO-recommended values. It is noteworthy that between August and September, wildfires occurring in the Amazon region and Rio Grande do Sul may have influenced these elevated levels. The analysis of PM₁₀ data in Esteio during the specified period reveals a concerning reality: in two out of the five months evaluated, pollution levels surpassed international health standards. This scenario underscores the urgent need for coordinated actions to monitor and mitigate the effects of air pollution on public health. Public health is intrinsically linked to the quality of the air we breathe. Therefore, strengthening the State's commitment to environmental surveillance and collective health protection is not merely an institutional responsibility—it is an investment in the well-being and quality of life of the population of Rio Grande do Sul.

Keywords: FEPAM, Particulate matter, World Health Organization.

BIOPROSPECTION OF HEAVY METAL BIOREMEDIATOR MICROALGAE

Taís Ribeiro Reis^{1*}, Jéssica Caroline Evangelista Vilhena², Alexandro César Fiorentino³

¹Bolsista, de Iniciação Científica da Universidade Federal do Amapá, campus Macapá;

²Coorientadora, Departamento de Ciências Ambientais - Programa de Pós-Graduação em Ciências Ambientais, Universidade Federal do Amapá;

³Orientador, DCET/Curso de Química, Universidade Federal do Amapá, campus Macapá.

*Contact: tribeiroreis@gmail.com

Actually, the contamination by heavy metals comprises a major environmental problem due to persistence, lack of biodegradability, and the capability for bioaccumulation into trophic webs. Among heavy metals, copper (Cu) could be highlighted due to its ample utilization in agriculture, industry, and mining, and it is frequently found in contaminated water bodies. In this context, the bioremediation with microalgae represents a low-cost, sustainable alternative to traditional, conventional methods. This study aimed to realize the bioprospection of microalgae from the genus *Scenedesmus* sp. present in water bodies in the Amapá state, and to evaluate their bioremediator in relation to copper. Samples were collected in the Macacoari and Pedreira rivers. Algae were isolated in the CHU treatment and cultivated under controlled light and temperature conditions. The cell growth was monitored in Neubauer, and the efficiency of copper removal was determined by Vis spectrophotometry. Results revealed the predominance of *Scenedesmus* sp. in samples, representing about 99% of the isolated units. Concerning the ecotoxicological essay, although elevated copper concentrations ($15 \text{ mg} \cdot \text{L}^{-1}$) had inhibited initial growth, the microalgae presented resilience and adaptation throughout the essay. The spectrophotometric analysis evidenced removal rates from 86% to 95%, with the highest efficiency in the interval between 48 and 72 hours. We concluded that *Scenedesmus* sp. has elevated potential as a bioremediator and bioindicator agent, confirming its applicability in recovering contaminated aquatic environments. It also highlights its importance to the bioprospection of Amazon species for developing clean technologies.

Palavras-chave: Bioremediation, Copper, Heavy metals, Microalgae, *Scenedesmus* sp.

BIRD DIVERSITY AT FEDERAL UNIVERSITY OF FRONTEIRA SUL, ERECHIM CAMPUS, RS

Breno Paiva Magalhães^{1*}, Ellen C. Bronstrup¹, Marília Hartmann², Paulo Afonso Hartmann²

¹Undergraduate student, Biological Sciences – Bachelor's Degree, Federal University of the Southern Frontier (UFFS), Erechim Campus;

²PhD, Professor, Federal University of the Southern Frontier (UFFS), Erechim Campus.

*Contact: brenodpaivam@gmail.com

Birds are among the most diverse groups of vertebrates, acting as important bioindicators of environmental quality. The distribution of Birds is affected by habitat degradation and fragmentation, especially in the Atlantic Forest, one of the most threatened biomes in Brazil. In this context, the present study aimed to estimate the richness, species composition, and spatial distribution of avifauna at the Erechim Campus of the Federal University of Fronteira Sul (UFFS), in southern Brazil. Sampling was carried out between October 2024 and April 2025 in six transects distributed across two areas with different levels of human occupation and vegetation regeneration, using the point count method supported by binoculars, photographic records, audio recordings, and species identification with specialized guides and software. A total of 101 bird species were recorded, belonging to 17 orders and 40 families, representing 14.3% of the avifauna known for Rio Grande do Sul. Passeriformes was the most represented order, with Thraupidae and Tyrannidae standing out as the most numerous families. The Area 2 presented a greatest number of species ($N=84$), diversity index ($H'=4.01$), number of sensitive to environmental disturbances, and exclusive species. The Area 1 concentrated more generalist species associated with anthropized environments. Omnivorous and insectivorous birds predominated, with a broad use of different habitats. The results indicate that even anthropized areas may serve as relevant refuges for bird conservation, especially when they present environmental heterogeneity and forest remnants at different stages of regeneration. It is concluded that the Erechim Campus of UFFS, in addition to contributing to regional bird conservation, also presents potential for environmental education, leisure, and birdwatching activities, reinforcing the importance of maintaining and valuing green areas within modified landscapes.

Keywords: Atlantic Forest, Avifauna, Conservation, Fragmentation.

CHARACTERIZATION OF THE PHYSICOCHEMICAL VARIABLES OF SURFACE WATER IN THE ESTREITO DOS COQUEIROS, IN THE SECTION UNDER DIRECT INFLUENCE OF THE ALUMAR PRIVATE USE TERMINAL (TUP), SÃO LUÍS ISLAND, MA

Filipe França dos Santos Silva^{1*}, Danielle Viana Mendes¹, Scarlleth Patricia Salomão da Silva¹, Alcione Sousa da Silva¹, Larissa Gabrielle Pinheiro Ferreira¹, Felipe Martins Sousa², Ingryd Lorena Batista de Oliveira³, Beatriz Camara Xavier³, Yasmim Gomes Medeiros⁴, Daniella Patrícia Brandão Silveira⁵, Marcelo Henrique Lopes Silva⁶, James Werllen de Jesus Azevedo⁶, Antonio Carlos Leal de Castro⁶

¹Program in Development and Environment, Federal University of Maranhão (UFMA);

²Program in Environmental Science and Technology, Federal University of Maranhão (UFMA);

³Undergraduate Program, Oceanography, Federal University of Maranhão (UFMA);

⁴Undergraduate Program, Veterinary Medicine, Anhanguera College;

⁵PhD, Biotechnology Doctoral Program – RENORBIO, Federal University of Maranhão (UFMA);

⁶Professor, Department of Oceanography, Federal University of Maranhão (UFMA).

*Contact: filipe.franca@discente.ufma.br

Estuaries are among the ecosystems most impacted by human activity, exacerbated by unplanned population growth and inadequate use of water resources. The coastal zone of Maranhão harbors a mosaic of ecosystems of high environmental importance. Still, it is under intense anthropogenic pressure, particularly due to its integration with a port complex comprising the Itaqui, Vale, and Alumar terminals, as well as an industrial district in São Luís. In this context, this study aimed to evaluate the quality of the Estreito dos Coqueiros estuary in an area under the influence of the Alumar Private Use Terminal (TUP), considering the physicochemical variables of surface water across different seasonal periods. Three sampling campaigns were conducted during the rainy, dry, and transition periods to understand how rainfall dynamics affect environmental parameters. Measurements were performed *in situ* using a HANNA probe (model HI 98494), recording temperature, conductivity, pH, salinity, dissolved oxygen, electrical conductivity, and total dissolved solids. Water transparency was determined using a Secchi disk and measuring tape. Results indicated increased transparency during the dry season, attributed to lower sediment loads due to reduced riverine competence. A decreasing gradient of salinity, conductivity, dissolved oxygen, pH, and total dissolved solids was also observed, which is associated with the influx of more saline oceanic waters. These variations highlight the marine influence on estuarine dynamics. The analysis further revealed that estuarine waters are unsuitable for human consumption due to high salinity concentrations, even during the rainy season. However, they are suitable for recreational activities, fishing, and other uses, underscoring the importance of continuous monitoring to support management and conservation strategies for this environment.

Keywords: Environmental impact, Estuary, Seasonality.

CLIMATE CHANGE AND MENTAL HEALTH: AN INTEGRATIVE REVIEW OF ASSOCIATED PSYCHOLOGICAL DISORDERS

Gabriel Max A. Pedrotti^{1*}, Rudimar Risso de Oliveira Junior¹, Bianca Cimarosti¹, Gabriel Henrique Graff¹, Caroline Ciprandi Vieira¹, Guilherme Cruz Simon¹, Fernanda Bolzan Calabria¹, Gabriel Altíssimo Borella¹, João Artur Lucateli Bernardi¹, Thomaz Pereira de Assis¹, Clara Pittol Milani¹, Júlia Tainá Signor Piaia¹, Larissa Kochenborger Behm²

¹Student, University of Passo Fundo, Campus II;

²Professor, University of Passo Fundo, Campus II.

*Contact: 152444@upf.br.

Climate change has emerged as one of the greatest threats to global health, not only in physical terms but also in the psychological domain, contributing to conditions such as anxiety, depression, post-traumatic stress disorder, and feelings of hopelessness among populations exposed to extreme events. Within this context, the objective of this study was to identify and analyze, through a systematic literature review, the main effects of climate change on mental health, as well as to discuss strategies for mitigation and coping. The methodology involved searches in the PubMed and SciELO databases, covering the period from 2014 to 2025, using a combination of controlled descriptors and free terms. A total of 35 articles that met the predefined inclusion criteria were selected. The findings indicate that the psychosocial impacts of climate change are multifactorial and disproportionately affect vulnerable groups, including young people, Indigenous peoples, and low-income communities. These impacts manifest as eco-anxiety, ecological grief, heightened symptoms of post-traumatic stress disorder, depression, and other conditions associated with territorial loss, forced displacement, and socioeconomic insecurity. The discussion highlights that such effects are exacerbated in contexts of structural inequality and limited health system response capacity, reinforcing the need to integrate mental health into public policies for climate adaptation and mitigation, while also considering cultural and community-specificities. In conclusion, the study emphasizes that the climate crisis must be recognized as a social determinant of mental health, requiring interdisciplinary and intersectoral approaches that combine epidemiological surveillance, environmental education, the strengthening of community resilience, and the expansion of access to psychological care services. Such efforts are essential to consolidate mental health as a strategic priority within collective and environmental health agendas.

Keywords: Climate change, Climate stress, Extreme weather events, Environmental anxiety, Mental health.

COMPARATIVE STUDY OF PNEUMONIA CASES IN THE MUNICIPALITY OF CAXIAS DO SUL (JULY TO OCTOBER 2023 AND 2024)

Eduarda da Rocha Grison^{1*}, Eloize Schütz¹, Manuela Gonçalves Rodrigues², Lennon Gabriel Ribas Severo³, Igor Silva do Amaral⁴, Daiane Bolzan Berlese⁵, Daniela Muller de Quevedo⁵

¹Chiropractic undergraduate student at Feevale University;

²Chemistry Technician, Liberato Salzano Vieira da Cunha Technical School Foundation;

³PhD in Environmental Quality, Feevale University;

⁴Undergraduate in Administration, Uniftec;

⁵Professor at Feevale University.

*Contact: eduarda.r.grison@gmail.com

Pneumonia is a disease that affects the lungs and is characterized by inflammation of the air sacs within these organs, known as alveoli. This inflammation can be caused by various agents, including bacteria, viruses, fungi, other microorganisms, and chemical substances. Symptoms include coughing, fever, chest pain, and shortness of breath. In 2022, Caxias do Sul had an estimated population of 463,501 inhabitants and a demographic density of 280.52 inhabitants per square kilometer. Compared with other state municipalities, it ranked 2nd and 22nd out of 497, respectively. This study aims to compare and analyze pneumonia cases in the municipality of Caxias do Sul, Rio Grande do Sul. The data analyzed were obtained and made available by DataSus, covering cases reported between July and October of the years 2023 and 2024. In 2023, 95 pneumonia cases were recorded in July, 77 in August, 86 in September, and 69 in October. In 2024, 72 cases were reported in July, 62 in August, 96 in September, and 94 in October. When comparing the months, a pattern was observed in which the distribution of cases remained relatively similar. Possible factors contributing to the higher number of cases in 2023 (327) compared to 2024 (324) may include the excessive rainfall that occurred in Rio Grande do Sul during that period or, alternatively, wildfires that could also be indirectly associated with this elevated number. It is important to emphasize that, although the data are expressive, further analyses are required to establish potential causal relationships for the elevated incidence. Pneumonia can be fatal if left untreated; therefore, prevention and public awareness are essential to mitigating the severity of the disease.

Keywords: DataSus, Lung infection, Prevention.

COMPARISON OF EFFLUENT TOXICITY BEFORE AND AFTER ELECTROCOAGULATION TREATMENT BASED ON THE *Allium cepa* TEST

Alice da Silva Gonçalves^{1*}, Suzymeire Baroni², Fernando Henrique Borba³

¹Master's student in Environment and Sustainable Technologies, Federal University of Fronteira Sul, campus Cerro Largo;

²PhD in Genetics and Breeding, teacher at the Federal University of Fronteira Sul, campus Cerro Largo;

³PhD in Chemical Engineering, teacher at the Federal University of Fronteira Sul, campus Cerro Largo.

*Contact: alice.goncalves@estudante.uffs.edu.br

The discharge of inadequately treated effluents introduces high loads of organic matter and a range of emerging contaminants into water resources, consequently disrupting aquatic ecosystems. Therefore, this research aimed to use meristematic cells from the *Allium cepa* roots to evaluate the cytotoxicity of an industrial effluent treated both conventionally and with an electrochemical process. The raw and conventionally treated effluent samples were collected and transferred to the effluent analysis laboratory at the Federal University of Fronteira Sul, Cerro Largo Campus. There, they were treated via electrocoagulation (EC) using one pair of iron (Fe) electrodes (EC-Fe) and one pair of aluminum (Al) electrodes (EC-Al) for five minutes. After the treatments, ultraviolet absorbances were measured at a wavelength of 254 nm using a spectrophotometer. Furthermore, for the cytotoxicity tests, *Allium cepa* roots were exposed for 24 hours to a negative control, a positive control, raw effluent, conventionally treated effluent, and effluent treated via EC-Fe and EC-Al. Subsequently, slides were prepared from the root meristematic region. One thousand cells per slide were analyzed using an optical microscope with a 40× objective to determine the mitotic index (MI). A reduction in the absorbance of the EC-treated samples was observed compared to the conventionally treated effluent. This indicates a decrease in organic matter, as this absorbance range is characteristic of organic compounds, such as humic substances. There was a reduction in cytotoxicity with the EC-Fe treatment, with the MI being close to that of the negative control. However, the EC-Al treatment showed a reduced MI. Studies corroborate that the presence of this metal in high concentrations in the environment can induce cytotoxicity and cell death by apoptosis. These findings suggest that electrocoagulation using iron electrodes represents a promising treatment for the tertiary treatment (or final polishing) of industrial effluent.

Keywords: Contamination, Cytotoxicity, Wastewater.

CONNECTIONS BETWEEN ENVIRONMENTAL EDUCATION AND TEXTBOOKS IN BRAZILIAN POSTGRADUATE: A CRITICAL ANALYSIS

Gilmar José Schons^{1*}, Fernanda Schons², Guilherme José Schons²

¹Master's student in Geography, Federal University of Fronteira Sul, campus Chapecó and Erechim;

²Master in Human Sciences, Federal University of Fronteira Sul, campus Erechim.

*Contact: gilmar.schons@estudante.uffs.edu.br

The objective of this study was to examine how research conducted in *stricto sensu* postgraduate programs in Brazil has linked Environmental Education and textbooks. Based on the theoretical framework of Epistemologies of the South, this study examines this topic closely, considering the connections between public policies that impact textbook publishing, namely the *Base Nacional Comum Curricular* (BNCC) and the *Programa Nacional do Livro e do Material Didático* (PNLD). Methodologically, a bibliographic survey was conducted in the *Biblioteca Digital Brasileira de Teses e Dissertações* (BDTD), using the descriptors, in Portuguese, *Educação Ambiental* (Environmental Education) and *Livro Didático* (Textbook). The study allowed us to infer that the eight research projects produced in master's and doctoral programs in Brazil, originating from institutions registered with the BDTD, after the approval of the BNCC (2018), address the connections between Environmental Education and textbooks in a largely superficial and uncritical manner. They disregard their specificities as cultural, editorial, marketing, and pedagogical objects, in addition to neglecting the appropriations of the field by neoliberalism – a facet that is not mentioned in most of the studies analyzed. Finally, discussions surrounding Environmental Education, in the studies mapped, do not encompass problematizations that allow for the connection between colonialism and coloniality and environmental degradation. Thus, the need for research that examines this topic through the critical, sensitive, and decolonial lenses of Epistemologies of the South emerges.

Keywords: Decoloniality, Educational Public Policies, Environment, Epistemologies of the South, Interdisciplinarity.

CONSERVATION OF ORCHIDS AND CHALLENGES IN THE (NON-) IMPLEMENTATION OF SUSTAINABLE DEVELOPMENT GOALS 13 AND 15 IN THE MUNICIPALITY OF NOVO HAMBURGO, SOUTHERN BRAZIL

Anderson Moraes da Silva^{1*}, Vanesca Souto Severo², Delio Endres Júnior³, Annette Droste⁴

¹PhD candidate in the Graduate Program in Environmental Quality, Universidade Feevale;

³PhD in Environmental Quality, Universidade Feevale;

⁴PhD in Genetics and Molecular Biology, Full Professor in the Graduate Program in Environmental Quality, Universidade Feevale.

*Contact: andersonmoraes522@gmail.com

The incorporation of orchids into conservation and environmental restoration programs is of particular relevance, as these species are recognized as bioindicators of environmental quality and play integral roles in key ecological processes such as nutrient cycling and trophic networks. Nonetheless, the conservation of natural resources remains a critical challenge, particularly within metropolitan regions. The protection of threatened species is contingent upon the effectiveness of environmental governance, including policies aligned with the United Nations Sustainable Development Goals (SDGs). This study assessed the implementation of SDG 13 (Climate Action) and SDG 15 (Life on Land) in the municipality of Novo Hamburgo, located in the Metropolitan Region of Porto Alegre in southern Brazil. The analysis focused on two indicators: the percentage of deforested municipal territory (SDG 13) and the extent of conservation units (CUs) (SDG 15). Data were sourced from the Sustainable Cities Development Index (Instituto Cidades Sustentáveis). For SDG 13, the municipality exhibits considerable shortcomings, with 0.44 of its territory classified as deforested (MAPBIOMAS), representing areas of natural vegetation converted to non-vegetated or agricultural land. This figure exceeds the recommended threshold of 0.05. Regarding SDG 15, the municipality also performs poorly, with conservation units covering only 0.02 of the territory (Ministry of the Environment), a figure drastically below the target value of 28.69. These findings indicate substantial loss and fragmentation of natural habitats, exacerbated by insufficient designation of protected areas. The scarcity of conservation units undermines efforts to safeguard native ecosystems and threatens the persistence of endangered species such as orchids, which depend on intact habitats. The data point to systemic weaknesses in environmental policy implementation, impeding progress toward SDG targets and intensifying anthropogenic pressures on biodiversity. This underscores the urgent need for integrated strategies involving sustainable urban planning, forest restoration, and the expansion of conservation units in Novo Hamburgo.

Keywords: Biodiversity conservation, Conservation units, Development index, Environmental policies, Sustainable cities.

CORN YIELD PROJECTIONS UNDER CO-OCCURRENCE OF DROUGHT AND HEAT

Rudimar Risso de Oliveira Junior^{1*}, Noryam Bervian Bispo²

¹Student of Biological Science at IFRS, Campus Sertão;

²Professor at IFRS, Campus Sertão.

*Contact: rudirisso45@gmail.com

Climate is considered the main uncontrollable factor affecting agricultural production, potentially explaining more than 60% of global variations in agricultural productivity. Among climate stressors, drought and heat are the two most important factors affecting corn production. Thermal conditions influence a wide range of plant life processes, from germination to phenological development. Water deficits, on the other hand, affect virtually all aspects of plant development, reducing leaf area, decreasing photosynthesis, and interfering with several other physiological processes. The articles were collected by searching for specific terms in the Web of Science database. The terms were entered following the keywords: "CLIMATE CHANGE" and "FUTURE SCENARIO" and "MAIZE," related to the years 2023 to 2025, which were present in the titles, abstracts, and/or keywords of the papers. A total of 273 articles were included in a word cloud of the main relevant terms. From these documents, a preliminary reading of the titles and abstracts was performed to exclude articles outside the scope of this review, systematize the state of the art, and generate discussions and correlations on the topic of this work, totaling 16 articles. The results obtained from the preliminary search in the Web of Science database were explored using the "Bibliometrix" tool in RStudio® software, version 1.4.1106. This study investigated projected corn yield under CMIP6 warming levels under the SSP scenarios described in the literature between 2023 and 2025. Drought frequency is expected to increase by 11.3% and 13.6%, and droughts will intensify by 5.1% and 7.3% (SSP245 and SSP585, respectively). Temperatures are projected to increase by 0.63-1.90°C, 0.85-2.13°C, and 1.21-2.42°C (SSP245) and 1.42-2.76°C, 1.84-3.07°C, and 2.01-3.57°C (SSP585) in 2030, 2060, and 2090, respectively. In a global scenario, the most vulnerable regions at the end of the 21st century will be Central America, the Mediterranean, South Africa, and the Amazon basin. The conditional probabilities of simultaneous drought will be 84%, 64%, and 37% in France, Mexico, and Brazil, revealing that the co-occurrence of drought and heat affects crop yields. North America will face the highest loss rate, followed by Asia, South America, Europe, Africa, and Oceania. Future corn yield without adaptation to climate stressors was projected to decline by 4.3% in the 2040s (2021–2060) and 56.0% in the 2080s (2061–2100). Furthermore, according to rainfall reductions ranging from 25% to 42%, there is a simulated average reduction of 21, 33, and 50% under warming of 1, 2, and 4°C. In Brazil, the SSP1-RCP2.6 scenario stood out as the most stable, with smaller declines and relative increases of 7.9% (2020–2039), 9.8% (2040–2069), and 4.8% (2070–2100) in the North region; 16.35% (2020–2039), 13.1% (2040–2069), and 14.45% (2070–2100) in the Central region; and 3.6% (2020–2039), 6.3% (2040–2069), and 4.02% (2070–2100) in the South region. As an adaptation strategy, postponing sowing dates, increasing plant density, and architecting root density can provide yields between 97.6% and 25.5% in the 2040s and 2080s.

Keywords: Climate Change, Drought, Maize.

CRIMES AGAINST WILDLIFE IN THE NORTH OF THE STATE OF RIO GRANDE DO SUL, SOUTHERN BRAZIL

Equiton Lorengian Grégio^{1*}, Paulo Afonso Hartmann¹

¹Ecology and Conservation Laboratory, Federal University of Fronteira Sul, UFFS, Erechim, Brazil.

*Contact: equiton.gregio@estudante.uffs.edu.br

Brazil holds one of the world's largest biodiversities but faces intense pressure from wildlife trafficking, which removes millions of individuals from nature each year in Rio Grande do Sul, the northern region emerges as a hotspot for such crimes, given its ecological wealth and the high demand for valuable species on the illegal market. The objective of this study was to analyze the dynamics of crimes against fauna in the northern region of Rio Grande do Sul between 2018 and 2024, discussing patterns of offenses, the most affected species, the profile of offenders, and the effectiveness of the penalties applied. The methodology was based on the analysis of official records from the Environmental Police (Polícia Ambiental da Brigada Militar - PATRAM), including infringement notices, police reports, and inspection reports. The information was systematized in electronic spreadsheets, allowing for quantitative and qualitative analyses of temporal, spatial, biological, and legal variables. The partial results indicate the registration of 203 infringement notices involving 1,683 individuals. Of this total, 1,108 were wild animals (65.8%) and 575 were domestic/exotic animals (34.2%). Within the wild fauna, birds accounted for 1,049 individuals (94.7%), followed by 55 fish (5.0%), and 2 mammals (0.4%). The incidents were concentrated in urban areas (76.4%), and the offenders were predominantly male (86.9%), with recidivism observed in 22.8% of the cases. Article 29 of Law No. 9,605/1998 was the most frequently applied, with fines ranging from R\$ 678.25 to over R\$ 1 million. The results indicate that crimes against fauna primarily impact wild birds, including threatened species. The concentration of infringements in urban areas and the recidivism of offenders reinforce the need to strengthen enforcement and expand environmental awareness.

Keywords: Biodiversity; Environmental enforcement; Environmental legislation.

CURRICULAR CHALLENGES FOR AGROECOLOGY: AN ANALYSIS OF COURSE PEDAGOGICAL PROJECTS IN AGRONOMY

Nycollas Stefanello Vianna^{1*}, Matheus Fernando Mohr², Leandro Carlos Ody³, Helen Treichel⁴, Altemir José Mossi⁵

¹PhD student in Environmental Science and Technology, Federal University of Fronteira Sul, campus Erechim;

²Interdisciplinary Undergraduate Course in Field Education: Natural Sciences – Degree, Federal University of Fronteira Sul, campus Erechim;

³Professional Postgraduate Program in Education (Master's Degree), Federal University of Fronteira Sul, campus Erechim;

⁴Postgraduate program Environmental Science and Technology, Federal University of Fronteira Sul, campus Erechim;

⁵Laboratory of Microbiology and Bioprocesses, Federal University of Fronteira Sul, campus Erechim, Environmental Science and Technology.

*Contact: nycollasvianna@gmail.com

Concern about the environmental and social impacts of conventional agriculture is growing, fuelling discussion about Agroecology as a sustainable alternative. Against this backdrop, this study examined the presence of agroecology in undergraduate agronomy curricula in Brazil, which have been historically shaped by the logic of agribusiness and the Green Revolution. This pilot study analysed the Course Pedagogical Projects (PPCs) of 20 higher education institutions from various regions, and the research will be expanded to include all courses available online in the country at a later stage. The exploratory analysis revealed that, while agroecology is referenced, its inclusion in curricula tends to be peripheral and fragmented. In many cases, it appears as an optional subject, a supplementary topic, or additional reading material, rather than forming a central part of the training. Reference authors in the field, such as Miguel Altieri, Stephen Gliessman, Francisco Caporal, and Ana Maria Primavesi, are often only listed as supplementary reading, which supports the idea that agroecology occupies a secondary position in the curriculum. Furthermore, the research revealed a significant challenge: 42% of the 497 identified agronomy courses do not have their PPCs publicly accessible, which undermines transparency and access to information — a fundamental principle of public management in Brazil. The results highlight the urgent need for a curriculum reform that establishes agroecology as an epistemological, ethical, and political reference point in agronomy courses. This change is crucial if the training of future professionals is to align with social and environmental demands, and if a more just and sustainable agricultural system is to be constructed.

Keywords: Agroecology, Curriculum, Higher education, Sustainability.

DETERMINATION OF ARSENIC AND ZINC IN *SCIADES HERZBERGII* (BLOCH, 1794) FROM THE BACANGA RIVER ESTUARY IN THE METROPOLITAN AREA OF THE BRAZILIAN AMAZON COASTAL ZONE

Larissa Gabrielle Pinheiro Ferreira^{1*}, Ulisses Nascimento Magalhaes², Daniella Patricia Brandão Silveira³, Daniele Viana Mendes³, Scarleth Patricia Salomão da Silva³, Ingryd Lorena Batista de Oliveira³, Marcelo Henrique Lopes Silva²

¹Master in Development and Environment, Federal University of Maranhão;

²PhD Professor, Federal University of Maranhão (UFMA);

³Master's student in Development and Environment, Federal University of Maranhão (UFMA).

*Contact: Lgabriellepinheiro@gmail.com

Estuaries are biodiverse coastal zones vulnerable to pollution. Metals in these areas pose health risks due to bioaccumulation in aquatic life, especially fish, which are important protein sources in developing countries. Monitoring metals in fish muscle helps assess ecosystem health and protect consumers. This study measured metal levels in *Sciades herzbergii* from the Bacanga estuary in the Coastal Amazon. Results showed seasonal variation in metal concentrations, with some exceeding environmental safety limits. Arsenic exceeded the Maximum Tolerance Limit (MTL) of 1.0 mg/kg set by ANVISA in many samples and surpassed FAO limits in several others. Arsenic levels were higher during the dry season, indicating potential public health risks. Arsenic enters aquatic organisms through ingestion and skin absorption, causing harmful effects such as impaired metabolism, reduced growth, and inhibited cellular functions. The fish's diet includes benthic crustaceans that accumulate arsenic, highlighting contamination through the food chain and the need to monitor metals in both water and organisms consumed by fish. Zinc concentrations varied widely within the same season, with some samples exceeding recommended safety limits. While zinc is essential for aquatic life, excessive amounts act as contaminants, causing physiological and morphological harm, including growth delays. High zinc levels can reduce iron absorption, possibly leading to anemia and impaired development in fish. Zinc competes with copper for transport sites, reducing copper absorption in the intestine and decreasing copper availability in the organism. These interactions between zinc and other metals can worsen effects on fish health. These findings emphasize the need for continuous monitoring and control of metal contamination in aquatic ecosystems to protect wildlife and human communities reliant on these resources. In light of this, implementing control measures and environmental policies is essential to ensure water sustainability and public health protection.

Keywords: Aquatic ecosystem, Aquatic pollution, Bioaccumulation, Environmental monitoring, Food safety.

DEVELOPMENT AND CHARACTERIZATION OF A CELLULOSE SLUDGE-BASED HYDROGEL FOR BROMAZEPAM REMOVAL FROM SYNTHETIC EFFLUENTS

Danieli Brandler^{1*}, Bruna da Conceição Marques², Yago Vitório Colares Pinto¹, Gabriela Cristina Perusin Flores², Kauê Câmara Leal de Oliveira², Vitória Bôaventura Midon³, Aluizio Araújo Passos³, Bianca Trindade Oldoni⁴, Eduardo Pavan Korf⁵, Gean Delise Leal Pasquali⁵

¹Master's student, Postgraduate Program in Environmental Science and Technology, Federal University of Fronteira Sul, campus Erechim;

²Undergraduate student, Environmental and Sanitary Engineering, Federal University of Fronteira Sul, campus Erechim;

³Undergraduate student, Biological Sciences, Federal University of Fronteira Sul, campus Erechim;

⁴PhD student, Postgraduate Program in Environmental Science and Technology, Federal University of Fronteira Sul, campus Erechim;

⁵PhD, Postgraduate Program in Environmental Science and Technology, Federal University of Fronteira Sul, campus Erechim.

*Contact: danielibrandler@gmail.com

The presence of pharmaceuticals in effluents is a growing concern, as they pose environmental and human health risks. These compounds, widely used in medicine, are often not fully metabolized by the human body and are subsequently excreted, reaching sewage systems and water bodies. Conventional treatments, based on physicochemical and biological processes, are not fully effective in removing these pollutants, which encourages the search for more sustainable alternatives. In this context, hydrogels have emerged as promising materials due to their highly hydrophilic three-dimensional structure, which enables a high absorption capacity and interaction with specific contaminants. Furthermore, the possibility of synthesizing them from industrial and agricultural residues strengthens their alignment with the principles of the circular economy and the development of environmentally responsible technologies, contributing directly to the achievement of the Sustainable Development Goals (SDGs). Among the potential sources for hydrogel production, sludge from the pulp and paper industry is of particular interest due to its high availability and lignocellulosic composition. This residue contains functional groups such as hydroxyls, carbonyls, and C–O bonds, which favor intermolecular interactions and enhance efficiency in the adsorption of pharmaceuticals. Based on this, the present study aims to develop and characterize a hydrogel derived from pulp sludge for application in the removal of bromazepam from synthetic effluents. For this purpose, the hydrogel was synthesized using sodium alginate and calcium chloride, followed by physicochemical characterization of the material and evaluation of its adsorption capacity for the drug under different experimental conditions. Chemical characterization revealed a high content of organic matter and inorganic compounds, in addition to a point of zero charge at 8.04, suggesting amphoteric behavior and a variable interaction capacity depending on pH. Preliminary assays indicated that the adsorption process occurs in two distinct stages, involving both surface interactions and molecular transport within the polymeric matrix.

Keywords: Adsorption, Circular economy, Pharmaceuticals, Waste valorization, Wastewater treatment.

DEVELOPMENT OF *Physalaemus gracilis* EMBRYOS EXPOSED TO A BIOLARVICIDE

Cristina Bridi^{1,2*}, Jenifer Eduarda Luterek^{1,2}, Flávia Bernardo Chagas^{2,3}, Aline Pompermaier^{2,4}, Paulo Afonso Hartmann^{2,5}, Marilia Hartmann^{2,5}

¹Undergraduate Student in Biological Sciences, Federal University of Fronteira Sul, campus Erechim;

²Laboratory of Ecology and Conservation, Federal University of Fronteira Sul, campus Erechim;

³Doctoral Student in Environmental Science and Technology, Federal University of Fronteira Sul, campus Erechim;

⁴Adjunct Professor, Federal University of Fronteira Sul, campus Erechim;

⁵Full Professor, Federal University of Fronteira Sul, campus Erechim.

*Contact: crisbridi123@gmail.com

Bioinputs are products derived from plants, microorganisms, or algae that aim to enhance agricultural production, either by controlling diseases and pests or by improving soil quality. One of the most widely known and applied bioinputs worldwide is *Bacillus thuringiensis israelensis* (Bti), a bacterium-based biolarvicide. To evaluate the effects of a Bti-based bioinsecticide on the development of *Physalaemus gracilis* embryos. Egg masses of *P. gracilis* were collected (< 24 h post-oviposition) from a pond at UFFS and maintained in distilled water. The bioinsecticide used was VectoBac 12AS, diluted in distilled water and tested at five concentrations: 1.5, 2.5, 5, 10, and 15 µg/L, along with a control group containing only distilled water. Ten embryos (Gosner stage 18–21) were placed in glass containers with 200 mL of each test solution, in quintuplicate, for seven days. At the end of the experiment, 15 embryos from each concentration were weighed using an analytical balance and measured with a digital caliper. Based on these data, the Body Mass Index (BMI) and the Scaled Mass Index (SMI) were calculated. Data analysis was performed using One-Way ANOVA, with p-values < 0.05 considered statistically significant. The BMI of control tadpoles was higher than that of tadpoles exposed to concentrations of 1.5, 2.5, 5, and 10 µg/L ($F_{(6,87)} = 4.663$; $p = 0.0009$), and the SMI of tadpoles exposed to 1.5 µg/L was significantly lower compared to the control ($F_{(6,88)} = 4.469$; $p = 0.0012$). Lower BMI and SMI values in tadpoles indicate impaired physiological condition caused by exposure to Bti, which may compromise survival and performance. Our study demonstrates that VectoBac 12AS is capable of impairing embryonic development, even at concentrations typically used for direct application in aquatic insect control.

Keywords: Amphibians, Bioinsumes, Sustainability.

DIET COMPOSITION OF *Athene cunicularia* BASED ON PELLET ANALYSIS IN NORTHERN RIO GRANDE DO SUL

Ellen Cristina Brönstrup^{1,2*}, Matheus Rubini², Teodoro Companhoni Pasquali², Aluizio Araújo Passos², Jenifer Luterek², Breno Paiva Magalhães², Daniel Galiano²

¹Biological Science Student, Universidade Federal da Fronteira Sul, campus Erechim;

²Ecology and Conservation Laboratory, University of Federal Fronteira Sul, campus Erechim.

*Contact: ellencristinabronstrup@gmail.com

The burrowing owl (*Athene cunicularia*), a nocturnal raptor highly distributed in Brazil, belongs to the order Strigiformes and is often found in anthropomorphized environments. Its generalist diet varies according to food availability, consisting mainly of small vertebrates and arthropods. The analysis of pellets allows us to identify its diet and understand aspects of the species' feeding ecology. The objective of this study is to determine what *Athene cunicularia* feeds on at the Erechim campus of the Federal University of the Southern Frontier, analyzing the frequency of each food item in its diet. Pellets were collected from three active burrows, every two weeks over a year, starting in April 2023 to May 2024. The samples were stored and examined under a stereomicroscope for quantitative analysis of prey remains, and the frequency of occurrence of each type of item was calculated. A total of 8,914 items from the collected pellets were analyzed. Small mammals, represented by bones, were the most frequent items, representing 55.9% of the total, followed by Coleoptera, which accounted for 40.2%. Insects from the orders Hymenoptera, Orthoptera, and Hemiptera were also identified, accounting for 3.3%. To a lesser extent, seeds were observed, equivalent to 0.6%, and polluting materials represented 0.1%. These results indicate that the diet of the burrowing owl is composed mainly of small vertebrates and insects, with occasional occurrence of seeds and evidence of interaction with anthropogenic residues, such as plastic and expanded polystyrene (EPS). The results reinforce that the species presents high dietary plasticity and adaptability to urban environments, exploiting the variety of resources available in its surroundings. Furthermore, the presence of plastic residues in the diet highlights the influence of human activity and reinforces the need for continuous studies on the relationship between wildlife and anthropogenic impacts.

Keywords: Feeding ecology, Invertebrates, Small mammals.

DISTRIBUTION OF *Ocotea puberula* (LAURACEAE) IN THE PHYTOGEOGRAPHIC REGIONS OF RIO GRANDE DO SUL, BRAZIL: AN ANALYSIS BASED ON HERBARIUM RECORDS

Mariana Dal Pizzol^{1*}, Delio Endres Júnior², Jairo Lizandro Schmitt³, Leonardo Airtton Ressel Simões⁴, Annette Droste⁵

¹Bachelor's degree in Biological Sciences, master's student in the Graduate Program in Environmental Quality, Feevale University, FAPERGS fellow;

²PhD in Environmental Quality from Feevale University. Participant in the Program for Scientific Advancement at Feevale University;

³PhD in Botany from the Federal University of Rio Grande do Sul, coordinator of the Master's Program in Environmental Sciences, Federal University of Alagoas;

⁴PhD in Biological Sciences: Physiology from the Federal University of Rio Grande do Sul, postdoctoral researcher in the Graduate Program in Environmental Quality, Feevale University;

⁵PhD in Genetics and Molecular Biology from the Federal University of Rio Grande do Sul, professor in the Graduate Program in Environmental Quality, Feevale University.

*Contact: marianadpizzol@gmail.com

Ocotea puberula (Rich.) Ness is a tree species of Lauraceae, native to Brazil, with a wide geographic distribution, occurring from the Federal District to the state of Rio Grande do Sul. The species has ecological relevance by providing fruits for birds, contributing to the maintenance of disperser fauna and to vegetation recovery, and is widely recommended for restoration projects in degraded areas. This study analyzed the occurrence of *O. puberula* in Rio Grande do Sul based on herbarium records available on the virtual platform *speciesLink*. Duplicate data (same collector, collection year, and site, deposited in different herbaria), and incomplete records (without locality description) were excluded, resulting in 425 valid records from an initial total of 630. The occurrence points were georeferenced according to the municipalities, plotted in Google Earth, and exported as a KML file, overlaid on the map containing the phytogeographic regions and biomes of Rio Grande do Sul, obtained from the Brazilian Institute of Geography and Statistics (IBGE). Occurrences were recorded in 103 municipalities distributed across the phytogeographic regions of the state, with the highest representativeness in Deciduous Seasonal Forest, with 59 municipalities (57.3%), followed by Steppe, with 16 municipalities (15.5%), Semideciduous Seasonal Forest, with 14 municipalities (13.6%), Mixed Ombrophilous Forest, with 9 municipalities (8.7%), and Dense Ombrophilous Forest, with five municipalities (4.9%). These formations are part of the Atlantic Forest and Pampa biomes, occurring in different phytogeographic regions. This occurrence pattern highlights the relevance of *O. puberula* for biodiversity conservation and its potential use in native vegetation restoration.

Keywords: Canela-guaicá, Ecological restoration, Species distribution, Voucher.

DISTRIBUTION OF SEEDLINGS IN GEOGRAPHY EDUCATION

Ricardo Pedro da Silva^{1*}, Helena Paula de Barros Silva²

¹Master's Student in Environmental Science and Technology, University of Pernambuco, Campus Mata Norte;

²Teacher in the Geography Program, University of Pernambuco, Campus Mata Norte.

*Contact: ricardo.pedro@upe.br

Due to the negative environmental impacts on Brazilian forests caused by anthropogenic activities, Brazil loses millions of hectares of native vegetation every year. In view of the need for environmental protection actions, this study aims to contribute to forest conservation through the development of environmental awareness workshops in Geography Education. To this end, after a bibliographic review, seedlings of cashew tree (*Anacardium occidentale*), pink trumpet tree (*Handroanthus impetiginosus*), strawberry, and mulberry were planted in reused food containers, which were distributed during the workshop “Geography and the Environment: Seedling Distribution at the University of Pernambuco,” held at the XVII Geography Week event on the Mata Norte Campus, following discussions on the topic. During the workshop, the importance of planting native species in schools was discussed, the reuse of empty containers for seedling planting was promoted to reduce waste disposal, and the preservation of native species from the Caatinga and Atlantic Forest biomes was supported by distributing pink trumpet tree and cashew tree seedlings. A total of 13 students participated, and 42 seedlings were distributed across the Campus. In light of the above, this work promoted environmental awareness in Geography Education, contributing to the development of pedagogical practices capable of strengthening the protection of native species and reducing deforestation, especially in the Caatinga and Atlantic Forest biomes.

Keywords: Deforestation, Distribution of seedlings, Environmental awareness, Geography education, Workshop.

DOES PHARMACEUTICAL POLLUTION AFFECT THE DEVELOPMENT AND REPRODUCTION OF AMPHIBIANS?

Flávia Bernardo Chagas^{1*}, Aline Pompermaier², Marília Hartmann³

¹PhD student in Environmental Science and Technology, Federal University of Fronteira Sul, campus Erechim;

²Postdoctoral in Environmental Science and Technology, Federal University of Fronteira Sul, campus Erechim;

³Professor at Federal University of Fronteira Sul, campus Erechim.

*Contact: flavia_bio@uffs.edu.br

Pharmaceutical residue contamination of water has become a growing environmental concern, as it can cause toxicological effects on non-target organisms. These compounds are not fully metabolized by organisms and are released into aquatic environments through domestic sewage, effluents from pharmaceutical industries, improper disposal of expired medicines, and veterinary use. Amphibians, especially during their larval stages, are highly sensitive to environmental changes and can therefore serve as bioindicators. Research on this group seeks to understand the biological effects induced by pharmaceuticals, particularly given that amphibian populations are in global decline. In this scientometric review, we searched scientific databases and summarized the main findings on the effects of pharmaceutical pollution on the development and reproduction of amphibians. Our search retrieved 29 articles published between 2015 and 2024, all of which used amphibians under laboratory conditions to assess the toxicological effects of pharmaceuticals. The order Anura was the only one represented among the studies. The data showed that exposure to antibiotics, anti-inflammatories, antidepressants, and antipsychotics affected amphibian growth and development, leading to changes in body size, mass, physical performance, increased mortality, and physiological abnormalities. Reproductive endpoints were also impacted: exposure to contraceptives and anticancer drugs affected sexual differentiation and development, including persistent changes in gene expression. This review highlights the need for further research on different pharmaceutical classes to determine whether they can affect amphibians at environmentally relevant concentrations. In addition, future studies should evaluate the effects of pharmaceuticals under different temperatures, investigate persistent and transgenerational effects, assess reproductive toxicity, and include native species and other amphibian groups. Finally, we emphasize that public programs promoting the rational use of medicines and the development of efficient water treatment technologies are essential to mitigate pharmaceutical contamination of aquatic environments.

Keywords: *Anura*, Bioindicators, Environmental concern, Pharmaceutical residues, Toxicological effects.

EFFECT OF POLYSTYRENE MICROPLASTIC ON THE ESTROUS CYCLE IN SWISS MICE

**Anne Pereira da Silva^{1*}, Albanin Aparecida Mielniczki Pereira¹, Clarice Steffens¹,
Helissara Silveira Diefenthaler², Silvane Souza Roman¹**

¹Ecology Pos-Graduation, Integrated Regional University of Alto Uruguai and Missões, campus Erechim;

²Graduate Program in Food Engineering, Integrated Regional University of Alto Uruguai and Missões, campus Erechim.

*Contact: 095405@aluno.uricer.edu.br

Plastic pollution has become a major global concern, and microplastics (MPs, <5 mm) have been detected in multiple ecosystems and biological systems, raising questions about their effects on mammalian reproduction. This project aims to evaluate the effects of polystyrene microplastic (PS-MP) exposure on the estrous cycle of female Swiss mice, focusing on hormonal cyclicity as a key indicator of reproductive performance. Female mice were exposed orally to PS-MPs at a dose of 0.5 mg/kg/day for 15 consecutive days. Vaginal smears were collected daily and stained for cytological identification of estrous cycle phases, while body weight, water, and food intake were also monitored. Data analysis followed OECD 421 and 422 guidelines for reproductive toxicity assessment. Preliminary findings indicate that PS-MP exposure did not significantly alter the duration of each estrous phase. However, a consistent trend of prolonged estrus and shorter metaestrus and diestrus phases was observed, suggesting a possible estrogenic or endocrine-disrupting effect of polystyrene. This could transiently enhance sexual receptivity and early fertility, potentially masking adverse reproductive effects in later stages. The expected results include a better understanding of how PS-MPs interfere with ovarian cyclicity and fertility markers, contributing to the growing evidence of reproductive risks associated with plastic contaminants. Further analyses of hormone levels and histological evaluations will help determine whether the observed cyclic changes represent temporary physiological adaptation or the onset of chronic reproductive dysfunction. These findings may provide valuable insights into the mechanisms by which environmental microplastics disrupt female reproductive health in mammals.

Keywords: Microplastics, Polystyrene, Reproductive toxicity, Swiss mice.

EFFECT OF THERMAL STRESS ON THE SUSCEPTIBILITY OF TILAPIA ALEVINs (*Oreochromis niloticus*) TO *Megalocytivirus pagrus1* (SUBTYPE ISKNV): AN EXPERIMENTAL STUDY

**Gabriele Antunes dos Santos^{1*}, Rafael Lopes Faria¹, Maria Rita Conde Simone¹,
Guilherme Felicioni¹, Ana Maria Cristina Rebello Pinto da Fonseca Martins², Ricardo
Harakawa², Cláudia Maris Ferreira³**

¹Master's degree graduate student, Fisheries Institute, Aquaculture Research Division, São Paulo;

²PhD, Biological Institute - APTA – SAA, São Paulo;

³PhD, Fisheries Institute, Aquaculture Research Division, São Paulo.

*Contact: gantunessantos@gmail.com

Aquaculture has consolidated itself as a growing practice, promoting the production and consumption of aquatic organisms on a global scale. However, this intensive farming presents significant challenges, including the fight against infectious diseases. These diseases may be associated with management failures or inadequate conditions in fish farms and animal transport, among other factors. The development of studies aimed at understanding the pathogenicity involved, as well as proposing effective control and prevention strategies, is therefore essential. Nile tilapia (*Oreochromis niloticus*), one of the most farmed species worldwide, has been affected by several etiological agents, including viruses belonging to the *Iridoviridae* family, genus *Megalocytivirus*. One of these is *Megalocytivirus pagrus1*, which is the ISKNV genotype and is responsible for high mortality rates and significant economic losses. To understand this disease better, we did two experiments with ISKNV to see how temperature changes affect the susceptibility of fry of this species. The fish were subjected to thermal stress for six hours under two experimental conditions: high temperature (32°C) and low temperature (18°C). The first experiment lasted 14 days, and the second 21 days. Spleen and kidney samples were collected for analysis by conventional/real-time PCR and histological examination. The results showed higher mortality and viral load in fish kept at 18°C, suggesting that low temperature favors viral replication and aggravates infection. In contrast, high temperature seems to have had an attenuating effect on disease progression. These results support the idea that using non-lethal hyperthermia in the early days of an outbreak could be a good emergency way to reduce the impact of infection, even though there are some limits to using it in the field.

Keywords: Infectious spleen and kidney necrosis virus, Nile tilapia, Temperature changes.

EFFECTS OF SEED TREATMENTS ON INITIAL GROWTH AND NUTRITIONAL QUALITY OF BEET MICROGREENS

Claudia Kulba Sette^{1*}, Ana Paula Madaloz¹, Angela Aparecida dos Santos de Almeida²,
Vanessa Neumann Silva³

¹Agronomy student, Federal University of the Fronteira Sul, Campus Chapecó;

²Laboratory technician, Federal University of the Fronteira Sul, Campus Chapecó;

³PhD in Plant Science, Federal University of the Fronteira Sul, Campus Chapecó.

*Contact: claudia.sette@estudante.uffs.edu.br

Indoor horticulture in urban environments has emerged as an innovative and resilient strategy in response to the challenges posed by climate change. This production model enables the growth of vegetables and other food crops with reduced reliance on external factors such as climate, soil conditions, and water availability. In addition to lowering the carbon footprint associated with food transportation logistics, indoor farming enhances urban food security by offering a sustainable alternative in the face of extreme weather events, water scarcity, and environmental degradation. Within this context, microgreen production presents a promising strategy. Among the species suitable for this system, beet (*Beta vulgaris*) stands out due to its high nutritional value and richness in bioactive compounds, antioxidant pigments, and essential vitamins. Seed pre-treatments can influence germination, early growth, and the final quality of the product. Thus, this study aimed to evaluate the effect of different seed treatments on emergence, plant height, and vitamin C content in beet microgreens. The experiment was carried out in a laboratory under controlled conditions, at UFFS campus Chapecó, with seven soaking treatments: T1 (water at 20 °C), T2 (salicylic acid at 20 °C), T3 (ascorbic acid at 20 °C), T4 (water at 25 °C), T5 (salicylic acid at 25 °C), T6 (ascorbic acid at 25 °C), and T7 (no soaking). Seeds were soaked for 48 h and then cultivated in vermiculite under natural light. Vitamin C content was determined using a colorimetric method adapted from Strohecker and Henning (1967), with absorbance read at 520 nm, and results expressed in mg/100 g. Seed emergence was favored by T6 (ascorbic acid at 25 °C), which showed greater vigor and germination uniformity. Regarding plant height, T2 promoted higher initial growth, but the control treatment (T7) reached the greatest values at later stages. For vitamin C, significant differences were observed, with T1 (water at 20 °C) showing the highest concentration (0.053 g/L), while the lowest value was recorded in the control (0.028 g/L). It is concluded that soaking seeds in ascorbic acid at higher temperatures favors seedling emergence, while soaking in water at 20 °C increases vitamin C content. Therefore, the choice of pre-treatment should consider both germinative performance and nutritional quality of beet microgreens.

Keywords: Antioxidants, *Beta vulgaris*, Nutritional quality, Seed germination.

EFFECTS OF TEMPERATURE AND DROUGHT ON SOYBEAN CROPS IN SOUTHERN BRAZIL: A BIBLIOMETRIC REVIEW

Rudimar Risso de Oliveira Junior^{1*}, Noryam Bervian Bispo²

¹Student of Biological Science at IFRS, Campus Sertão;

²Professor at IFRS, Campus Sertão.

*Contact: rudirisso45@gmail.com

Soybean productivity is highly sensitive to climate variability during the growing season. Evaluated a scenario of a 2 °C increase in temperature and a 20% reduction in precipitation (negative effect, water deficit) and a 50% increase in precipitation (positive effect on the reproductive stage) in the northwestern region of southern Brazil, integrating dry, hot, and humid conditions. The results showed that the increase in temperature resulted in shorter growing cycles and an impact of up to 70% on the leaf area index (LAI), while a 50% increase in precipitation increased LAI during the reproductive period, and a 20% reduction in precipitation resulted in water deficit conditions, which impact soil moisture and reduce LAI. The articles were collected by searching for specific terms in the Web of Science database. The terms were entered following the keywords: "HEAT" and "DROUGHT" and "SOYBEAN", and "SOUTHERN OF BRAZIL" related to the years 2015 to 2025, which were present in the titles, abstracts, and/or keywords of the papers. A total of 50 articles were included in a word cloud of the main relevant terms. From these documents, a preliminary reading of the titles and abstracts was performed to exclude articles outside the scope of this review, systematize the state of the art, and generate discussions and correlations on the topic of this work, totaling 5 articles to compose this mini-review. This study systematized bibliographic data on the impacts of drought and heat on soybeans in Rio Grande do Sul between 2015 and 2025. The increase in minimum temperatures, combined with higher CO₂ concentration, may enhance soybean yield potential, although it reduces frost occurrence. Moreira et al. (2023) found that a 2 °C rise increases the frequency of crop cycles, but a 20% reduction in rainfall negatively affects soil moisture and the leaf area index. Reported a significant yield reduction, reaching up to 2000 kg ha⁻¹ losses under a +6 °C scenario. On the other hand, it has been demonstrated that supplemental irrigation increases yield stability, with gains of up to 758 kg ha⁻¹ compared to rainfed systems. Finally, concluded that rising temperatures tend to reduce soybean yields, although management adjustments, such as changes in sowing dates, may mitigate the impacts. The studies analyzed indicate that climate change will have distinct effects on soybean production in southern Brazil.

Keywords: Drought, Heat, Soybean.

ENTEROBACTERIA PROFILE PRESENT AT A MUNICIPAL SOLID WASTE SORTING PLANT

Aline Viancelli^{1*}, Maisa Merlo Collato², Aleandro Evangelista Ramos³, Ana Carolina De Carli³, Ellen da Silva Colli³, Felipe Gabriel Klein³, Lediane Maiara Polli Guiotto³, William Michelin¹

¹Teacher at Master's Program of Engineering, University of Contestado, campus Concórdia;

²Biology student, University of Contestado, campus Concórdia;

³Medical student, University of Contestado, campus Concórdia.

*Contact: alinevbortoli@gmail.com

The growing consumption of products packaged in recyclable materials has increased the volume of municipal solid waste and, consequently, the demand for sorting plants. In these facilities, the presence of organic waste mixed with recyclables exposes workers to microbiological risks. This study aimed to characterize the community of enterobacteria present on different surfaces of a municipal solid waste sorting plant. Ten sampling points were selected, including personal protective equipment (gloves and vests) and surfaces of equipment frequently touched by workers (press buttons, conveyor panel controls, bale elevator levers, and support arms). A total of 28 samples were collected over three campaigns. Samples were analyzed for thermotolerant coliforms using the multiple-tube method and for enterobacteria identification through selective culture and biochemical tests. A total of 23 species of enterobacteria were isolated, distributed across 16 genera. The most frequent species were *Citrobacter freundii* (17.24%), mainly on gloves and vests, and *Klebsiella aerogenes* (13.79%), often detected on support arms of equipment. Four species (*C. freundii*, *Kluyvera ascorbata*, *Salmonella* spp., and *Yokenella regensburgei*) were present in all sampled surfaces, indicating widespread distribution. Several species showed site-specific occurrence, such as *Enterobacter sakazakii* on equipment controls and *Proteus vulgaris* on vests. Except two points, all sampling locations presented concentrations above 10² MPN/cm² of thermotolerant coliforms, confirming high levels of fecal contamination indicators. These findings highlight the potential occupational risks associated with handling contaminated surfaces in waste sorting facilities. Gloves and vests, in particular, were identified as critical points due to their direct contact with workers' hands and potential transfer of pathogens to mucous membranes or food. The results reinforce the need for continuous biosafety training, strict adherence to personal protective equipment protocols, and public awareness regarding the proper separation of recyclable and organic waste to reduce risks at the source.

Keywords: Biosafety, Occupational health, Thermotolerant coliforms.

ENVIRONMENTAL ASSESSMENT OF THE BEACHES ON THE NORTHERN COAST OF SÃO LUÍS, MARANHÃO

Alcione Sousa da Silva^{1*}, Danielle Viana Mendes¹, Filipe França dos Santos Silva¹, Felipe Martins Sousa¹, Ingryd Lorena Batista de Oliveira², Larissa Gabrielle Pinheiro Ferreira¹, Scarlleth Patrícia Salomão da Silva¹

¹Master's student, University of Federal Maranhão, campus São Luís;

²Undergraduate, University of Federal do Maranhão, campus São Luís.

*Contact: alcione.sousa@discente.ufma.br

This research aimed to evaluate the quality of beaches on the north coast of the city of São Luís through environmental indicators in order to contribute to coastal zone management strategies. To this end, a survey was carried out on the administrative and legal management guidelines aimed at the beaches of São Luís, the assessment of environmental quality through the application of the Beach Quality Index (IQP) using the indicators bathing ability, sanitary sewage system, solid waste management, and environmental characterization through the application of the SWOT Matrix (FOFA). The results showed that there is a deficit, with little legislation directed and applied to improve, protect, and improve the quality of the beaches. The application of the Beach Quality Index - IQP, resulted in the classification of beaches on the North Coast as “regular”. Bathing reports indicated worrying results, with 78% of the samples analyzed as unsuitable for recreational use. Coverage of the sanitary sewage and solid waste management systems presented reasonable results. However, the problem of irregular disposal of raw sewage into the environment, illegal connections to rainwater networks, and the vast number of illegal dumps in the region are emblematic issues that require careful attention and urgent action. The IQP proved to be a tool for indicating environmental conditions, being able to form part of an instrument for environmental control and assessments, and to guide the actions to be taken by competent public bodies, in the preservation, improvement, and maintenance of the environmental quality of coastal ecosystems.

Keywords: Beach ecosystems, Environmental indicators, Environmental quality index.

EVALUATION OF INHALABLE PARTICULATE MATTER (PM₁₀) CONCENTRATIONS IN CANOAS, RIO GRANDE DO SUL

Igor Silva do Amaral^{1*}, Eduarda da Rocha Grison², Eloize Schütz³, Manuela Gonçalves Rodrigues³, Lennon Gabriel Ribas Severo⁴, Daiane Bolzan Berlese⁵, Daniela Muller de Quevedo⁵

¹Undergraduate in Administration, Uniftec;

²Chiropractic undergraduate student at Feevale University;

³Chemistry Technician, Liberato Salzano Vieira da Cunha Technical School Foundation;

⁴PhD in Environmental Quality, Feevale University, contact;

⁵Professor at Feevale University contact.

*Contact: igorsilva621@gmail.com

Inhalable particulate matter (PM₁₀) stands out as one of the main pollutants affecting air quality, exerting direct consequences on human health. Consisting of particles smaller than 10 micrometers in diameter, PM₁₀ can easily penetrate the respiratory system, reaching the pulmonary region and contributing to the onset of both respiratory and cardiovascular disorders. Canoas, a key municipality within the Metropolitan Region of Porto Alegre, is marked by high population density, significant economic activity, and intense urban dynamics. With more than 300,000 residents, the city faces considerable public health challenges that demand coordinated interventions and the implementation of effective policies to safeguard adequate living standards. Environmental monitoring carried out by regulatory bodies indicates that, at certain times, atmospheric PM₁₀ concentrations in Canoas surpass the limits set by the World Health Organization (WHO), which establishes a maximum annual average of 15 µg/m³ and a daily exposure limit of 45 µg/m³. This study evaluated PM₁₀ levels in the municipality from August to December 2024, using data provided by the State Foundation for Environmental Protection (FEPAM). The monthly averages observed were: August – 19.53 µg/m³; September – 17.15 µg/m³; October – 16.41 µg/m³; November – 16.57 µg/m³; and December – 11.95 µg/m³. From August through November, all values exceeded WHO recommendations. It is worth noting that wildfires in both the Amazon and Rio Grande do Sul between August and September may have contributed to these elevated concentrations. The findings portray an alarming scenario: in four out of the five months analyzed, pollution levels were above the international benchmarks for health protection. This underscores the urgent necessity of integrated strategies focused on continuous air quality monitoring and the mitigation of pollution-related health risks. The interconnection between environmental quality and public health is undeniable. Consequently, it is imperative that the State reinforces its commitment to environmental oversight and health protection policies. Beyond an institutional duty, such actions constitute a fundamental investment in promoting well-being and enhancing the quality of life of Rio Grande do Sul's population.

Keywords: FEPAM, Human health, World Health Organization.

EVALUATION OF SUMMER WEED CONTROL BY THE ASSOCIATION OF *Trichoderma koningiopsis* BASED BIOCOMPOSITE AND SYNTHETIC HERBICIDE (2,4-D + PICLORAM)

Nair Silveira^{1,3*}, Vinicius Woitysiak², Vitoria Longo¹, Kauê Oliveira¹, Helen Treichel³, Altemir Mossi³

¹Undergraduate in Environmental and Sanitary Engineering, Federal University of the Fronteira Sul, campus Erechim;

²Undergraduate in Agronomy, Federal University of the Fronteira Sul, campus Erechim;

³Agroecology Laboratory and Microbiology and Bioprocesses Laboratory, Federal University of the Fronteira Sul, campus Erechim.

*Contact: nairfreire460@gmail.com

Weeds are one of the greatest challenges in agriculture. To control them, synthetic herbicides such as 2,4-D and Picloram are used. The continuous use of these products causes environmental contamination, health risks, and increased resistance in invasive species. In this context, interest in sustainable alternatives, such as bioinputs, is growing. This study aimed to investigate the biocomposite effect of *T. koningiopsis* on summer weeds and agricultural crops under greenhouse conditions, as well as to evaluate the association of *T. koningiopsis* with the mixture 2,4-D + Picloram. The fungus was cultivated on PDA plates; spores were transferred to a liquid culture medium and incubated at 120 rpm and 28°C for 72 h, followed by evaluation of enzymatic activities. For the greenhouse experiment, 240 pots were used. The experiment tested the interaction of 2,4-D and the mixture 2,4-D + Picloram on soybean (*Glycine max*), amaranth (*Amaranthus spp.*), and milkweed (*Euphorbia heterophylla*), with 10 treatments, including controls, applied after 19 days of growth. The sprays were prepared according to recommended doses, adjusted to 150 mL, following the order: herbicide, water, oil, and fungus. The application was performed using plastic sprayers, maintaining a distance of 15 cm and 7 sprays per pot. Plants were then kept under observation for 15 days. Evaluations began 7 days after application, with two plants removed per pot. Leaf coloration was assessed using Compu Eye software. Data were subjected to ANOVA and Tukey's test for comparison among treatments. In the analysis of enzymatic activities, lipase showed the highest specific activity (347.87 U/mg). In conclusion, although full-dose treatments were more effective, half-dose treatment plus fungus stands out as a more sustainable management strategy, reducing environmental impact without compromising weed control.

Keywords: Bioinput, Fungi, Sustainable management, Summer weeds.

FERMENTATION IN AIRLIFT BIOREACTOR WITH THE FUNGUS *Trichoderma koningiopsis*, EMPHASIS ON THE GENERATION OF BIOCOMPOSITES

Emanuely Fagundes da Silva^{1,3*}, Marcelli Powzum Amorim^{2,3}, Nair Mirely Freire Pinheiro Silveira^{1,3}, Isabely Sandi Baldasso^{1,3}, Vitória Dassoler Longo^{1,3}, Helen Treichel^{1,3}

¹Graduate Program in Environmental and Sanitary Engineering, Federal University of Fronteira Sul, campus Erechim;

²Postgraduate Program in Environmental Science and Technology, Federal University of Fronteira Sul, campus Erechim;

³Laboratory of Microbiology and Bioprocess, Federal University of Fronteira Sul, campus Erechim.

*Contact: emanuelyfagundesdasilva@gmail.com

Microalgae have the potential to remove pollutants and accumulate enzyme-rich biomass. In this study, enzymatic activities were investigated through fermentation in an Airlift bioreactor, yielding fungal biocomposites from microalgae derived from wastewater treatment. To avoid photoinhibition and stimulate diversity, the microalgae were cultivated at 28°C, under an average light intensity of 914.48 $\mu\text{mol m}^{-2} \text{s}^{-1}$, with 50% blocking of natural radiation, in a 50L transparent tank containing pretreated sewage from a UASB reactor and 5L of native microalgae inoculum from the Candeia station, Bauru, São Paulo. The fungus *Trichoderma koningiopsis* was cultivated in PDA medium, subcultured, and maintained in a BOD incubator at 28°C for 7 days. Fermentation occurred in a sterile 3L Airlift bioreactor containing 11.06g of microalgae in distilled water and 16mL of antifoam, totaling 2 L, for 72 h at 28°C, with an inoculum rate of 10 spores/mL. Twenty-mL samples were collected every 24h, filtered, centrifuged, and stored for enzymatic analysis. Cellulase, amylase, peroxidase, laccase, lipase, protease, catalase, ascorbate peroxidase, superoxide dismutase, and tannase were quantified. Laccase and catalase showed no activity. Protease started at 119.44 mL, lipase at 0.90 U/mL, both with progressive declines; superoxide dismutase started at 11.01 U/mL and also declined over time. Cellulase, a characteristic of *Trichoderma*, ranged from 0.061 U/mL at baseline to 0.969 U/mL at 24 hours, and then disappeared by 48 hours. Amylase reached 60.83 U/mL, ascorbate peroxidase 2.9 U/mL, and peroxidase 3.05 U/mL at 48 hours. The fungal biocomposites obtained from wastewater via fermentation of *Trichoderma koningiopsis* in an Airlift bioreactor demonstrated viability and potential in biotechnological and environmental processes, highlighting their cellulolytic activity in biomass degradation and the generation of value-added products.

Keywords: Biocomposites, Enzymes, Microalgae, *Trichoderma koningiopsis*, Wastewater.

FERMENTATION IN BIOREACTOR FOR THE PRODUCTION OF BIOCOMPOSITES

Vitória Dassoler Longo^{1,3*}, Marcelli Powzum Amorim^{2,3}, Nair Mirely Freire Pinheiro Silveira^{1,3}, Isabely Sandi Baldasso^{1,3}, Emanuely Fagundes da Silva^{1,3}, Helen Treichel^{1,3}

¹Graduate Program in Environmental and Sanitary Engineering, Federal University of Fronteira Sul, campus Erechim;

²Postgraduate Program in Environmental Science and Technology, Federal University of Fronteira Sul, campus Erechim;

³Laboratory of Microbiology and Bioprocess, Federal University of Fronteira Sul, campus Erechim.

*Contact: vitorialongo22@gmail.com

The growing demand for environmentally sustainable technologies and products has driven the development and adoption of biocomposites and alternative biomasses. In this context, microalgae stand out due to their high carbohydrate content, which, upon hydrolysis, releases sugars that can be readily utilized in fermentation processes. This study aimed to optimize the enzymatic hydrolysis of microalgal biomass, using yeast from the brewing industry as a low-cost alternative. The assays were prepared in 0.2 M sodium phosphate buffer (pH 5.5), frozen at -80 °C for 24 hours, and then kept at 4 °C for an additional 24 hours. They were subsequently subjected to a thermostatic water bath at 100 °C for 10 minutes to promote gelatinization and break down carbohydrate chains. After this pretreatment, enzymes were added according to the Central Composite Rotational Design, and the mixture was kept under agitation for 1 hour. The pH of the wort was then adjusted, and fermentation was initiated with the inoculation of *Wickerhamomyces* sp. yeast. The experiments were conducted at 30 °C and 120 RPM for 48 hours, with samples collected at 0, 12, 24, and 48 hours to quantify total reducing sugars and other compounds. The results showed the production of various metabolites of industrial interest, such as glycerol and acetic acid, both of which have wide applications and high economic value, highlighting microalgal biomass as a promising and cost-effective alternative.

Keywords: Biotechnology, Enzyme, Fermentation, Microalgae, Optimization.

FORMATION OF CRITICAL CITIZENS IN THE FACE OF ENVIRONMENTAL CHANGES IN THE BRAZILIAN SCHOOL CONTEXT

Nycollas Stefanello Vianna^{1*}, Gerônimo Rodrigues Prado¹, Alexandre Hüller¹

¹PhD student in Environmental Science and Technology, Federal University of Fronteira Sul, campus Erechim.

*Contact: nycollasvianna@gmail.com

Climate change is one of the greatest global challenges of our time, and its inclusion in Brazilian basic education represents a fundamental opportunity to educate critical and conscious citizens. This paper presents a systematic review that sought to identify how the topic has been addressed in scientific literature over the last ten years (2015–2025), with an emphasis on the relationship between climate change, Brazil, and basic education. The Scopus, Web of Science, and SciELO databases were consulted, considering articles and reviews. Twenty-eight studies were found, and the results show that, despite growing interest, production is still limited and scattered. Empirical studies reveal that elementary school children, especially in Amazonian and riverside contexts, recognize environmental impacts but have significant conceptual gaps, reinforcing the need for contextualized approaches. Research analyzing the National Common Core Curriculum (BNCC) identifies the inclusion of the topic in a cross-cutting manner, highlighting the use of playful strategies, such as games, and interdisciplinary methodologies (Science-Technology-Society) as tools to engage students. Recent systematic reviews indicate that climate literacy in Brazil remains below expectations, with a predominance of content-based practices and little focus on active methodologies. Other studies emphasize the relevance of education for adaptation, especially about child health and the reduction of socio-environmental vulnerabilities. International documents, such as UNESCO's educational profiles, reinforce that, despite national guidelines, the implementation of educational actions related to climate change occurs unevenly across regions and school networks. It can be concluded that climate education in Brazil still faces significant challenges, but also has potential, mainly when it mobilizes dialogue between scientific, academic, traditional, and community knowledge. Expanding these initiatives is essential for training individuals capable of facing the “irreversible times” ahead.

Keywords: Active methodologies, Environmental education, Scientific literacy.

FROM TRADITIONAL TO SUSTAINABLE: TECHNICAL AND ENVIRONMENTAL FEASIBILITY OF TRENCHLESS METHODS IN URBAN INFRASTRUCTURE

Camila Escaramusa Vaz^{1*}, Aline Raquel Müller Tones², Alcione Aparecida Almeida Alves²

¹Master's Student, Graduate Program in Environment and Sustainable Technologies, Federal University of Fronteira Sul, campus Cerro Largo;

²PhD, Teacher Graduate Program in Environment and Sustainable Technologies, Federal University of Fronteira Sul, campus Cerro Largo.

*Contact: camilaescaramusa@gmail.com

The expansion of urban infrastructure, essential for development, generates potentially negative environmental effects, especially in sanitation works. The traditional trench excavation method (Destructive Method - DM) leads to adverse effects, such as high material consumption, waste generation, pollutant emissions, and traffic disruption. In this context, trenchless methods (TM) emerge as a promising alternative to mitigate these effects. This study aimed to analyze and compare the environmental impacts of DM and TM in infrastructure works, focusing on CO₂ emissions, material consumption, and solid waste generation, considering scenarios of irregular stone pavement and asphalt paving. The methodology consisted of quantifying and comparing these indicators for both methods. The results demonstrated the environmental superiority of TM. In CO₂ emissions, there was a reduction of over 80% compared to DM, due to the rationalization of equipment use and the minimization of excavations. Regarding material consumption and waste generation, the TM showed significant reductions of over 90% in the use of sand, clayey soil, and crushed stone, with the complete elimination of sub-bases in the repaving preparation. The amount of solid waste decreased by 92% in stone pavement and was completely eliminated in asphalt pavement. The discussion indicates that, in addition to the identified environmental gains, TM reduces interference in urban traffic and inconvenience to the population, as the installation occurs predominantly on sidewalks. It is therefore considered that TM is validated as an efficient technical alternative, economically viable and socially responsible, promoting more sustainable practices in civil construction and aligning with the objectives of urban development with lower environmental impact.

Keywords: Basic sanitation, Trench excavation, Underground networks.

GENOTOXIC POTENTIAL OF ZOLPIDEM IN Nile tilapia (*Oreochromis niloticus*) FINGERLINGS

Guilherme Felicioni^{1*}, Maria Rita Conde Simone¹, Erna Elisabeth Bach², Claudia Máris Ferreira³

¹Master's degree graduate student, Fisheries Institute, Aquaculture Research Division, São Paulo;

²Doctor, Biological Institute - APTA – SAA, São Paulo;

³Doctor, Fisheries Institute, Aquaculture Research Division, São Paulo.

*Contact: guifelicioni@gmail.com

The recent increase in drug concentrations in surface waters is concerning. When discarded, they can negatively affect local fauna and cause irreparable damage to DNA. One of these drugs is zolpidem hemitartrate (HZ), a sedative-hypnotic drug that causes decreased excitability of neuronal cells. This study aimed to evaluate the genotoxicity potential of HZ on Nile tilapia (*Oreochromis niloticus*) fry using the micronucleus test. Fry weighing 6.05 ± 0.08 g were placed in aquariums at a density of 1.5L per individual with constant aeration and a 12-hour photoperiod. Before the start of the test, blood was collected from five individuals (0h). The animals were divided into four groups with two replicates each: negative control (C-), positive control (C+ - 8µg/L formaldehyde), and two intoxicated groups (E1-30µg/L and E2-800µg/L HZ). The test was semi-static with a duration of 96h. At the end of the experiment, two animals from each treatment were sampled for micronucleus analysis. The slides were stained using the Feulgen/Fast Green technique, and 1000 erythrocytes/organism were analyzed. Statistical analysis was performed using GraphPad software. The results indicated no significant difference between C- and 0h ($p > 0.05$). C- was different from C+ and E2 ($p = 0.03$). This indicates that the highest concentration of HZ tested was as toxic as C+ to fish. This concentration is found in the urine of users treated with the drug and can reach surface waters. Although studies indicate that HZ has a low risk of environmental hazard in acute tests, further investigation of its long-term effects is recommended.

Keywords: Environmental contamination, Ecotoxicology, Residual drugs.

HIGH-DENSITY PLANTING AND TWO-DIMENSIONAL TRAINING IN ‘RUBIMEL’ PEACH TREES: IMPACT ON YIELD OVER TWO SEASONS

Thiago Vinicius Rech^{1*}, Vanderlei Smaniotto², Edson da Silva¹, Moisés de Abreu Barbosa³, Caroline Silva Freitas³, Jhonatan Marcante³, Sabrina Tolloti Peruzzo⁵, Clevison Luiz Giacobbo⁴

¹Master’s student, Graduate Program in Environmental Science and Technology, Federal University of Fronteira Sul, campus Erechim;

²Doctoral student, Graduate Program in Environmental Science and Technology, Federal University of Fronteira Sul, campus Erechim;

³Agronomy undergraduate student, Federal University of Fronteira Sul, campus Chapecó;

⁴Professor Program in Environmental Science and Technology, Federal University of Fronteira Sul, campus Chapecó;

⁵Professor CESURG.

*Contact: thiagorech37@gmail.com

Intensification of peach orchards through more efficient, two-dimensional training arrangements has been proposed to increase area-based yield without expanding the cultivated surface. This study evaluated the production of ‘Rubimel’ across two seasons (2023/24 and 2024/25), comparing seven training systems with system-specific spacing: open vase, “Y”, central leader, double, triple, and quadruple leader, and Guyot. The experiment was conducted in the UFFS/Chapecó experimental orchard using a randomized complete block design (7 treatments × 3 replications); plots contained six trees, with the four central trees used as experimental units under standardized management. We quantified the number of fruits and yield per plant (kg plant⁻¹); yield per area (t ha⁻¹) was estimated from planting density. A strong season effect was observed, with an overall increase in 2024/25. In the first year, the triple- and quadruple-leader systems showed the highest per-plant production, whereas open vase and Guyot were lower; in the second year, Guyot stood out, followed by triple and quadruple leader, while open vase, “Y,” and central leader maintained the lowest performance. The stability of the central leader across years suggests lower responsiveness, and the high coefficient of variation indicates heterogeneity among plants. In summary, more efficient, high-density arrangements tend to maximize per-plant yield and, especially, yield per unit area, enabling greater production within a smaller cultivated area. We conclude that systems such as Guyot and multi-leader forms are promising for the sustainable intensification of ‘Rubimel’.

Keywords: Canopy architecture, High-density planting, Two-dimensional training, Yield per hectare.

HOSPITALIZATIONS FOR ASTHMA IN THE MUNICIPALITY OF NOVO HAMBURGO-RS BETWEEN JULY AND OCTOBER OF 2023 AND 2024

Eloize Schütz^{1*}, Eduarda da Rocha Grison^{1*}, Manuela Gonçalves Rodrigues², Lennon Gabriel Ribas Severo³, Igor Silva do Amaral⁴, Daiane Bolzan Berlese⁵, Daniela Muller de Quevedo⁵

¹Chiropractic undergraduate student at Feevale University;

²Chemistry Technician, Liberato Salzano Vieira da Cunha Technical School Foundation;

³PhD in Environmental Quality, Feevale University;

⁴Undergraduate in Administration, Uniftec;

⁵Teacher at Feevale University.

*Contact: eloize__schutz@hotmail.com

Asthma is a chronic disease characterized by inflammation and narrowing of the airways, presenting with symptoms such as shortness of breath, wheezing, and coughing. Its occurrence may be influenced by genetic and environmental factors, including dust, mites, fungi, and air pollution. Novo Hamburgo, in the state of Rio Grande do Sul, has a structured healthcare network to serve its population of approximately 250,000 inhabitants. The municipality includes reference hospitals, such as the Municipal Hospital, Hospital Regina, and Unimed Hospital, in addition to primary healthcare units distributed across neighborhoods. The objective of this study was to compare and analyze Hospital Admission Authorizations (AIH) for asthma approved in Novo Hamburgo-RS, located in the Vale dos Sinos region, during the periods from July to October in 2023 and 2024. Data were obtained from the DataSUS system, considering hospital admissions recorded within these intervals. In 2023, a total of 79 AIHs for asthma were registered, distributed as follows: 14 in July, 24 in August, 22 in September, and 19 in October. In the same period of 2024, a reduction to 47 AIHs was observed, with 5 in July, 15 in August, 12 in September, and 8 in October. Despite the forest fires in the Amazon in 2024, which affected air quality in several Brazilian states, a higher number of hospitalizations was recorded in the previous year. This result suggests that local factors, such as climatic conditions, environmental exposures, and household risk factors, may have played a relevant role in the worsening of cases in 2023. It is concluded that there was a significant reduction in asthma-related hospitalizations in 2024 compared to 2023, underscoring the importance of preventive measures and health surveillance to minimize asthma exacerbations and associated healthcare costs.

Keywords: DataSUS, Public health, Respiratory disease.

HOSPITALIZATIONS FOR DENGUE IN NOVO HAMBURGO, RS, BETWEEN APRIL AND JUNE OF 2023 AND 2024 AND THEIR RELATIONSHIP WITH CLIMATIC EVENTS

Eloize Schütz^{1*}, Eduarda da Rocha Grison¹, Manuela Gonçalves Rodrigues², Lennon Gabriel Ribas Severo³, Igor Silva do Amaral⁴, Daiane Bolzan Berlese⁵, Daniela Muller de Quevedo⁵

¹Chiropractic undergraduate student at Feevale University;

²Chemistry Technician, Liberato Salzano Vieira da Cunha Technical School Foundation;

³PhD in Environmental Quality, Feevale University;

⁴Undergraduate in Administration, Uniftec;

⁵Teacher at Feevale University.

*Contact: eloize__schutz@hotmail.com

Dengue is an arboviral disease caused by the dengue virus, transmitted by the mosquito *Aedes aegypti*, whose incidence is directly related to environmental factors such as heavy rainfall and high temperatures, which favor vector proliferation. Located in Rio Grande do Sul, the municipality of Novo Hamburgo has an organized healthcare network serving approximately 250,000 residents. Its main services include reference hospitals — such as the Municipal Hospital, Hospital Regina, and Unimed Hospital — as well as several primary healthcare units distributed across neighborhoods. The aim of this study was to compare and analyze hospital admissions due to dengue in Novo Hamburgo-RS, situated in the Vale dos Sinos region, during the periods from April to June in 2023 and 2024. Data were obtained from the DataSUS system, considering the number of Hospital Admission Authorizations (AIH) approved for the disease in the municipality. In 2023, 22 hospitalizations for dengue were recorded, with 7 in April, 8 in May, and 7 in June. In 2024, the number was substantially higher, with 79 admissions, distributed as 52 in April, 23 in May, and 4 in June. Therefore, a significant increase was observed in April and May 2024 compared to the previous year, a period that coincided with a severe dengue epidemic in the state and the historic May flood, which contributed to environmental and sanitary changes. It is concluded that the variation in hospitalizations may be related both to increased viral circulation and to the atypical climatic and environmental conditions experienced in 2024. The findings highlight the importance of surveillance measures, prevention, and vector control to reduce the impact of the disease during periods of greater environmental vulnerability.

Keywords: *Aedes aegypti*, DataSUS, Heavy rainfall.

IDENTIFICATION OF CRITICAL POINTS IN METHODOLOGY USED FOR MICROPLASTIC CONTAMINATION IN AQUATIC ORGANISMS

Daniella Patrícia Brandão Silveira^{1*}, Scarlleth Patrícia Salomão da Silva², Danielle de Jesus Silva², Filipe França dos Santos Silva², Danielle Viana Mendes², Larissa Gabrielle Pinheiro Ferreira², Ingrid Lorena Batista de Oliveira³, Carmem Lucia de Sousa Mendes⁴, James Werllen de Jesus Azevedo⁵, Antonio Carlos Leal de Castro⁵, Marcelo Henrique Lopes Silva⁵

¹PhD, Biotechnology Doctoral Program – RENORBIO, Federal University of Maranhão (UFMA);

²Program in Development and Environment, Federal University of Maranhão (UFMA);

³Undergraduate Program, Oceanography, Federal University of Maranhão (UFMA);

⁴Technician at the Federal University of Maranhão (UFMA);

⁵Teacher, Department of Oceanography, Federal University of Maranhão (UFMA).

*Contact: daniella.silveira@ufma.br

Given the current environmental challenges and the entire scenario of water bodies contamination, studies on microplastics (MP) have been widely conducted in the most diverse environments, substrates, and organisms. Considering the ease with which these particles reach environments and easily diffuse in the air and on surfaces, the need arose to identify critical points during the methodological process that could overestimate the results associated with the object of study in question. In an attempt to make the data found for analysis in aquatic organisms reliable and without contamination arising from the methodological process, strategies were developed to mitigate external sources of MP contamination. Some recommendations were maintained, such as using light-colored cotton clothing and cotton lab coats during sample processing. Several critical points were identified: a) the analysis of new filters under an optical microscope showed contamination by MP in the form of fibers and fragments; 12% of the analyzed filters contained MP; b) The methodology that includes washing filters with ultrapure water is inefficient in cleaning MP and further contaminates the filters; approximately 85% of the washed filters showed MP; c) The blanks of the filtration process consistently showed the presence of MP, which was associated with the use of air conditioning directed toward the filtration area, the washing of glassware with unfiltered distilled water, and the solution used for organism digestion being not pre-filtered. The main solutions consisted of eliminating the critical points associated with external contamination, thus avoiding the overestimation of contaminants associated with the research samples. The research results obtained after this study and the application of the developed methods ensure greater reliability in the contamination data of the studied samples.

Keywords: Methodological bias, Methodological process, Plastic, Pollutants.

IMMUNE RESPONSE OF *APLASTODISCUS PERVIRIDIS* TADPOLES IN DIFFERENT ENVIRONMENTS OF THE NATURAL PARK OF SERTÃO, RS

Jenifer E. Luterek^{1,2*}, Caio E. M. Bagnolo², Valentina W. Prigol², Ellen C. Brönstrup², Teodoro C. Pasquali², Aluizio A. Passos², Aline Pompermaier², Flávia B. Chagas², Paulo A. Hartmann², Marília Hartmann²

¹Biological Science Student, Federal University of Fronteira Sul, Campus Erechim;

²Laboratory of Ecology and Conservation, Federal University of Fronteira Sul, Erechim, RS.

*Contact: luterekjenifer@gmail.com

Amphibians are undergoing a global decline due to multiple stressors, including habitat fragmentation and water contamination. The Natural Park of Sertão (NPS), a forest remnant in northern Rio Grande do Sul State surrounded by an agricultural matrix, hosts a diverse assemblage of amphibian species. Among them, *Aplastodiscus perviridis*, a stream-breeding species, provides a suitable model to assess the influence of environmental factors on tadpole development and survival. This study aimed to evaluate the immune response of *A. perviridis* tadpoles by quantifying leukocyte counts across different environments in the NPS. Fifteen tadpoles were collected from streams in the buffer, edge, and core areas. A blood drop was obtained from each individual, and smears were prepared and stained using a rapid Panoptic kit. For each tadpole, 100 leukocytes were counted and classified as lymphocytes, basophils, eosinophils, monocytes, or neutrophils. Significant differences were observed only for lymphocytes and basophils. Lymphocyte counts were lower in the buffer than in the core ($F_{(2,42)} = 3.08$, $p < 0.05$), while basophils were higher in the buffer compared to both the edge and core ($F_{(2,24)} = 4.53$, $p < 0.05$). Leukocytes are key mediators of the immune response, and shifts in their abundance often reflect exposure to pathogens or toxic compounds. In this study, the reduced lymphocyte counts observed in the buffer zone may be indicative of stress associated with environmental disturbances. At the same time, the elevated numbers of basophils are consistent with chronic inflammatory responses or allergic reactions. Together, these findings suggest that stressors present in the buffer zone of the NPS are influencing the immune system of *A. perviridis* tadpoles, potentially compromising the overall health and resilience of this species.

Keywords: Anurans, Conservation, Immunotoxicology.

IMPACT OF BURNING ON THE INCIDENCE OF PULMONARY EMPHYSEMA IN BAGÉ, RIO GRANDE DO SUL

Manuela Gonçalves Rodrigues^{1*}, Eduarda da Rocha Grison², Eloize Schütz², Lennon Gabriel Ribas Severo³, Igor Silva do Amaral⁴, Daiane Bolzan Berlese⁵, Daniela Muller de Quevedo⁵

¹Chemistry Technician, Liberato Salzano Vieira da Cunha Technical School Foundation;

²Chiropractic undergraduate student at Feevale University;

³PhD in Environmental Quality, Feevale University;

⁴Undergraduate in Administration, Uniftec;

⁵Professor at Feevale University.

*Contact: Fale@feevale.br

Pulmonary emphysema is a chronic and progressive condition that compromises people's respiratory capacity by directly affecting the lungs. Genetic predisposition is a factor that contributes to an individual's increased vulnerability to the disease, but the main cause remains smoking and exposure to irritants such as smoke, air pollutants, dust, and chemicals. The data analyzed was obtained from DataSus based on records from July of the years 2022, 2023, and 2024. This study aims to compare and analyze data from medical consultations related to pulmonary emphysema in the municipality of Bagé. In July 2024, in Bagé, there was a significant increase in cases of pulmonary emphysema, about 3,000% more than in July 2023 and 11,000% more than in July 2022, according to DATASUS. This significant increase coincides with the burning season in Rio Grande do Sul, which releases large amounts of smoke and toxic gases into the air. With this in mind, it is possible to say that continuous inhalation of these substances can aggravate cases of pulmonary emphysema or trigger the condition in people with a genetic predisposition, contributing to an increase in the number of cases related to this disease in the Bagé region. Research studies such as this one are extremely important for the management of public policies for disease prevention and for the allocation of public spending, aiming to reduce the worsening of conditions such as this in places that suffer from fires and, thus, improving the health of the Brazilian population.

Keywords: Air pollution, Pulmonary emphysema, Smoking.

IMPACT OF WATER REGIMES AND SULFENTRAZONE DOSES ON THE CONTROL OF *Urochloa plantaginea*

Rodrigo José Tonin^{1*}, Daiani Brandler², Michelangelo Muzell Trezzi², Hugo Von Linsingen Piazzetta¹, Leandro Galon¹

¹Federal University of the Southern Frontier, Erechim, RS, Brazil;

²Federal Technological University of Paraná, Pato Branco, PR, Brazil.

*Contact: rodrigo.tonin@uffs.edu.br

The climate has a direct influence on agricultural productivity, with water availability being one of the most critical factors, especially in scenarios of extreme weather events. In this context, the objective of this study was to evaluate the control of alexandergrass (*Urochloa plantaginea*) subjected to different doses of the herbicide sulfentrazone in sandy and clayey soils, conducted under different water regimes. The experiment was conducted in a randomized block design, in a $4 \times 2 \times 3$ factorial scheme, with four replicates, testing four doses of sulfentrazone (0, 200, 400, and 600 g a.i. ha⁻¹), two soil types (sandy and clayey), and three water regimes (50, 80, and 100% of field capacity, θ_{CC}). Control assessments were performed 7, 14, and 21 days after application (DAA), with percentage scores ranging from 0% (no control) to 100% (plant death). Treatment means were compared using Tukey's test ($p \leq 0.05$). In sandy soil, doses of 400 and 600 g a.i. ha⁻¹ provided 100% control at all evaluation times. The dose of 200 g a.i. ha⁻¹ showed a response dependent on soil moisture at 7 DAA, with an increase in control as the moisture content increased, reaching 89.5% in the 50% θ_{CC} regime. In clay soil, there was no significant difference between the doses of 400 and 600 g a.i. ha⁻¹ at all times, while the dose of 200 g a.i. ha⁻¹ resulted in control close to 90% for moisture contents of 50 and 80% θ_{CC} at 7 DAA and 50% θ_{CC} at 14 DAA. The results demonstrate the efficiency of the herbicide sulfentrazone in controlling *U. plantaginea*, and that this control is influenced by the dose applied, soil texture, and water availability.

Keywords: Alexandergrass, Soil herbicide, Soil texture, Water availability.

IMPACTS OF AMAZONIAN DEFORESTATION ON RAINFALL REGIMES AND WATER SECURITY IN BRAZIL

Aline Lopes^{1*}, Lilian Cristine Camillo², Giuliette Barbosa Mano³, Sthefanie Gomes Paes³, Michelle Guterres Pazin⁴, Maria Teresa Fernandez Piedade⁴

¹PhD in Ecology, Cesumar University, Postgraduate Program in Clean Technologies, campus Maringá;

²Mestranda, Universidade Cesumar, Programa de Pós-graduação em Tecnologias Limpas, Maringá;

³Doutoranda, Instituto Nacional de Pesquisas da Amazônia, Grupo de Ecologia, Monitoramento e Uso Sustentável de Áreas Úmidas – MAUA, Manaus;

⁴Doutora, Instituto Nacional de Pesquisas da Amazônia, Grupo de Ecologia, Monitoramento e Uso Sustentável de Áreas Úmidas – MAUA, Manaus.

*Contact: aline.llopes@unicesumar.edu.br

Deforestation in the Amazon significantly alters rainfall patterns in Brazil, prolonging the dry season and directly affecting agriculture and water availability. This study aimed to analyze the impacts of deforestation on rainfall regimes by synthesizing empirical evidence and recent climate modeling results. The methodology was based on a comprehensive literature review, including field observations and high-resolution atmospheric simulations. The findings demonstrate that deforested areas receive up to 18% less rainfall compared to preserved forests, while neighboring regions are also affected, particularly in the southern and southeastern Amazon, where forest loss is most intense. The impact depends on scale: in small patches, localized increases in rainfall may occur due to thermally induced circulations, but in larger deforested areas, the reduction of evapotranspiration, the delay of the rainy season onset by up to 76 days, and an annual decrease of up to 360 mm of rainfall become dominant. Furthermore, surface warming associated with forest loss intensifies the reduction in cloud formation and precipitation, exacerbating regional water imbalances. These changes compromise agricultural productivity, especially for crops such as soybean and maize, and reduce hydroelectric power generation, thereby threatening the country's food and water security. In conclusion, there is a strong scientific consensus that Amazonian deforestation plays a central role in modifying rainfall regimes, with negative consequences for climate, agriculture, and regional sustainability, highlighting the urgent need for public policies on forest conservation and sustainable land management to safeguard Brazil's climatic stability and water security.

Keywords: Climate change, Dry season, Evapotranspiration, Land use, Precipitation variability.

IMPLEMENTATION OF SUSTAINABLE PRACTICES ON SMALL RURAL PROPERTIES: CASE STUDY IN THE MUNICIPALITY OF SANANDUVA, RS

Equiton Lorengian Gregio^{1*}, Gerônimo Rodrigues Prado², Eduarda Portugal Canale¹, Alexandre Hüller¹, Oberdan Teles da Silva³

¹Postgraduate Program in Environmental Science and Technology, University Federal of Fronteira Sul, campus Erechim;

²Permanent teacher State University of Rio Grande do Sul of Rio Grande do Sul, Doctoral student Postgraduate Program in Environmental Science and Technology, University Federal of Fronteira Sul, campus Erechim;

³Dr, Teacher permanent, State University of Rio Grande do Sul.

*Contact: equitonlg@gmail.com

Family farming plays an essential role in food production in Brazil, but faces challenges related to sustainability due to the intensive use of chemical inputs and inadequate resource management. In this context, sustainable practices emerge as alternatives capable of reconciling productivity, environmental conservation, and economic viability. The objective of this study was to implement and monitor low-cost practices on small rural properties in Sananduva/RS, evaluating their environmental, social, and economic impacts. The research was conducted in 2024 in the municipality of Sananduva/RS, covering three selected family properties. The activities included: (i) separation and reuse of solid waste, with proper disposal and composting; (ii) collection and storage of rainwater through a simple system; and (iii) production of vegetables (lettuce and beets) without the use of pesticides, applying agroecological management techniques. Monitoring took place weekly between September 27 and October 31, 2024, through field visits, monitoring records, weighings, measurements, and qualitative observations, including farmers' perceptions of the development of the practices. The results indicated that waste separation reduced improper disposal and enabled the generation of organic compost, with a projected yield of more than two tons of recyclable materials per community per year. Rainwater harvesting proved viable for agricultural use, contributing to water savings and reducing dependence on drinking water. The production of pesticide-free vegetables was successful, with pest control using natural inputs and reduced costs for chemical pesticides. It can be concluded that simple sustainable practices, when accompanied by technical guidance, can be successfully integrated into the daily life of family farms, generating environmental, economic, and social benefits. However, there is a need for continuous environmental education and institutional support to increase farmers' autonomy and encourage the replication of these experiences in other communities.

Keywords: Agroecology, Family farming, Sustainability, Waste, Water resources.

INDUSTRY 4.0 AND MACHINE LEARNING: THE USE OF ARTIFICIAL INTELLIGENCE ALGORITHMS IN THE BRAZILIAN INDUSTRIAL SECTOR

Raquel da Silva Bechtold^{1*}, Júlio César Ramos¹, Daiana Rodrigues¹, Fernanda Furquim Bitello¹, Giane Daniela de Oliveira¹, Lara de Oliveira Bierei¹, Paula Restelli¹, Dusan Schreiber², Ermes Schmidt³, Marcelo Pereira⁴

¹Master's student in Environmental Quality, Feevale University, Campus II, CAPES scholarship holder;

²PhD in Administration, Feevale University, Campus II, CNPq scholarship holder;

³Bachelor in Administration, Feevale University, Campus II;

⁴Undergraduate student in Financial Management, Feevale University, Campus II.

*Contact: raquelbechtold@hotmail.com

This study aimed to analyze the feasibility of implementing artificial intelligence tools in the Brazilian industrial sector, based on the use of machine learning algorithms, with a focus on optimizing production processes, increasing productivity, and preventing imminent failures. The research is exploratory, with a descriptive and qualitative approach. The research method is deductive, and the techniques used include literature review, scientific articles, theses, content analysis, and material exploration. The qualitative approach enabled an analysis of the feasibility of using artificial intelligence tools in the Brazilian industrial sector within the context of Industry 4.0, as well as its relationship with the United Nations 2030 Agenda's Sustainable Development Goal 9 (SDG 9), which addresses Industry, Innovation, and Infrastructure. This SDG aims to promote the construction of resilient infrastructure and foster sustainable industrialization. The results showed that the use of artificial intelligence in the Brazilian industrial sector grew by 163%, with the number of companies using these algorithms increasing from 1.619 in 2022 to 4.261 in 2024, according to data from Pintec (IBGE). It was also evident that the use of these algorithms in Industry 4.0 contributed to real-time information delivery, process correction, and anticipation of failures and inefficiencies. Moreover, the use of these tools promotes process innovation and encourages more sustainable industrial practices, fostering a balance between economic growth and social and environmental responsibility. It is concluded that among the benefits of using these tools, the reduction of the industrial carbon footprint stands out, along with industrial innovation, reinforcing the commitment to SDG 9.

Keywords: Artificial intelligence, Environmental, Industry, Sustainability.

INDUSTRY 5.0 AND SUSTAINABILITY IN FASHION: FEASIBILITY OF IMPLEMENTING AUTOMATIC CUTTING MACHINES IN THE HANDBAG INDUSTRY IN BRAZIL

Júlio César Ramos^{1*}, Daiana Rodrigues¹, Fernanda Furquim Bitello¹, Raquel da Silva Bechtold¹, Giane Daniela de Oliveira¹, Lara de Oliveira Bierei¹, Paula Restelli¹, Dusan Schreiber², Ermes Schmidt³, Marcelo Pereira⁴

¹Master's student in Environmental Quality, Feevale University, Campus II;

²PhD in Administration, Feevale University, Campus II;

³Bachelor in Administration, Feevale University, Campus II;

⁴Undergraduate student in Financial Management, Feevale University, Campus II.

*Contact: jcesarramos090@gmail.com

This study aimed to analyze the technical and economic feasibility of implementing Comelz automatic cutting machines in the handbag industry, focusing on optimizing leather consumption, increasing productivity, and reducing operational costs, in line with the pursuit of sustainable technological solutions for production processes. The research was based on a project applied in partnership with the company Alfa, involving the acquisition of two CZ|XXL Plus machines and one ESA|NEK digital classifier, capable of performing simultaneous cuts, leather classification through automatic nesting algorithms, and digitization of defects and quality areas. The methodology consisted of a documentary analysis of the technical project, carried out in November 2022 in Novo Hamburgo/RS, including the evaluation of leather consumption data and outsourced cutting costs, as well as the simulation of efficiency gains in different production scenarios. The results showed an average reduction of 4% in leather consumption, annual savings of more than R\$ 950,000 in this input, and the elimination of expenses with outsourced cutting and cutting blades, representing an additional annual saving of more than R\$ 1.1 million. The estimated production with two machines operating in two shifts reaches more than 43,000 handbags per month, ensuring significant efficiency gains. The return on investment, calculated at R\$ 3.1 million, was projected to occur in approximately 18 months, demonstrating economic feasibility and alignment with sustainable practices. By integrating productive efficiency, waste reduction, and intelligent use of resources, the project aligns with the principles of Industry 5.0, which emphasizes human-machine collaboration and socio-environmental responsibility. It is concluded that the adoption of Comelz cutting technologies represents not only an advancement in industrial modernization but also a management strategy aligned with contemporary demands for innovation, sustainability, and SDG 9 of the 2030 Agenda, contributing directly to the achievement of SDG 9 targets in Brazil.

Keywords: Circular economy, Environmental management, Productive efficiency, SDG 9.

INNOVATIONS IN PLANKTON IMAGING: A HISTORICAL AND CONTEMPORARY OVERVIEW

Ludmilla Lopes Angelo^{1*}, Maira Rodrigues Lima¹, Maycon Tavares Morete¹, Eduarda Perazzoli¹, Rafaela Correa Varandas¹, Thiago da Silva Matos¹, Lohengrin Dias de Almeida Fenandes¹

¹Postgraduate Program in Marine Biotechnology, Admiral Paulo Moreira Institute of Marine Studies, Arraial do Cabo, Rio de Janeiro, Brazil.

*Contact: luferangelo@gmail.com

Plankton are a group of free-living aquatic organisms that cannot swim against ocean currents, being transported horizontally in the water column. This group includes phytoplankton, photosynthetic unicellular algae responsible for approximately 45% of global primary production, and zooplankton, composed primarily of herbivores that play an essential role in transferring energy to higher trophic levels. Given their ecological relevance, understanding how plankton are studied is essential for expanding knowledge about marine processes. In this context, this work aims to understand how technological advances have improved plankton imaging over time. For this purpose, a comparative temporal analysis was conducted between studies using classical techniques and those employing modern technologies, allowing for assessing changes in the quality, speed, and scope of analyses. Historically, the first observations were made in the 19th century, after the Hensen Expedition (1889), using simple optical microscopes and manual analysis of samples collected with plankton nets. With the advancement of optical and electron microscopy, such as the scanning electron microscope (SEM), and flow cytometry, greater structural detail and identification of microscopic organisms became possible. Beginning in the 1990s, automated imaging technologies such as ZooScan and FlowCam emerged, capable of digitizing samples and providing high-resolution images, combined with semi-automatic recognition and classification software. More recently, collaborative digital platforms such as EcoTaxa have enabled the storage, sharing, and taxonomic classification of images obtained by various devices, enhancing integration among researchers. Thus, using high-resolution imaging combined with artificial intelligence has emerged as a promising tool for reducing analysis time and increasing taxonomic accuracy, highlighting the significant evolution of plankton imaging from its origins to the present day.

Keywords: Phytoplankton, Plankton, Plankton imaging, Technological advances, Zooplankton.

LABORATORY TESTS IN TUBERCULOSIS: FROM PPD TO GeneXpert

Laís Destri dos Santos^{1*}, Mariana Rossoni Chiella¹, Henrique Bianchi Deboni¹, Felipe Calza Chiodi¹, Arieli Sara Hickmann¹, Stefanie de Souza Cardozo¹, Nicoli Acordi Severo¹, Maria Clara Gottschalck Valcarenghi¹, Gabriel da Silva dos Santos¹

¹Undergraduate in Medicine from the University of Contestado, campus Concórdia.

*Contact: lais.santos@aluno.unc.br

Tuberculosis is a transmissible bacterial disease with a predilection for the lungs, requiring rapid and accurate diagnosis. The tuberculin skin test (PPD) is widely used but is affected by prior BCG vaccination and HIV infection. The GeneXpert MTB/RIF assay detects *Mycobacterium tuberculosis* and rifampicin resistance within 1–2 hours, offering a faster and more precise molecular alternative. To compare the sensitivity, specificity, turnaround time, and cost-effectiveness of PPD versus GeneXpert MTB/RIF, based on multicenter studies and clinical trials published between 2020 and 2025. A systematic review was conducted using PubMed, Embase, and Cochrane databases, including studies that evaluated the sensitivity, specificity, response time, and cost-effectiveness of both tests. Of the 312 publications analyzed, four directly compared PPD and GeneXpert. PPD sensitivity ranged from 63% to 80%, while GeneXpert achieved 81.6%–95%, depending on sample type. Specificity for PPD ranged from 56% to 85%, whereas the molecular method showed $\geq 86.9\%$ in pulmonary TB, $\geq 78.9\%$ in extrapulmonary TB, and $\geq 98\%$ overall. GeneXpert provided results within 1–2 hours, compared to 48–72 hours for PPD. Although the unit cost of GeneXpert (USD \$17–23) is higher than that of PPD (USD \$4–6), a 12%–15% reduction in cost per detected case was observed in high-prevalence settings. These findings highlight GeneXpert's superiority in diagnostic accuracy and speed, which are critical for transmission control and early treatment initiation. The scarcity of direct multicenter comparative studies limits definitive conclusions, underscoring the need for head-to-head trials and long-term impact assessments. GeneXpert MTB/RIF outperforms PPD in sensitivity, specificity, diagnostic speed, and cost-effectiveness in settings with high tuberculosis burden and HIV coinfection. Its expansion is recommended in TB control programs. Future research should prioritize direct multicenter comparisons and extended clinical and economic evaluations.

Keywords: Cost-effectiveness, GeneXpert MTB/RIF, Sensitivity and specificity, Tuberculin skin test, Tuberculosis.

LAND USE CHANGE AND HYDROLOGICAL REGIME ALTERATIONS IN THE PARANÁ RIVER BASIN

Aline Lopes^{1*}, Lilian Cristine Camillo², Vanessa Campagnoli Ursulino², Helio Henrique Soares Franco³, Stéphanie Abisag Sáez Meyer Piazza³

¹ Doutora, Universidade Cesumar, Programa de Pós-Graduação em Tecnologias Limpas, Maringá;

² Mestranda, Universidade Cesumar, Programa de Pós-Graduação em Tecnologias Limpas, Maringá;

³ Pós-Doutorando, Campus Maringá-PR, Universidade Cesumar - UNICESUMAR. Bolsista ICETI-UniCesumar/Fundação Araucária.

*Contact: aline.llopes@unicesumar.edu.br

Land use changes in the Paraná River Basin have significantly altered its hydrological regime, as evidenced by both observational studies and hydrological modeling. This study aimed to synthesize the main impacts of land conversion on river discharge dynamics and associated ecological processes. The methodology was based on a literature review using long-term data on precipitation, streamflow, and land cover. Results indicate that over the past 40 years, river discharge has increased despite no significant rise in rainfall, a trend mainly attributed to the replacement of forests and cerrado with agricultural fields and pastures. Deforestation has altered key hydrological variables, including interception, evapotranspiration, and runoff, with simulations indicating that approximately 39% of the increase in mean river flow can be attributed to changes in vegetation. In comparison, 61% is linked to precipitation variability. Furthermore, the seasonal patterns of peak discharge shifted from January/February in the 1970s to March in recent decades, reflecting the combined influence of land-use change and climate variability. These alterations also produced marked ecological consequences: in the middle course of the Paraná River, reductions in water levels and flood magnitudes have decreased channel–floodplain connectivity, contributing to declines in fish densities. While some hydrological shifts are associated with rainfall variability, evidence suggests that land-use change remains a dominant driver of long-term discharge dynamics. In conclusion, land conversion in the Paraná River Basin has profoundly reshaped hydrological regimes and associated processes, with direct implications for water availability, aquatic ecology, and the sustainable management of regional water resources.

Keywords: Agricultural expansion, Floodplain connectivity, Hydrological modeling, River discharge, Streamflow variability.

LEGAL AND ENVIRONMENTAL CHALLENGES IN THE BRAZILIAN ANTHROPOCENE

Dênis Silvano Domingues^{1*}, Paulo Afonso Hartmann²

¹PhD student in Postgraduate Program in Environmental Science and Technology, University of Federal Fronteira Sul, campus Erechim;

²Teacher in Program in Environmental Science and Technology, University of Federal Fronteira Sul, campus Erechim, Ecology and Conservation Laboratory, Federal University of Fronteira Sul, campus Erechim.

*Contact: domingues.silvano@gmail.com

The concept of the Anthropocene accounts for the evidence of human impact on the planet, moving beyond philosophical, theological, anthropological, and political concepts to gauge the scale of its impact on transformations of nature and the climate. Although it is a global phenomenon, the environmental crisis manifests itself disproportionately, primarily affecting the most vulnerable segments of society. The central objective of this study was to analyze the relationships between major environmental events, state actions, and corresponding legislation during the period of the Brazilian Anthropocene. This study was based on the hypotheses that Brazilian environmental legislation is predominantly passive and reactive, that state responses are more influenced by economic than environmental impacts, and that disaster governance reinforces a pattern of environmental racism. To evaluate these premises, socio-environmental indicators were selected to assess qualitative and systemic dimensions of the events and their interconnections among ecological degradation, social destabilization, economic losses, and institutional actions. These indicators allowed for the selection of four events with significant socio-environmental impacts in the Brazilian Anthropocene: 1) the construction of the Itaipu Hydroelectric Power Plant in Paraná state; 2) the failures of the tailings dams in Mariana and Brumadinho, Minas Gerais state; 3) the chronic process of deforestation and wildfires in the Legal Amazon; and 4) the historic floods in Rio Grande do Sul. The analysis of these emblematic cases corroborates the initial hypotheses, where the legislative response and the subsequent late amendment to the National Dam Safety Policy demonstrate its reactive nature. Governmental actions, from enabling mega-projects to structuring complex financial agreements for environmental disaster remediation, highlight the primacy of economic interests over comprehensive ecological protection. Finally, the investigation indicates that the application of legislation and public policies results in an unequal distribution of damages, which systematically falls upon the most vulnerable populations.

Keywords: Climate change, Environmental law, Environmental racism.

MAMMALS UNDER PRESSURE? OCCURRENCE PATTERNS IN THE SUBTROPICAL ATLANTIC FOREST

Vitória Rodrigues Martiny^{1*}, Paulo Afonso Hartmann²

¹Master's student, Postgraduate Degree in Environmental Science and Technology, Federal University of Fronteira Sul, campus Erechim;

²PhD, Teacher Postgraduate Degree in Environmental Science and Technology, Federal University of Fronteira Sul, campus Erechim.

*Contact: vyrodrigues4927@gmail.com

Medium and large mammals play key ecological roles, including seed dispersal, predation, and population regulation. The subtropical Atlantic Forest has a significant species richness of this group while simultaneously representing a highly fragmented biome, a condition that may influence their distribution and occurrence. The objective of the study was to analyze the distribution patterns of diversity, richness, and species composition of medium and large mammals in the Brazilian subtropical Atlantic Forest. To this end, a systematic review of the literature published between 2004 and 2024 was conducted, focusing on records of these mammals in forest remnants of the subtropical Atlantic Forest in Brazil, with emphasis on the states of Paraná, Santa Catarina, and Rio Grande do Sul. The review identified 59 sampling units, of which 20 were located in Paraná, 29 in Santa Catarina, and 10 in Rio Grande do Sul. Thirteen species were present in 60% or more of the fragments, while six species occurred in 80% of the sampling units. Only two species, *Nasua nasua* and *Dasypus novemcinctus*, were classified as dominant, with records in more than 90% of the remnants. This pattern demonstrates that most species display restricted distributions within forest fragments, reflecting different levels of tolerance to direct and indirect anthropogenic impacts. These differences can lead to significant changes in the structure of medium and large mammal communities in the subtropical Atlantic Forest, reinforcing the importance of conservation strategies that prevent imbalances in the ecological functions performed by these species.

Keywords: Composition, Communities, Forest remnants.

MASS MOVEMENTS ALONG A RIVER CHANNEL IN THE SERRA PARQUE JABOTICABA ENVIRONMENTAL PROTECTION AREA, VERANÓPOLIS, BRAZIL

Eleonai Garcia da Silva^{1*}, Delio Endres Júnior², Leonardo Airton Ressel Simões³, Annette Droste⁴

¹Master's Student in Environmental Quality, Graduate Program in Environmental Quality, Universidade Feevale;

²PhD in Environmental Quality, Participant in the Program for Scientific Advancement, Universidade Feevale;

³PhD in Biological Sciences: Physiology, Federal University of Rio Grande do Sul, postdoctoral researcher in the Graduate Program in Environmental Quality, Universidade Feevale, FAPERGS Fellow;

⁴PhD in Genetics and Molecular Biology, Full Professor in the Graduate Program in Environmental Quality, Universidade Feevale.

*Contact: eleonaigs@gmail.com

The municipality of Veranópolis, located in the state of Rio Grande do Sul, Brazil, is highly susceptible to mass movements, intensified by the extreme rainfall event of May 2024 that triggered 636 landslides across the region, including debris flows, block falls, and soil creep. This study analyzed the occurrence and physical impacts of mass movements in the Serra Parque Jaboticaba Environmental Protection Area and their effects on the Jaboticaba River, a Taquari-Antas tributary. Mass movements were identified at three points: upstream (P01), midstream within the Parque Jaboticaba (P02), and downstream near the confluence with the Taquari-Antas River (P03), as well as in surrounding drainage channels. Mapping was performed using the data from Federal University of Rio Grande do Sul (UFRGS, 2025): WebMapa de Movimentos de Massa, based on high-resolution satellite imagery (World View, EROS C, BlackSky, and CBERS 4/WPM), which allowed the identification of scars up to 300m from the river channel and 200m from its tributaries. No movements were observed upstream of P01. Between P01 and P02, 21 landslides were mapped, some directly overlapping drainage sections and reaching the river channel, including large-scale events where debris flows occupied more than 300m of the Jaboticaba river channel. Ten landslides were identified in a single drainage channel upstream of P02, most of them ending in the watercourse. Between P02 and P03, 31 occurrences were recorded with similar impacts. The results indicate a concentration of mass movements in the midstream-to-downstream section, causing sediment accumulation, channel narrowing, and geomorphic changes of the Jaboticaba River. These findings highlight the geomorphological vulnerability of Veranópolis and suggest that mass movement mapping provides a critical baseline for understanding impacts on water quality, which will be assessed by physico-chemical and genotoxic parameters.

Keywords: Environmental monitoring, Geomorphology, Natural hazards, Sediment transport.

MICROPLASTIC CONTAMINATION IN *Anomalocardia* sp. FROM THE PORT REGION OF MOCAJITUBA, PAÇO DO LUMIAR, MARANHÃO, BRAZIL

Ingryd Lorena Batista de Oliveira^{1*}, Maria Luísa Araújo França¹, Beatriz Carama Xavier¹, Brenda Raissa Gomes Louzeiro², Filipe França dos Santos Silva³, Danielle Viana Mendes³, Scarlleth Patricia Salomão da Silva³, Alcione Sousa da Silva³, Larissa Gabrielle Pinheiro Ferreira³, Felipe Martins Sousa⁴, Daniella Patrícia Brandão Silveira⁵, Katiene Regia Silva Sousa⁶

¹Undergraduate, Oceanography Course, Federal University of Maranhão;

²Undergraduate, Economic Sciences Course, Federal University of Maranhão;

³Postgraduate Program in Development and Environment, Federal University of Maranhão;

⁴Postgraduate Program in Environmental Science and Technology, Federal University of Maranhão;

⁵PhD, Doctoral Program in Biotechnology-RENORBIO, Federal University of Maranhão;

⁶Teacher Department of Oceanography, Federal University of Maranhão.

*Contact: ingryd.batista@discente.ufma.br

Currently, concern about the effects of plastic pollution on marine environments is growing, leading to this topic being increasingly investigated by the scientific community. One of the central focuses of this research is microplastics, particles resulting from the degradation of plastic that are already widely distributed in various ecosystems, taking on different forms and presenting a contaminating potential that remains largely unexplored. Given this scenario, efforts are being directed towards assessing the levels of this pollution in the oceans. To this end, marine bivalves have been used as environmental monitoring tools due to their effectiveness as bioindicators of the presence of microplastics. This study investigated the occurrence of microplastics in *Anomalocardia* sp. collected in the Mocajituba port region, located in Paço do Lumiar, Maranhão. Bivalve samples, totaling part of the 150 specimens collected during the dry, transition, and rainy seasons, were analyzed to identify and quantify the presence of microplastics according to morphotype (pellet, filament, and fragmentation) and predominant color. The soft parts of the organisms were digested with a 10% potassium hydroxide (KOH) solution, filtered, and analyzed under an optical microscope. The analysis revealed a higher number of microplastics recorded during the transition period (56 particles), followed by the dry season (53) and the rainy season (50). Blue fibers predominated in all periods. The increase in the transition period indicates that the onset of rainy weather favors the flow of accumulated particles, increasing the contribution of microplastics. During rainy weather, higher flow and dilution reduce the detected values, while during dry weather, there is accumulation due to reduced water dispersion. The results point to significant microplastic contamination in the Mocajituba port area, highlighting the importance of continuous environmental monitoring and the implementation of effective solid waste management policies.

Keywords: Bioindicators, Bivalves, Estuarine environments, Marine pollution, Seasonality.

MICROPLASTIC OCCURRENCE IN *Anomalocardia spp.* (BIVALVE) FROM A COASTAL AREA ADJACENT TO THE PORT OF ITAQUI, MARANHÃO, BRAZIL

Maria Luísa Araújo França^{1*}, Ingrid Lorena Batista de Oliveira¹, Maristela Soares de Sousa¹, Andrey Silva Borges¹, Francisco Moisés da Silva Fernandes¹, Yann Ramos Carneiro¹, Katiene Régia Silva Sousa²

¹Undergraduate student in oceanography, Federal University of Maranhão (UFMA);

²Teacher, Department of Oceanography, Federal University of Maranhão (UFMA).

*Contact: mla.franca@discente.ufma.br

The growing production of plastics has caused considerable impacts on marine ecosystems, which has attracted scientific attention. In this scenario, microplastics, resulting from the fragmentation of this material, are an emerging concern, being found in different environments and in multiple forms, with contamination risks that are still poorly understood. To assess this problem, studies have been carried out using bivalve molluscs, recognized as efficient bioindicators of microplastic pollution. Therefore, the present work aimed to investigate the occurrence of microplastics in *Anomalocardia spp.* in the port region of Itaqui, located on the island of São Luís, Maranhão. The samples were collected in the Boqueirão area, close to the port of Itaqui, 50 organisms in three periods (rainy, transition, dry) totaling 150 specimens (75 pools), which had their morphometric characteristics measured and the soft parts separated to be digested in a 10% potassium hydroxide solution, dried in an oven, filtered and then examined under an optical microscope for identification and quantification of the microplastics. The results showed that 94.6% of the samples contained at least one microplastic particle. In total, 320 particles were found, namely: 161 blue fibers, 36 red fibers, 5 transparent fibers, 85 blue fragments, 26 red fragments, 1 transparent fragment, 2 blue pellets and 4 red pellets. The predominance of the color blue is related to the wide use of synthetic fibers in the textile industry, which reach the environment mainly through washing clothes, but also through the use of nets and other fishing gear, in addition to the degradation of packaging and cosmetics. The high frequency of microplastics in the samples indicates a worrying scenario associated with the inadequate disposal of plastic waste. These findings reinforce the importance of continuous monitoring and implementing effective environmental management policies.

Keywords: Bioindicator, Coastal ecosystem, Environmental monitoring, Fibers, Pollution.

MONITORING ENVIRONMENTAL POLLUTION: DETECTION OF MALAOXON RESIDUES VIA FTIR-ATR SPECTROSCOPY

Diego Maroso Silva^{1*}, Eliel Pereira Machado¹, Ilizandra Aparecida Fernandes¹, Juliana Steffens¹, Clarice Steffens¹

¹Graduate Program in Food Engineering, Integrated Regional University of Alto Uruguai and Missões, campus Erechim.

*Contact: diegomaroso852@hotmail.com

The environmental contamination caused by pesticide residues is a growing concern due to their persistence and toxic effects on ecosystems and human health. Malaoxon, a highly toxic oxidative metabolite of malathion, plays a significant role in this context, as it can accumulate in soil, water, and food chains. This study aimed to develop and validate a methodology for detecting malaoxon residues using Fourier-transform infrared spectroscopy with attenuated total reflectance (FTIR-ATR), contributing to environmental pollution monitoring. The methodology involved spectral analysis of malaoxon across a concentration range of 1 to 50 $\mu\text{g/mL}$ to identify key absorption bands and molecular changes that enable its reliable detection. The FTIR-ATR spectra revealed characteristic bands at 2957 cm^{-1} , $2925\text{--}2929\text{ cm}^{-1}$, and $2871\text{--}2873\text{ cm}^{-1}$, related to C-H stretching vibrations of methyl and methylene groups, indicating that the basic molecular structure remains intact. Peaks at $1461\text{--}1464\text{ cm}^{-1}$ and $1375\text{--}1379\text{ cm}^{-1}$ reflected angular C-H deformations. In commercial malathion samples, an additional band at 1744 cm^{-1} was observed, attributed to carbonyl (C=O) groups, likely resulting from impurities, degradation products, or stabilizers. Malaoxon exhibited a similar spectral profile to malathion, with slight shifts in band intensities due to the oxidation of P-S to P=O groups. These spectral differences provide a basis for identifying malaoxon in contaminated matrices. The results indicate that FTIR-ATR is a sensitive and effective technique for detecting malaoxon residues, supporting its application in environmental monitoring and pollution control strategies. In conclusion, this methodology offers a rapid and non-destructive tool for assessing pesticide-related contamination, helping to mitigate ecological and public health risks linked to environmental pollution.

Keywords: Contaminant detection, Malaoxon, Organophosphates, Pesticide residues, Spectral analysis.

OCCURRENCE OF MICROPLASTICS IN SHRIMP CAUGHT IN THE BACANGA RIVER ESTUARY, SÃO LUÍS, MARANHÃO

Cecília Mendes Póvoas Netta^{1*}, Scarlleth Patricia Salomão da Silva², Filipe França dos Santos Silva³, Graziela Santos Leite⁴, Marcelo Henrique Lopes Silva⁴

¹Undergraduate in biology, Federal University of Maranhão (UFMA), Campus São Luís;

²Master's students in the postgraduate program in development and environment, Federal University of Maranhão (UFMA), Campus São Luís;

³Undergraduate in oceanography, Federal University of Maranhão (UFMA), Campus São Luís;

⁴Professor Dr. Department of Oceanography and Limnology, Federal University of Maranhão (UFMA), Campus São Luís.

*Contact: cecilianetta.23@gmail.com

This study investigated the occurrence of microplastics (MPs) in white shrimp (*Litopenaeus schmitti*) collected in the Bacanga River estuary in São Luís, Maranhão, an environment of ecological and socioeconomic importance. The objective was to assess the incidence of microplastics in individuals, considering the species' potential as a bioindicator of plastic pollution. The collections were conducted with artisanal fishermen during the dry season (November 2024) and rainy season (May 2025), totaling 28 individuals, equally divided between males and females. After capture, the shrimp were processed in a laboratory, where biometric analyses were performed, body parts (soft tissue and carapace) were separated, and chemical digestion with a 30% hydrogen peroxide solution was performed. The resulting residue was filtered, dried, and analyzed under a stereomicroscope for microplastic identification. The biometric results indicated seasonal differences: in the dry season, males presented larger body dimensions, while in the rainy season, females showed greater length and weight, suggesting reproductive influence. In total, 757 MPs were counted, 357 in the dry season and 400 in the rainy season, demonstrating greater contamination during the rainy season. Females showed higher accumulation rates in both seasons, especially on the carapace, while males predominantly accumulated on the abdomen. Regarding particle type, fibers were predominant (69.22%), followed by fragments (28.53%) and pellets (2.25%), the latter restricted to the dry season. Seasonal analysis showed variations in color and shape, with blue and colorless fibers more frequent in the dry season and black fibers and blue fragments more prevalent in the rainy season. The correlation between individual weight and MP abundance was weak or nonexistent, suggesting that physiological and environmental factors have a greater influence on bioaccumulation. We conclude that *L. schmitti* is a relevant bioindicator for monitoring plastic pollution in estuarine environments, reflecting the influence of sex, seasonality, and body part on microplastic accumulation.

Keywords: Bioindicators, Estuary, *Litopenaeus schmitti*, Microplastics, Plastic pollution.

OCCURRENCE OF MICROPLASTICS IN THREE SPECIES OF FISH FROM THE BACANGA RIVER ESTUARY, SÃO LUÍS-MA

Scarlleth Patricia Salomão da Silva^{1*}, Danielle Viana Mendes¹, Filipe França dos Santos Silva¹, Alcione Sousa da Silva¹, Lis Helena Salomão da Silva³, Felipe Martins Sousa², Larissa Gabrielle Pinheiro Ferreira¹, Danielle de Jesus Silva¹, Ingrid Lorena Batista de Oliveira³, Cecília Mendes Póvoas Netta³, Daniella Patrícia Brandão Silveira⁴, Marcelo Henrique Lopes Silva⁵, James Werllen de Jesus Azevedo⁵, Antonio Carlos Leal de Castro⁵

¹Graduate Program in Development and Environment, Federal University of Maranhão;

²Graduate Program in Environmental Science and Technology, Federal University of Maranhão;

³Graduation from the Federal University of Maranhão;

⁴Doctorate Program in Biotechnology-RENORBIO, Federal University of Maranhão;

⁵Professor, Department of Oceanography, Federal University of Maranhão.

*Contact: scarlleth.patricia@discente.ufma.br

Water pollution caused by polymers is one of the major contemporary environmental challenges. Its severity increases when these polymers fragment into pieces smaller than 5 mm, known as microplastics (MP), which can be inadvertently ingested by aquatic organisms. This study investigated the presence of microplastics in the gastrointestinal tract of three fish species collected in the Bacanga River estuary, in São Luís. Three collections were conducted in October 2023, January 2024, and May 2024. In the laboratory, morphometric measurements were recorded, including total length (TL), total weight (WT), and stomach weight (WS), in addition to gonadal analysis. The stomachs were then subjected to enzymatic digestion using potassium hydroxide (KOH 10%) to separate the microplastics from the stomach contents. Subsequent filtration was performed using a vacuum pump and a GF-3 Macherey-Nagel glass microfilter (~0.6 µm). The resulting particles were counted and classified by shape and color using a microscope. One hundred seven individuals were analyzed, and a total of 374 microplastic particles were counted, distributed across 100% of the samples. The abundance of microplastic particles was 146 in *Sciades herzbergii*, 122 in *Centropomus undecimalis*, and 108 in *Mugil* sp. Regarding the diversity of microplastic particles, the most common forms were fiber (87.12%) and fragment (12.88%), with black (41.69%) and blue (40.18%) fiber being the most representative. The Kendall correlation test revealed no relationship between the number of microplastic particles ingested and stomach weight. The presence of microplastics in all individuals is concerning, as it may indicate possible human contamination and affect fish development. Therefore, it is necessary to reduce the consumption of plastic materials, as well as adequate waste management in order to mitigate this problem.

Keywords: Environmental contamination, Estuarine fish, Ichthyofauna, Plastic pollution.

OCCURRENCE OF THE GENUS *Didelphis* IN A NEIGHBORHOOD OF SAPUCAIA (RJ): EVALUATION OF MONITORING METHODS

Aluizio Araujo Passos^{1*}, Gabrieli Zanette², Bianca Trindade Oldoni², Ellen Brönstrup¹, Gabriela Cristina Perusin Flores³, Yago Vitório Colares Pinto², Jenifer Eduarda Luterek¹, Vitória Bôaventura Midon¹, Bruna da Conceição Marques³, Teodoro Companhoni Pasquali¹, Ralph Iasbeck⁴, Daniel Galiano⁵

¹Biological Sciences, Federal University of Fronteira Sul, Campus Erechim;

²Postgraduate Program in Environmental Science and Technology, Federal University of Fronteira Sul, campus Erechim;

³Environmental and Sanitary Engineering, Federal University of Fronteira Sul, campus Erechim;

⁴MSc, Federal University of Juiz de Fora, graduation teacher at Educational Foundation of Além Paraíba;

⁵PhD teacher, Postgraduate Program in Environmental Science and Technology, Federal University of Fronteira Sul, campus Erechim.

*Contact: aluiziozx@gmail.com

The genus *Didelphis* comprises solitary and nocturnal marsupials, restricted to the New World, with four species occurring in Brazil, commonly referred to as “gambá,” “saruê,” or “raposa.” These animals exhibit both terrestrial and arboreal habits. When threatened, they employ defensive strategies such as thanatosis, the release of pungent secretions, urination and defecation, and the display of canines accompanied by vocalizations. This study evaluated the occurrence and activity of the genus within a neighborhood of Sapucaia (Rio de Janeiro, Brazil) through continuous nocturnal monitoring conducted over 40 nights, between September 22 and October 31, 2021, during the COVID-19 pandemic. The methodology consisted of nocturnal surveys along a fixed route of approximately 1 km, at one-hour intervals randomly assigned between 20:00 and 04:00. Simultaneously, edible baits (banana and peanut butter) were placed at fixed points for subsequent assessment of markings left by the genus. Four sightings of *Didelphis aurita* were recorded, with minimum activity estimated at 112 hours of the 320 monitored hours (~35% of the sampling period), thereby confirming the species' presence and demonstrating the effectiveness of nocturnal surveys. Fixed baits proved ineffective, being consumed by birds. For a more accurate assessment, baits should be deployed in areas with confirmed occurrence, combined with camera traps to identify interacting animals. The results highlight the adaptive capacity of *D. aurita* to anthropogenic environments. Although the methods present limitations, direct observation through field surveys proved viable. Furthermore, the findings emphasize the importance of local monitoring and of raising public awareness regarding the presence and conservation of these marsupials.

Keywords: Anthropic Environments, *Didelphis*, Nocturnal Survey.

ORGANIC PRODUCTION SYSTEM: EVALUATION OF TOMATO SEEDLINGS OF THE *MILAGROS* VARIETY

Adilson José Szady^{1*}, Vinicius Gabriel Woitysiak², Nair Mirely Freire Pinheiro Silveira³, Nycollas Stefanello Vianna⁴, Altemir José Mossi⁵

¹Master's student in Environmental Science and Technology, Federal University of Fronteira Sul, campus Erechim;

²Graduate student in Agronomy, Federal University of Fronteira Sul, campus Erechim;

³ Graduate student in Environmental and Sanitary Engineering, Federal University of Fronteira Sul, campus Erechim;

⁴PhD student in Environmental Science and Technology, Federal University of Fronteira Sul, campus Erechim;

⁵Teacher Postgraduate program Environmental Science and Technology, Federal University of Fronteira Sul, campus Erechim.

*Contact: adilson_szady@hotmail.com

The production of tomato seedlings in organic systems has gained increasing interest due to environmental benefits and demand for sustainable food. Seedling quality is essential for crop success, which depends directly on the balanced development of the root system and the aerial part. The present study aims to evaluate the effect of different container sizes on root growth, vegetative growth, and productivity of tomato plants of the Milagros cultivar. The research will be conducted initially in a greenhouse in a completely randomized design (RCA) with 4 replicates and $n=20$, collecting data on variables such as seedling height, collar diameter, green mass, dry mass, leaf area, and root system development. In a second stage, the seedlings will be taken to the field, and the fruit size, fruit weight, and productivity will be evaluated. The field experiment will use biological inputs and adopt a randomized block experimental design with 4 replicates and $n = 24$. The research will last five months and will take place in the municipality of Erechim at the Federal University of Fronteira Sul, and on the Szady family's rural property located in the municipality of Barão de Cotegipe, Rio Grande do Sul. Data analysis will be performed using analysis of variance (ANOVA), followed by comparison of means using Tukey's test, considering a significance level of 5%, with the aid of Statistica 10.1 software (StatSoft Inc., USA). The root system of the plants will be evaluated using Safira v1.1 software (Fiber and Root Analysis System, Embrapa Instrumentação Agropecuária, São Paulo, Brazil). This work is expected to contribute to family farming and tomato production in organic production systems, increasing farmers' income and producing healthier food.

Keywords: Container Size, Organic Tomato Seedlings, Productivity.

PAYMENTS FOR ENVIRONMENTAL SERVICES IN BRAZIL: WEAKNESSES AND PERSPECTIVES OF STATE POLICIES

Alexandre Hüller^{1*}, Tiago Schneider de Jesus⁴, Equiton Lorengian Gregio¹, Gerônimo Rodrigues Prado², Oberdan Teles da Silva³, Eduarda Portugal Canale¹, Caroline Fasolo¹, Nycollas Stefanello Vianna¹

¹Postgraduate Program in Environmental Science and Technology, UFFS/Erechim, RS;

²Teacher permanent State University of Rio Grande do Sul of Rio Grande do Sul Uergs, Doctoral student
Postgraduate Program in Environmental Science and Technology, UFFS/Erechim, RS;

³Dr, Teacher permanent, State University of Rio Grande do Sul of Rio Grande do Sul, UFFS/Erechim, RS;

⁴Postgraduate Program in Innovation, Technology and Sustainability at the Graduate Program in Administration,
Federal University of Rio Grande do Sul – Porto Alegre, RS.

*Contact: alexandre.huller@gmail.com

Recently, payments for Environmental Services (PES) have gained prominence as instruments to foster ecosystem conservation and restoration, representing a bridge between economy and sustainability. In Brazil, although the National Policy on PES (Law No. 14.119/2021) has established legal and institutional foundations, state-level implementation still shows weaknesses, particularly regarding the predictability of monitoring and evaluation (M&E), which is essential to ensure effectiveness and trust among stakeholders. This study aimed to verify whether State Policies for Payments for Environmental Services (PEPSA) in Brazil explicitly and consistently include M&E mechanisms in their central and regulatory frameworks, assessing their alignment with the national policy and their potential for consolidation as robust public policies. This research is applied, qualitative, and descriptive. Information was collected from the websites of environmental agencies across the 27 states, including laws, decrees, and regulations, and analyzed through content analysis. A narrative literature review on PES, environmental public policies, and evaluation instruments was also conducted to contextualize the discussion and highlight existing gaps. The results show that 19 Brazilian states currently have PEPSA, 13 of them established by state law and six by decree. However, only four states (21%) explicitly include M&E indicators in their central norms, while another 12 (63%) partially include them in complementary regulations. The analysis also reveals a recent acceleration in policy adoption, particularly after the enactment of Law No. 14.119/2021, confirming its catalytic role. Nevertheless, most states restrict evaluation criteria to specific project calls, leading to heterogeneity, limited comparability, and reduced predictability. It is concluded that, despite the progress made, there remains a need for minimum standardization of indicators and M&E criteria within PEPSA. The consolidation of PES as a state policy depends on transparent institutional arrangements, solid contracts, and continuous monitoring—conditions essential to build trust among actors and secure long-term environmental outcomes.

Keywords: Environmental Governance, Monitoring and evaluation, Payments for Environmental Services, Public policy.

PHYSICOCHEMICAL CHARACTERIZATION OF SOILS IN ACTIVE *Ctenomys* BURROWS IN MATO GROSSO

Gabrieli Zanette^{1*}, Ândrea Machado Pereira Franco², Aluizio Araújo Passos³, Thales Renato Ochotorena de Freitas⁴, Daniel Galiano⁵

¹PhD student in Environmental Science and Technology, Federal University of Fronteira Sul, campus Erechim;

²PhD in Soil Science, Laboratory Technique, Federal University of Fronteira Sul;

³Undergraduate student, Biological Sciences, Federal University of Fronteira Sul, campus Erechim;

⁴PhD teacher, Postgraduate, Department of Genetics, Federal University of Rio Grande do Sul;

⁵PhD teacher, Postgraduate Program in Environmental Science and Technology, Federal University of Fronteira Sul, campus Erechim.

*Contact: gabrieli_zanette@hotmail.com

Subterranean rodents influence ecosystem dynamics through their burrowing activities, but little is known about soil conditions in the burrows they occupy. The objective of this study was to characterize the physicochemical properties of the soil in active *Ctenomys* burrows in the state of Mato Grosso (MT), providing an initial basis for understanding the conditions of subterranean environments in this region. Eleven soil samples were collected from burrows located at different occurrence points, covering three municipalities in MT. The analyses included pH, moisture (Ug), organic carbon (OC), organic matter (OM), aluminum (Al^{3+}), nitrogen (N), phosphorus (P), and potassium (K). The average results indicated a pH of 4.4; Ug of 12%; OC of 1.06%; OM of 1.73%; and Al^{3+} of 0.55 mg L⁻¹. The average levels of the macronutrients N, P, and K were 0.04%; 2.4 mg dm⁻³; and 24.84 mg dm⁻³, respectively. Potassium showed the greatest variation (5.13 and 84.77 mg dm⁻³). The presence of aluminum, common in acidic soils, contributes to low phosphorus availability, limiting plant development. Low nitrogen levels may be related to limited OM levels, while low phosphorus levels reflect the tendency of acidic soils in MT. High potassium levels indicate the presence of primary and less weathered minerals, typical of drier regions. This study provides the first physicochemical characterization of soils in active *Ctenomys* burrows in MT, revealing that they are predominantly acidic and of low fertility. Although previous studies suggest that subterranean rodents may modify soil attributes, it is not possible to infer such effects in this case, as this is a preliminary study. Nevertheless, the results provide a foundation for future research and serve as a reference for comparative studies on how the presence of these rodents influences or associates with soil characteristics.

Keywords: Nutrient availability, Soil characterization, Subterranean rodent, Tuco-tuco.

PHYTOTOXICITY OF PESTICIDES APPLIED IN ISOLATION OR IN TANK MIXTURES ON BEAN PLANTS

Juan C. Onesko^{1*}, Eduarda B. Giacomolli², Eduardo Cechet², Flávia B. Lazzari², Letícia Bampi², Lucas Tedesco², Otávio A. Dassoler², Renata Zicatto², Rodrigo J. Tonin³, Leandro Galon⁴

¹Master student, University of Federal Fronteira Sul, campus Erechim;

²Undergraduate student, University of Fronteira Sul, campus Erechim, Departament of Agronomy;

³Ph.D. Student, University Federal of Fronteira Sul, campus Erechim, Departament of Agronomy;

⁴Professor Ph. D., University of Federal Fronteira Sul, campus Erechim.

*Contact: juanonesko@hotmail.com

In common bean crops, pests (diseases, insects, and weeds) are the main factors causing losses in yield and harvested grain quality. To control these pests, producers mix fungicides, insecticides, and herbicides in the sprayer tank. Therefore, the objective of this study was to evaluate the selectivity, the effect on gas exchange, and the yield components of common bean crops in the presence of fungicides, insecticides, and herbicides applied alone or in mixtures in the sprayer tank. The experiment was conducted in the 2024/25 harvest season in a randomized complete block design with four replicates. The 16 treatments used were the herbicides: fomesafen (250 g ha⁻¹), clethodim (108 g ha⁻¹), the fungicide: prothioconazole + trifloxystrobin (87.38 + 75 g ha⁻¹), and the insecticide: isocycloseram + lambda-cyhalothrin (27 + 37.5 g ha⁻¹) applied alone or in tank mixtures. The treatments were applied at the V3 to V4 stage of the common bean plant. At 7 and 14 days after application of the treatments (DAT), the phytotoxicity caused by the pesticides to the common bean plant was evaluated. Gas exchange was determined at 21 DAT, and the grain yield components (number of pods per plant, number of grains per pod, thousand-grain weight, and grain yield) were determined at the time of crop harvest. The isolated application of herbicides, fungicides, and insecticides resulted in the lowest phytotoxicity to common beans than the use of the products in tank mixes in the sprayer tank. The tank mix containing fomesafen + clethodim + prothioconazole + trifloxystrobin + isocycloseram + lambda-cyhalothrin showed the greatest phytotoxicity to the IPR Urutau bean cultivar. The evaluated treatments did not negatively affect the physiological variables or grain yield components of the beans.

Keywords: Herbicides, Pest infestation, *Phaseolus vulgaris*.

POTENTIAL OF CORN STRAW BIOCHAR AS AN ADSORBENT FOR REACTIVE BLUE 5G AND REACTIVE RED 4B DYES

Weslen Fernandes da Silva Matusiaki^{1*}, Raquel Aparecida Loss², Iêda Araújo de Carvalho³

¹Specialist, Mato Grosso State University, Tangará da Serra, scholarship (CAPES);

²Doctor, Mato Grosso State University, Tangará da Serra;

³Graduate, Mato Grosso State University, Tangará da Serra, scholarship holder (CAPES).

*Contact: Weslen.fernandes@unemat.br

Corn straw is an agricultural residue often discarded on the soil, contributing to increased carbon dioxide (CO₂) emissions and impacting the greenhouse effect. Converting this residue into biochar through phosphoric acid activation at 85% for 4 hours and subsequent carbonization at 500 °C for 1 hour demonstrates a sustainable strategy for waste valorization and emission mitigation. The produced biochar was evaluated for its capacity to adsorb toxic dyes used in the textile industry, specifically reactive blue 5G and reactive red 4B. In experiments, 0.3 g of biochar was added to 50 mL of solutions at 100 mg/L⁻¹ of each dye, and samples were analyzed via spectrophotometry. The average adsorption reached approximately 91% for reactive red 4B (standard deviation of 1.78) and 92% for reactive blue 5G (standard deviation of 1.82). These results indicate the high potential of corn straw-derived biochar as an effective adsorbent, with efficiencies exceeding 85%, which is considered ideal for effluent treatment applications. Therefore, this material represents an economical and sustainable alternative for removing pollutants from textile effluents, contributing to environmental impact reduction and promoting the reuse of agro-industrial residues.

Keywords: Biomass, Carcinogens, CO₂.

POTENTIAL OF DEOXYNIVALENOL (DON)-CONTAMINATED BARLEY FOR BIOETHANOL PRODUCTION: FEASIBILITY AND MYCOTOXIN-RELATED CHALLENGES

Gabrielle Fusiger Berwian^{1*}, Lauren Barbosa Diniz², Ana Júlia Duarte Lampugnani¹,
Jéssica Mulinari¹, Luciane Maria Colla^{1,2}

¹University of Passo Fundo (UPF), School of Agricultural Sciences, Graduate Program in Agronomy (PPGAGRO), Innovations and Business (ESAN), Passo Fundo, Rio Grande do Sul, Brazil;

²Universidade de Passo Fundo, School of Agricultural Sciences, Innovation and Business, Postgraduate Program in Food Science and Technology, Passo Fundo, RS, Brazil.

*Contact: gabiberwian@gmail.com

The growing demand for renewable energy sources has boosted interest in biofuels, particularly bioethanol, as an alternative to conventional energy matrices. However, the expansion of production depends on the availability of suitable feedstock. In this context, residual barley stands out as a promising option due to its high carbohydrate content and its disposal by the brewing industry, especially when contaminated with mycotoxins such as deoxynivalenol (DON). This study evaluates bioethanol production from residual barley through the Separate Hydrolysis and Fermentation (SHF) process, as well as the reduction of DON in the biomass after processing, aiming at its reuse as animal feed. Contaminated and standard brewing barley samples were hydrolyzed with α -amylase, amyloglucosidase, and cellulase (Novonesis), following the manufacturer's recommendations, and subsequently fermented with *Saccharomyces cerevisiae*. DON quantification was carried out using the QuEChERS method with liquid chromatography (LC) analysis. Saccharification efficiencies reached 96% and 99% for the contaminated and standard samples, respectively. During fermentation, yields of 81% and 88% were obtained, with no significant differences between treatments. Despite the presence of DON, no impairment in fermentative performance was observed. The solid residue showed a 39.49% reduction in DON content compared to the hydrolyzed medium, reaching 3606.7 $\mu\text{g/kg}$ in the final residue. Although substantial, this reduction was insufficient to meet the safety limits established by ANVISA for animal feed, highlighting the need for additional detoxification strategies. Nevertheless, residual barley demonstrates potential for bioethanol production, contributing to energy sustainability, mitigation of improper waste disposal, diversification of feedstocks, and reduction of biofuel production costs.

Keywords: Contaminants, Enzymes, Energy sustainability, Residual barley, Reuse.

PRODUCTION OF *Spirulina platensis* THROUGH OPTIMIZATION OF CULTURE MEDIA

Lauren Barbosa Diniz^{1*}, Gabrielle Fusiger Berwian², Ana Júlia Duarte Lampugnan², Julia Catiane Arenhart Braun¹, Luciane Maria Colla^{1,2}

¹Postgraduate Program in Food Science and Technology, University of Passo Fundo, School of Agricultural Sciences, Innovation and Business (ESAN);

²Graduate Program in Agronomy, University of Passo Fundo, School of Agricultural Sciences, Innovations and Business (ESAN).

*Contact: laurendiniz07@gmail.com

The growing global demand for food has intensified the use of fertilizers in agriculture, leading to significant environmental impacts such as the contamination of water resources. In this context, microalgae cultivation emerges as a sustainable alternative for the production of agricultural inputs, given their rapid growth rate and high nutritional value, composed of proteins, carbohydrates, and bioactive compounds. However, large-scale application still faces limitations, particularly due to the reliance on synthetic culture media rich in chemical salts, which increase production costs. Therefore, the objective of this study was to evaluate the cultivation of *Spirulina platensis* in non-sterilized conditions, using Zarrouk medium at reduced concentrations (10%, 30%, and 50%), with distilled water and tap water, with and without micronutrient supplementation. Cultivations were conducted in 500 mL bioreactors, with a working volume of 125 mL, under controlled temperature (20–30 °C), continuous aeration, and a 12/12 h light–dark cycle using LED illumination. Cell growth was monitored by spectrophotometry at 670 nm, correlating absorbance with cell concentration. The results showed that the highest biomass yield was obtained with 50% Zarrouk medium ($1.047 \pm 0.083 \text{ g L}^{-1}$), with tap water producing higher algal concentrations compared to distilled water. Micronutrient supplementation enhanced growth under all tested conditions. Thus, the combination of higher medium concentration, tap water, and micronutrient addition proved to be the most efficient strategy to maximize *Spirulina platensis* biomass yield. Since the use of tap water makes it possible to reduce production costs, as there is no need to distill water for the process. Nonetheless, the high cost of synthetic medium remains a challenge, and a promising alternative to reduce its concentration would be the use of agro-industrial residues, which provide available nutrients and promote the sustainability of large-scale cultivation.

Keywords: Biomass, Crop optimization, Microalgae, *Spirulina platensis*.

PUBLIC HEARING ON ACCESS TO CANNABIDIOL IN ERECHIM

Micheli Basso^{1*}, Altemir José Mossi²

¹Master's student in Environmental Science and Technology, Federal University of Fronteira Sul, campus Erechim,
Scholarship holder;

²PhD in Ecology and Natural Resources, teacher at the Federal University of Fronteira Sul, campus Erechim.

*Contact: michybasso@hotmail.com

Due to the increasing demand for medications based on *Cannabis sativa* L., a public hearing was held in Erechim/RS in May 2025 to debate this issue, given that access to these treatments remains restricted to a small portion of the population. This restriction is attributed to high prices, prejudice, and a lack of adequate information about their use. Therefore, the objective of this research is to analyze how this legislative debate can contribute to disseminating information about the medicinal use of Cannabis and broaden the discussion on the subject. The methodology involves the analysis of news reports related to the public hearing and its developments, aiming to understand the issue and its relevance descriptively and qualitatively. The hearing was proposed by councilors Sandra Picoli and Clairton Balen, in collaboration with the Regional Forum for Health Promotion and Prevention, and emerged in response to requests from local residents who use these medications but face difficulties in obtaining them. In addition to patients and family members who shared their experiences with the treatment, the hearing -which filled the City Council chamber- was also attended by healthcare professionals, researchers, representatives from Cannabis access associations, and public authorities. Following an extensive debate on use, access, indications, side effects, and public doubts, a report was prepared and sent to various bodies and entities. Given the impact of the hearing, the Municipal Health Council of Erechim placed on its meeting agenda the importance of demystifying prejudices and facilitating access to these medications. The public hearing was an important milestone in giving visibility to the history and struggle of patients and families, in addition to informing and raising awareness among the population, debating the importance of building public policies, and highlighting the need for further research in the field.

Keywords: Health promotion, Medicinal Cannabis, Public debate.

SCIENCE EDUCATION LANDSCAPE IN BRAZIL: AN ANALYSIS OF TEACHER EDUCATION INDICATORS

Inaê Carolina Sfalcin^{1*}, Merilim Piquelet²

¹PhD student in Genetic and Molecular Biology, Federal University of Rio Grande do Sul;

²Master in Ecology and Phd student in Science Education, Federal University of Rio Grande do Sul.

*Contact: biol.inae@gmail.com

In recent years, Brazilian education has faced a shortage of qualified classroom teachers. This study aimed to analyze current educational indicators to examine transformations in teacher education, with particular focus on science education. A narrative review of official data from national educational institutes, such as the INEP and the Higher Education Census, was conducted, focusing on science teacher education and qualification indicators. The collected data include the percentage of classes taught by teachers with specific subject training, the distribution of enrollments and graduates by modality (in-person and distance learning, DL) and degree type (bachelor's and licentiate degrees), as well as performance data from the Enade. Currently, only 70.1% of elementary science classes are taught by teachers of the biological sciences, highlighting a significant qualification gap. This shortage coincides with a 9.7% decline in licentiate degree completions in 2023, indicating diminishing interest in teaching careers, while bachelor's (+5.2%) and technological (+26.5%) programs saw increased completion rates. Simultaneously, the teacher education landscape has shifted dramatically toward distance learning, with 67% of current students enrolled in DL programs—95.9% of these in private institutions. DL enrollments grew by 325.9% in 2023, while in-person courses declined by 17.7%. Performance data further compounds these concerns: licentiate graduates in Biological Sciences, concentrated in private DL programs, showed lower performance than bachelor's graduates in the 2021 Enade. This suggests that bachelor's degree holders are better qualified, yet they comprised only 1.7% of basic education teachers in 2023. The migration toward distance education, coupled with licentiate graduates' inferior academic performance and declining completion rates in teaching licentiate programs, suggests a cycle of deteriorating science education quality. This situation requires policy interventions to enhance the attractiveness of science teaching careers and regulate the quality of distance learning licentiate programs.

Keywords: Distance learning, Science education, Teacher training.

SEASONAL VARIATION OF THE WEIGHT-LENGTH RELATIONSHIP AND CONDITION FACTOR OF CATFISH IN SÃO MARCOS BAY, MARANHÃO, BRAZIL

Danielle Viana Mendes^{1*}, Filipe França dos Santos Silva¹, Scarlleth Patricia Salomão da Silva¹, Larissa Gabrielle Pinheiro Ferreira¹, Daniella Patrícia Brandão Silveira², Marcelo Henrique Lopes Silva³, Antonio Carlos Leal de Castro³, James Werllen de Jesus Azevedo³

¹Graduate Program in Development and Environment, Federal University of Maranhão;

²Doctorate, Doctoral Program in Biotechnology-RENORBIO, Federal University of Maranhão;

³Doctor Professor, Department of Oceanography, Federal University of Maranhão.

*Contact: danielle.viana@discente.ufma.br

Fish are fundamental for maintaining aquatic ecosystems, performing important ecological functions such as energy control between trophic levels. The weight-length relationship and condition factor (K) are essential tools for evaluating growth, health, population structure, and conservation status of species, as well as the sustainability of fishery stocks. The present study aimed to evaluate seasonal variations in the weight-length relationship and condition factor of *Bagre bagre*, a migratory marine catfish species known as bandeirado. Samples were obtained by blocking nets over six years (2014–2020) with 14 samplings in São Marcos Bay, Maranhão, from environmental monitoring of aquatic biota conducted by the Laboratory of Ichthyology and Fishery Resources at UFMA. Total length (cm), total weight (g), sex classification, and gonadal stage of specimens were analyzed. During the study, 118 specimens were recorded, including 37 males (31.4%) and 81 females (68.6%), with females also predominant in both seasons of the year. Males presented average length and weight of 26.4 cm and 128.61 g, respectively. For females, the average values were 41.4 cm and 192.79 g for length and weight, respectively. The weight/length relationship by sex grouping was expressed by the equation $Wt = 0.0052 \cdot Lt^{3.0722}$, with angular coefficient (b) = 3.07 and $r^2 = 0.94$, indicating positive allometric growth, a pattern also consistent on a seasonal scale. The condition factor (K) showed low variation between seasonal periods, with average values of 1.02 in the dry period and 0.92 in the rainy period, suggesting that the species does not use the stretch of the Golfão Maranhense as a spawning area, but possibly as a feeding or migration zone. It is expected that this information will assist in the development of environmental policies for fishery management and conservation in estuarine ecosystems, contributing to regional and national sustainability.

Keywords: *Bagre bagre*, Fishery management, Sustainability.

SELENIUM AND SILVER LEVELS IN COMMERCIAL FISH FROM THE SAINT PETER AND SAINT PAUL ARCHIPELAGO, BRAZIL

Tayla Cosmann^{1*}, Daniel Galiano¹

¹Master's student in Environmental Science and Technology, Federal University of Fronteira Sul, campus Erechim;

¹PhD, Teacher, Federal University of Fronteira Sul, campus Erechim.

*Contact: tayla_cosmann@hotmail.com

Marine fish are an important source of nutrients, but they can also represent a route of exposure to metallic elements that pose a potential risk to human health. This study determined the concentrations of selenium (Se), an essential element, and silver (Ag), a metal associated with anthropogenic sources, in muscle samples from *Thunnus albacares* (yellowfin tuna) and *Acanthocybium solandri* (wahoo). Twenty individuals of each species were collected from the Saint Peter and Saint Paul Archipelago (ASPSP), a remote oceanic region of the equatorial Atlantic, during January and February 2023. The samples were subjected to acid digestion and analyzed by inductively coupled plasma optical emission spectrometry (ICP-OES). Differences between species were assessed using the nonparametric Kruskal–Wallis test ($p=0.05$). Mean Ag concentrations were low and showed no significant difference between *T. albacares* (0.03 mg/kg) and *A. solandri* (0.04 mg/kg; $H=3.58$; $p=0.0578$). For Se, significantly higher levels were observed in tuna (2.17 mg/kg) compared to wahoo (1.51 mg/kg; $H=7.60$; $p=0.0058$). In both cases, mean values remained below the maximum limits established by current Brazilian legislation. The findings highlight the dual dimension of ocean fish consumption: on the one hand, a relevant nutritional contribution through Se; on the other, a detectable presence of Ag, albeit at low concentrations, which reinforces the importance of continuous monitoring even in remote areas such as the ASPSP. An integrated assessment of essential elements and emerging contaminants proves essential to support risk analyses and food security strategies.

Keywords: Bioaccumulation, Food safety, ICP-OES, Marine pelagic fish.

SOCIOENVIRONMENTAL CHANGES CAUSED BY AGRICULTURE MODERNIZATION IN NORTHERN RIO GRANDE DO SUL: 1950- 1970

Marcos Paulo de Oliveira Júnior^{1*}

¹Master's Degree in Environmental History, University of Passo Fundo, Teacher Integrated Regional University of Alto Uruguai and Missões, campus Erechim.

*Contact: 143142@upf.br

This research seeks to understand the socio-environmental and landscape transformations introduced by the modernization of agriculture in northern Rio Grande do Sul, where the municipalities of Carazinho and Não-Me-Toque are currently located. This regional context is intertwined with the global process of agricultural transformations and must be understood within this context. The time frame begins shortly before the modernization of agriculture in the region, which occurred around 1960 and continued until the 1970s. The research employs conceptual and methodological frameworks from Environmental History, Geography, and Biology. It preliminarily concludes that the main socio-environmental and landscape changes were deforestation to clear new agricultural areas and roads, and environmental contamination from agrochemicals.

Keywords: Agriculture, Modernization, Socio-environmental.

SPATIAL ASSESSMENT OF WATER QUALITY AND METALS ALONG THE PEDREIRA RIVER, AMAPÁ, BRAZIL

Suzane Rodrigues de Oliveira^{1*}, Andrea Clementina Almeida Macedo¹, Edinaldo de Souza Mendes¹, Aluísio Medeiros da Silva¹, Jéssica Caroline Evangelista Vilhena¹, Alexandro César Florentino¹

¹Graduate Program in Environmental Sciences, University of Federal Amapá, campus Marco Zero.

*Contact: susanerodrigues@gmail.com,

Water is essential for sustaining life, and the quality of aquatic ecosystems serves as an indicator of environmental balance. This study aimed to assess the physicochemical parameters and metal concentrations in the upper, middle, and lower sections of the Pedreira River, comparing the results with the limits established by CONAMA Resolution 357/2005 for Class 2 freshwater. Sampling was conducted at 17 points. Parameters such as pH, dissolved oxygen (DO), and total dissolved solids (TDS) were measured in situ using a multiparameter probe (HI98194), and turbidity was determined with a turbidimeter (LinLab). For metal analysis, 1 L water samples were collected: aluminum (Al), copper (Cu), iron (Fe), and manganese (Mn) were evaluated by spectrophotometry (Hach DR 3900), and mercury (Hg) by direct analysis using the DMA-80 analyzer. The results showed spatial variations in parameters and metals. DO was below the minimum limit (5 mg/L) in the middle (2.86 mg/L) and lower (3.23 mg/L) sections, possibly due to higher organic matter presence and biological decomposition. pH ranged from 4.43 in the upper section to 5.42 in the lower section, reflecting the influence of natural processes. Turbidity remained within the legal limit (100 NTU), being higher in the lower section (16.78 NTU), likely due to siltation and surface runoff. Al, Mn, and Hg remained within the limits, whereas Cu and Fe exceeded the permitted values in all sections, with the highest concentrations in the lower section (Cu = 0.058 mg/L; Fe = 0.988 mg/L), possibly associated with natural and anthropogenic processes. It is concluded that there is progressive water quality degradation along the Pedreira River, with increasing metal concentrations and decreasing oxygen downstream, highlighting the importance of continuous monitoring to support environmental management actions and protect aquatic biota.

Keywords: Aquatic ecosystems, Environmental monitoring, Inorganic contaminants.

SPATIAL DISTRIBUTION OF THE HYDROPSYCHIDAE FAMILY (*Trichoptera*) IN THE COMANDAÍ SUB-BASIN, NORTHWEST RS

Bruna Amaral da Costa^{1*}, Isabela Alves dos Santos¹, João Fernando Medeiros Cardoso¹, Milton Norberto Strieder², David Augusto Reynalte-Tataje²

¹Master's Student, Federal University of Fronteira Sul, campus Cerro Largo;

²Postgraduate Program in Environment and Sustainable Technologies, Federal University of Fronteira Sul, campus Cerro Largo.

*Contact: bruna.amaral@estudante.uffs.edu.br

Continental aquatic ecosystems are extremely important because they play a fundamental role in maintaining the water cycle. In addition, macroinvertebrates are essential for the balance of aquatic ecosystems and play an important role in the food chain. Among the macroinvertebrates, the family Hydropsychidae stands out as one of the largest families in the order Trichoptera and is considered a good indicator of water quality. Their feeding habits utilize fine particulate organic matter suspended in the water column, helping to keep the water clean. The present study aims to verify the spatial distribution of the Hydropsychidae family. The research was conducted in the Comandaí sub-basin, where 18 sampling sites were selected, divided into 2 tributaries in the lower region, 2 in the middle region, and 2 in the upper region, and further separated into 3 sections (source, intermediate, and mouth). For the collections, active sampling methods using dipnet and kick-net were employed. The samples were collected in October 2024. The Hydropsychidae family showed a heterogeneous distribution (0–18.3%). The streams/sections with the highest number of individuals were Pessegueiro/I with 13.2%, followed by Lambedor/F (10.5%) and Luiza/N (9.6%), all of which had good dissolved oxygen (DO) levels and were better preserved. Studies indicate that streams with vegetation and reduced anthropogenic impacts tend to have a greater number of individuals and even larger body sizes. However, due to low DO levels, there was an absence of individuals in Pessegueiro/N and Comandaizinho/F. Comandaizinho/I also showed an absence, but with good DO levels, indicating that other factors may have influenced the results. Furthermore, more preserved areas are associated with environmental quality and food availability, which influence the presence or absence of individuals. Based on this, the family was present in much of the sub-basin, indicating good environmental quality.

Keywords: Aquatic macroinvertebrates, Environmental quality, Streams, Freshwater.

SUSTAINABLE WEED MANAGEMENT IN ANNUAL AND PERENNIAL CROPS

Gerônimo Rodrigues Prado^{1*}, Maico André Michelin Bagnara¹, Equiton Lorengian Gregio¹, Vanderlei Smaniotto¹, Nycollas Stefanello Vianna¹, Leandro Galon²

¹Postgraduate Program in Environmental Science and Technology, UFFS, Erechim, RS;

²Dr, Teacher permanent, Program in Environmental Science and Technology, UFFS, Erechim, RS.

*Contact: geronimo-prado@uergs.edu.br

Weeds represent one of the main biotic barriers to agricultural productivity, as they compete for nutrients, water, and light, and are hosts to undesirable organisms. Conventional control, largely based on chemical herbicides, while effective, raises concerns regarding environmental sustainability. Therefore, the objective of this study was to survey and critically analyze the main technologies aimed at sustainable weed management in annual and perennial crops. The methodology consisted of a systematic literature review, with searches conducted in the Web of Science database, prioritizing articles published between 2020 and 2025. Keywords such as "mechanical weed control," "biological weed control," and "sustainable weed management" were used. Twenty-seven articles addressing sustainable weed management practices were selected. The results revealed that physical and mechanical control strategies, such as manual weeding, the use of robotic weeders, and mulching with plant residues, have demonstrated high effectiveness, especially when combined with reduced herbicide use. Practices such as soil solarization and the application of biodegradable fabrics have also shown promise. Biological control, in turn, has been explored with the use of plant extracts, essential oils, and microbial and fungal bioherbicides, with effective results when applied to some weed species. Regarding chemical control, crop rotation and the controlled use of herbicides remain important strategies within integrated management. Also noteworthy is the emergence of innovative technologies such as nanoencapsulated herbicides, which provide controlled release and lower environmental impact. Furthermore, computer vision tools with artificial intelligence, such as YOLOV8, enable accurate weed detection in real time. However, widespread adoption of these technologies is still limited by factors such as cost, terrain adaptation, and the need for training. It is concluded that sustainable weed management requires an integrated and adaptable approach that combines traditional practices with technological innovations.

Keywords: New technologies, Sustainable management, Weed.

TANK MIX INTERACTIONS BETWEEN HERBICIDES AND FERTILIZERS APPLIED TO SOYBEAN WITH ENLIST® TECHNOLOGY

**Gabrieli Enge Zamboni^{1*}, Tailana Iager¹, Felipe Bittencourt Ortiz¹, Gilson Lucas Muller²,
Lucas Tedesco², Leandro Galon³**

¹Master's students of the Graduate Program in Environmental Science and Technology, Federal University of Fronteira Sul, campus Erechim;

²Undergraduate Agronomy students, Federal University of Fronteira Sul, campus Erechim;

³Professor of Agronomy and of the Graduate Program in Environmental Science and Technology, Federal University of Fronteira Sul, campus Erechim.

*Contact: gabrieli.zamboni18@gmail.com

The Enlist technology allows the use of herbicides such as 2,4-D, ammonium glufosinate, and glyphosate applied in soybean post-emergence, facilitating the management of problematic weeds, resistant or tolerant to EPSPS inhibitors. Considering that many farmers perform tank mixtures of products for different purposes, the objective was to evaluate the selectivity of associations between herbicides and foliar fertilizers applied individually or in combination in soybean crops. The experiments were conducted over two growing seasons (2021/22 and 2022/23), in a randomized block design arranged in a $3 \times 7 + 1$ factorial scheme, with four replications. In Factor A, the treatments consisted of glyphosate + 2,4-D choline ($2.77 + 2.13 \text{ L ha}^{-1}$), Stimulate (0.50 L ha^{-1}), Starter Platinum (1.50 L ha^{-1}), Mega-Fast (2.00 L ha^{-1}), and their combinations. Factor B corresponded to the soybean growth stages at which the products were applied (V3, V6, and V3+V6). Soybean phytotoxicity was evaluated at 7, 14, 21, 28, and 35 days after treatment (DAT). At harvest, yield components were determined. The combination of glyphosate + 2,4-D choline with fertilizers (Stimulate, Starter Platinum, and Mega-Fast) increased phytotoxicity in soybean, especially under sequential applications (V3+V6). The fertilizers alone did not cause phytotoxicity to soybean, regardless of the growth stage of application. The hand-weeded control and glyphosate + 2,4-D choline application showed the best performance in soybean grain yield components. The application of glyphosate + 2,4-D choline associated with fertilizers had a negative effect on grain yield. The isolated application of fertilizers resulted in an average increase of 3.16% in soybean grain yield.

Keywords: *Glycine max*, Grain yield, Phytotoxicity, Selectivity.

THE EXPRESSION OF LABOR FORMS IN FAMILY FARMING ASSOCIATED WITH THE SINDICATO UNIFICADO DA AGRICULTURA FAMILIAR DO ALTO URUGUAI (SUTRAF-AU)

Ezequiel Bampi^{1*}, Valdecir J. Zonin²

¹Master's student PPGTA, UFFS, Erechim Campus;

²PhD in Agribusiness, Professor UFFS, Erechim Campus.

*Contact: ezequiel.bampi@estudante.uffs.edu.br

The organization of labor in Brazil's rural sector is characterized by complexity, largely due to the prevalence of pluriactivity in the approach to productive systems—a condition shaped by historical and cultural patterns over time. Agriculture in this context encompasses both traditional practices and mechanized methods, with the former marked by high biodiversity and the latter by monoculture, revealing a socially diverse landscape of family farmers. This study aims to examine the nature of labor within family farming as represented by the Sindicato Unificado Da Agricultura Familiar Do Alto Uruguai (SUTRAF-AU). Data collection was conducted through printed questionnaires administered to a random sample of 65 families, approximately 10% of the total membership. Responses were organized in electronic spreadsheets and analyzed using descriptive statistics, with results presented in percentage-based charts. The analysis of the labor force in family farming reveals a predominance of families exclusively engaged in food production (60.2%), underscoring the centrality of agriculture as the primary source of income. Farmers with partial income, accounting for 16.1%, demonstrate a reorganization of labor relations within family units, seeking complementary sources of livelihood. The significant presence of retirees (18.1%) and students (19.3%) in productive activities, even if only partially involved, indicates a functional overlap that contributes to the sustainability of production units. The category of New Rural Actors (8.3%), composed of individuals who reside in rural areas but work in urban centers, reflects pluriactivity as a survival strategy in response to low agricultural profitability. It can be concluded that the labor structure in family farming is characterized by a strong dependence on the family nucleus, with a predominance of food production; however, there is a significant presence of pluriactivity. These factors reflect both the resilience and vulnerability of this productive model in the face of contemporary social and economic transformations.

Keywords: Agriculture, Food production, Income generation.

THE IMPACT OF COOPERATIVISM ON STRENGTHENING YOUTH AND SUSTAINABLE RURAL COMMUNITIES

Ian Felipe Nascimento^{1*}, Fábio dos Santos Massena², Nicolli Souza Silva³

¹Master's student in Biosystems, Federal University of Southern Bahia, Jorge Amado;

²Full Professor, Santa Cruz State University, Soane Nazaré;

³Master's student in Animal Science, Santa Cruz State University.

*Contact: nascimetoian31@gmail.com

This article is a section of the research project "The feeling of belonging and the affective representations of youth from family farming communities in Ilhéus". This segment focuses on the experiences and results of a Scientific Initiation project linked to the State University of Santa Cruz (UESC). The study aimed, through the lived experiences of Scientific Initiation with rural youth from southern Bahia, to demonstrate the impact of cooperativism as a potential strategy for the socioeconomic empowerment of young people, highlighting their perceptions of family farming in the rural community of Tibina, located in Ilhéus (BA). Cooperativism is both a model and a strengthening agent integrated into the development of sustainable environments, capable of improving living conditions in rural communities and inspiring the dreams of young people. The study reveals cooperativism as a powerful tool that impacts rural youth by reinforcing affective ties to their territory, strengthening positive representations of rural life, and encouraging youth leadership. It is concluded that by integrating values such as cooperation, ethics, and belonging, cooperativism contributes to the development of fairer and more united communities, expanding the possibilities for young people to remain in rural areas with dignity. Investing in rural youth and in the strengthening of cooperativism—with technical support, effective public policies, and active youth participation—is essential to ensure the future of cooperativism and family farming for a more cooperative, equitable, and sustainable society.

Keywords: Cooperativism, Cooperative education, Student perception, SDGs.

TROPOSPHERIC OZONE MEASUREMENTS: PASSIVE SAMPLING AS A LOW-COST APPROACH

Daniele Gomiero Polli Sartori^{1*}, Erika Pereira Felix²

¹Undergraduate Degree in Environmental Chemistry Technology, Federal University of Technology, campus Curitiba;

²PhD in Chemistry, Assistant Teacher, Department of Chemistry and Biology, Federal University of Technology, campus Curitiba.

*Contact: daniele_gp@hotmail.com

Tropospheric ozone is a strong photochemical oxidant that acts as a pollutant, reacting with unsaturated organic compounds and damaging materials and biological systems. Among atmospheric constituents, it has one of the narrowest margins between background concentrations and harmful levels for human health and ecosystems. Its formation depends on solar radiation, precursors (NO_x and VOCs), and dispersion conditions. At elevated concentrations, ozone contributes to photochemical smog and the greenhouse effect, making monitoring in urban areas essential for assessing environmental risks and compliance with air quality standards. This study evaluated ozone levels at UTFPR central campus in Curitiba and compared passive sampling results with active sampling data from the Environmental Institute of Paraná (IAP). Passive sampling employed cellulose filters impregnated with indigo-blue dye, bleached upon reacting with ozone, and quantified spectrophotometrically at 600 nm, while active sampling at IAP was based on UV absorption at 254 nm. Measurements were conducted at three locations on campus near the IAP station during September–October 2011. Passive sampling captured temporal patterns similar to IAP data but consistently reported higher mean concentrations. The IAP mean was $69.6 \mu\text{g}\cdot\text{m}^{-3}$, while campus means reached $127.8 \mu\text{g}\cdot\text{m}^{-3}$ at location 1, $123.2 \mu\text{g}\cdot\text{m}^{-3}$ at location 2, and $156.7 \mu\text{g}\cdot\text{m}^{-3}$ at location 3. Overall, 87.5% of campus measurements exceeded IAP values. The national limit in 2011 was $160 \mu\text{g}\cdot\text{m}^{-3}$ (1-h average, CONAMA 3/1990), while the current limit is $130 \mu\text{g}\cdot\text{m}^{-3}$ (8-h average, PI-2, CONAMA 506/2024), underscoring the relevance of these exceedances. Results demonstrate the spatial variability of ozone at the local scale and the tendency of the passive method to overestimate absolute levels. Although active sampling is accurate, it is costly; passive sampling has proven practical and low-cost, reinforcing its importance as an alternative method for urban air quality assessment.

Keywords: Air pollutant, Air quality, Alternative method, Indigo-blue dye, Ozone levels.

USE OF BIOMARKERS TO ASSESS MERCURY EXPOSURE IN TRADITIONAL COMMUNITIES IN THE STATE OF AMAPÁ

Aluísio Medeiros da Silva^{1*}, Alexandro Cezar Florentino², Cassiane dos Santos Videira³,
Jéssica Caroline Evangelista Vilhena⁴, Suzane Rodrigues de Oliveira³

¹Student at the University of Amapá;

²Teacher at the University of Amapá;

³Master's degree at the University of Amapá;

⁴Postdoctoral at the University of Amapá.

*Contact: aluisionsei123@gmail.com

Mercury contamination represents a significant concern for traditional communities that rely on fish as their main food source, as the bioaccumulation of this metal can pose serious health risks. Thus, biomarkers such as hair are essential for accurately assessing mercury exposure in these populations. The present study aimed to investigate the presence of mercury in communities in the state of Amapá, using hair as a biomarker to evaluate exposure levels and potential health risks. The research was conducted in the municipalities of Abacate da Pedreira (AP), Bonito da Pedreira (BP), and Assentamento Santo Antônio da Pedreira (AS), with the participation of 38 individuals. Total mercury concentrations were determined by atomic absorption spectrometry (DMA-80 Direct Mercury Analyzer). The results showed that the mean mercury concentration was highest in BP (0.6545 µg/g), followed by AS (0.5095 µg/g) and AP (0.3970 µg/g). Data variability was also higher in BP (SD = 0.5521), suggesting heterogeneity in exposure. The medians were 0.4691 µg/g (BP), 0.4955 µg/g (AS), and 0.2399 µg/g (AP). Values ranged from 0.09435 µg/g to 1.62165 µg/g. However, the Kruskal-Wallis analysis ($\chi^2 = 3.8271$; $p = 0.1476$) did not identify statistically significant differences between the communities. These findings indicate that mercury exposure occurs relatively uniformly among the populations studied, possibly due to similar fish consumption patterns and common environmental sources. The high variability in BP, however, suggests distinct individual exposure profiles. The study highlights the importance of using hair as an effective tool for monitoring mercury exposure and reinforces the need for further research with larger sample sizes.

Keywords: Environmental exposure, Metal, Monitoring.

USE OF COVER CROPS WITH THE POTENTIAL TO DECONTAMINATE SOIL POLLUTED BY HERBICIDES

**Tailana Iager^{1*}, Eduarda Batistelli Giacomolli², Otávio Augusto Dassoler², Lucas Tedesco²,
Gabrieli Enge Zamboni¹, Leandro Galon³**

¹Master's students in Programs in Environmental Science and Technology, Federal University of Fronteira Sul, campus Erechim;

²Undergraduate Agronomy students, University of Federal Fronteira Sul, campus Erechim;

³Professor of the Master's and Doctorate Programs in Environmental Science and Technology, Federal University of Fronteira Sul, campus Erechim.

*Contact: iagertailana@gmail.com

The frequent and sometimes improper use of herbicides in agriculture has led to environmental problems such as contamination of water resources and soil. Residues from these products can harm crops grown in succession and pose risks to human and animal health. Therefore, alternatives for decontaminating herbicide-contaminated soil through phytoremediation are being investigated. The objective of this study was to evaluate the potential of cover crop species for the phytoremediation of soil treated with the herbicides diuron, sulfentrazone, and diuron + sulfentrazone. The experiment was conducted in the experimental area of UFFS, using a randomized block design in a 3×9 factorial scheme with four replicates. The first factor consisted of plant species: *Avena strigosa*, *Vicia sativa*, *Secale cereale*, *Raphanus sativus*, *Fagopyrum esculentum*, *Lolium multiflorum*, *Lupinus albus*, a mix of species, and soil without cultivation. The second factor consisted of the herbicides diuron (490 g ha^{-1}), sulfentrazone (245 g ha^{-1}), and the commercial mixture of diuron + sulfentrazone ($490 + 245 \text{ g ha}^{-1}$). At 7, 14, 21, 28, and 35 days after emergence, phytotoxicity assessments were performed on the species with phytoremediation potential, assigning scores from zero (no injury) to 100% (plant death). The results indicated that diuron, evaluated at 7 and 35 days after plant emergence, did not cause phytotoxicity in any of the tested species. It was observed that *V. sativa* and *L. albus* showed the ability to decontaminate soil treated with diuron and sulfentrazone. Diuron caused less phytotoxicity to all species tested as potential soil phytoremediators. The species *L. albus* and *V. sativa* were the least affected by sulfentrazone and diuron + sulfentrazone.

Keywords: Decontamination, Green manure, Phytoremediation.

VALIDATING THE USE OF HERBARIUM DATA IN REPRODUCTIVE PHENOLOGICAL STUDIES IN PLANTS

Inaê Carolina Sfalcin^{1*}, Pietra Vittoria Cerqueira V. Toniolo², Merilim Piquelet³

¹Phd student in Genetic and Molecular Biology, Federal University of Rio Grande do Sul;

²Biological Sciences student, Federal University of Rio Grande do Sul;

³Phd student in Science Education, Federal University of Rio Grande do Sul.

*Contact: biol.inae@gmail.com

Phenological studies often require exhaustive field trips and substantial financial resources. To overcome this limitation, herbarium records emerge as a potential data source about plant phenological variations. This study aimed to test this hypothesis by investigating whether there is a difference in reproductive phenology between allopatric populations of plants, using herbarium data. For this purpose, *Herbertia quareimana* Ravenna (Iridaceae) was chosen as a model, as it has a restricted distribution in two distinct geographic locations and a rapid fruit development cycle. Collection records from SpeciesLink[®] were compiled and analyzed using Excell[®] for location, collection date, and presence of flowers and fruits. Pearson's Chi-Squared Test was applied using R software to verify whether flowering and fruiting differ between plants from the Campanha and Missões regions (Rio Grande do Sul), regarding the phenological period (early vs. late spring) and total fruit production. The 34 records obtained were concentrated between September and December, from 1971 to 2024. There was no statistical difference in the number of flowers between Campanha and Missões (p -value=1). Fruit concentration was significantly higher ($\chi^2=14.22$; $p<0.001$) in plants from Campanha (52 fruits; mean of 2.5 per plant) than in those from Missões (20 fruits; mean of 1.5 per plant). Campanha showed 6.4 times more fruits (45 fruits) at the end of the season (November/December) ($\chi^2=27.77$; $p<0.001$) than at the beginning (seven fruits; September/October). Missões concentrated more fruits in early season (57% more), but without statistical significance ($p=0.074$), possibly influenced by the low number of late-season collections ($n=2$). The evaluation of herbarium records indicated that in Campanha, plants fruit later and in greater quantity than in Missões, suggesting a phenological difference between plants from the different regions. Furthermore, this study confirms that herbarium data can be a useful tool for preliminary reproductive phenological studies.

Keywords: Exsiccates, Herbarium data, Phenology, Reproductive biology.

VALORIZATION OF LIGNOCELLULOSIC BIOMASS

Charline Veneral^{1*}, Airton Kunz², Helen Treichel³

¹Master's student in the Graduate Program in Environmental Science and Technology, Federal University of Fronteira Sul, campus Erechim;

²Researcher at Embrapa Swine and Poultry, Concórdia;

³PhD, Laboratory of Microbiology and Bioprocess, Federal University of Fronteira Sul, campus Erechim.

*Contact: charlineveneral@gmail.com

Sorghum (*Sorghum bicolor*) and elephant grass (*Pennisetum purpureum*) stand out as lignocellulosic biomasses with high potential for biotechnological applications, due to their high productivity and cellulose- and hemicellulose-rich composition. However, the presence of lignin and the high crystallinity of cellulose hinder their conversion, reducing the efficiency of biological processes. In this context, enzymes produced by fungi of the genus *Trichoderma*, such as *T. koningiopsis*, represent a sustainable alternative to increase the bioavailability of these biomasses. The present study aimed to evaluate the enzymatic activity of extracts obtained by solid-state fermentation (SSF) of *T. koningiopsis* on ensiled sorghum and elephant grass. The biomasses were previously washed, ground, and subjected to SSF for 96 h under conditions of 90% relative humidity. After incubation, the extracts were recovered by phosphate buffer extraction (100 mM, pH 7.0) and analyzed for cellulase activity by the dinitrosalicylic acid (DNS) method, and protease activity through the hydrolysis of a protein substrate. Results were compared with those obtained from the application of a cellulolytic enzymatic blend on both biomasses. Extracts derived from SSF showed detectable cellulase activity, higher than that observed in the initial enzymatic blend, indicating potential for application in biomass degradation processes. In addition, protease activity was detected, suggesting the production of a diversified enzymatic cocktail, which is advantageous for the hydrolysis of complex biomasses. Differences between sorghum and elephant grass highlighted the influence of lignocellulosic composition on process efficiency, reinforcing the importance of raw material selection. Thus, it is concluded that *T. koningiopsis* has biotechnological potential to increase the bioavailability of low-cost biomasses, although further optimization studies are required to improve enzymatic activity levels and broaden its applicability.

Keywords: Cellulase, Lignocellulosic biomass, Protease, Solid-state fermentation, *Trichoderma koningiopsis*.

VALORIZATION OF MIXED FRUIT WASTE FOR BIOETHANOL PRODUCTION AND D-LIMONENE EXTRACTION

Isabely Sandi Baldasso^{1,3*}, Vitória Dassoler Longo^{1,3}, Marcelli Powzum Amorim^{2,3}, Nair Mirely Freire Pinheiro Silveira^{1,3}, Emanuely Fagundes da Silva^{1,3}, Helen Treichel^{1,3}

^{1*}Graduate Program in Environmental and Sanitary Engineering, Federal University of Fronteira Sul, campus Erechim;

²Postgraduate Program in Environmental Science and Technology, Federal University of Fronteira Sul, campus Erechim;

³Laboratory of Microbiology and Bioprocess, Federal University of Fronteira Sul, campus Erechim.

*Contact: isabelysandibaldasso@gmail.com

Foods intended for human consumption are wasted throughout the production chain, especially non-reusable items such as fruit waste, which depletes the planet's natural resources. This highlights the need for viable technologies to utilize this waste, with a focus on the circular economy and the generation of high-value products. This study aims to utilize the peels of a mix of fruits, such as oranges, bananas, mangos, pineapples, and lemons, rich in fermentable sugars, to produce valuable bioproducts such as D-limonene and bioethanol. The procedure began with biomass processing, followed by D-limonene extraction using Soxhlet for 4 hours. The extract was purified using a rotary evaporator and subsequently resuspended. Enzymatic hydrolysis was optimized using a Central Composite Rotatable Design (CCRD) experimental design. To quantify only the soluble sugars generated, the biomass was washed in a Dubnoff bath. The hydrolyzed musts underwent alcoholic fermentation with the inoculation of the yeast *Wickerhamomyces* sp. Aliquots were taken at 0, 12, 24, and 48 h. Total reducing sugars were quantified by the 3,5-dinitrosalicylic acid method (DNS). Specific sugars and fermentation byproducts were analyzed using high-performance liquid chromatography (HPLC) with a Shimadzu system equipped with a refractive index detector and an Aminex column. The D-limonene concentration was determined by gas chromatography coupled to mass spectrometry, with hexane dilution and a capillary column. The results showed that D-limonene extraction yielded 6.41 mg/g. Optimization of enzymatic hydrolysis allowed a 40% reduction in enzyme use, enabling the conversion of 96.87% of glucose to ethanol in just 12 h of fermentation. This study demonstrated the favorable and sustainable conditions for an integrated biorefinery system, with significant potential for bioethanol production.

Keywords: Biocompounds, Enzymatic hydrolysis, Fruit residue, Soxhlet extraction.

WHAT ATTRACTS VISITORS TO PROTECTED AREAS IN THE CAATINGA BIOME? EVIDENCE FROM SOCIAL MEDIA

Isabela Alves dos Santos^{1*}, Daniela Oliveira de Lima¹

¹Master's student, Federal University of Fronteira Sul, campus Cerro Largo;

¹PhD, Federal University of Fronteira Sul, campus Cerro Largo.

*Contact: belaalvessantos@gmail.com

The Caatinga is an exclusively Brazilian biome, characterized by a diverse fauna and flora that are mostly endemic to Brazil, and it attracts many visitors to its Protected Areas (PAs). Social media platforms are increasingly being used in the management of PAs to better understand visitors' preferences and interactions with nature. In this context, an analysis of Facebook and Instagram posts was conducted to assess the provision of cultural ecosystem services, aiming to identify which characteristics of PAs are most attractive to visitors. Ten of the most popular PAs located in the Caatinga biome on social media were selected. For each PA, up to 30 posts (photos or videos) were analyzed on each platform. Posts were found for six of the selected PAs, resulting in a total of 341 posts: 183 from Facebook and 158 from Instagram, of which 313 were photos and 28 were videos. Among these, 224 posts featured landscapes, 58 water bodies, 20 fauna, 33 flora, 51 roads/trails, and 15 buildings. Regarding human presence, 171 posts presented only one person, 53 presented a group of people, 48 presented couples (two individuals regardless of gender), and 24 posts presented children. A total of 48 posts presented sports activities such as hiking, cycling, running, climbing, motorcycling, zip-lining, and trail, with cycling (15 posts) and trail (17 posts) being the most frequent. Additionally, five posts presented exotic or domestic animals. By identifying landscapes, water bodies, biodiversity, and sports activities as central to visitor experiences, this study demonstrates the potential of social media to inform the management of cultural ecosystem services in Caatinga PAs. These insights can contribute to strategies that strengthen the connection between people and nature, such as investing in the landscapes of these locations, the quality of their water bodies, the preservation of native species, and sustainable ecotourism.

Keywords: Ecotourism, Ecosystem services, Preservation.

YEAST-BASED TREATMENT IN THE INITIAL GROWTH OF BEET PLANTS

Vanessa Neumann Silva^{1*}, Ana Paula Madaloz², Claudia Kulba Sette², Camila Girardi de Oliveira³, Sérgio Luiz Alves Júnior⁴

¹PhD in Plant Science, UFFS, campus Chapecó;

²Undergraduate Student in Agronomy, University of Federal Fronteira Sul, campus Chapecó;

³Undergraduate Student in Environmental and Sanitary Engineering, University of Federal Fronteira Sul, campus Chapecó;

⁴PhD in Biotechnology, University of Federal Fronteira Sul, campus Chapecó.

*Contact: vanessa.neumann@uffs.edu.br

Yeasts that promote plant growth have stood out in agriculture. Their use as inputs can contribute to increased sustainability, as it is a clean technique that leaves no residues in food or the environment. Therefore, this study aimed to evaluate the effect of *Rhodotorula spp.* application on the initial growth of beet plants. The experiment was carried out in a laboratory and in an agricultural greenhouse at UFFS Chapecó campus, using beet seeds (Maravilha cultivar) without commercial treatment. Six treatments with five replications were used, as follows: Untreated seeds and substrate without yeast; Untreated seeds and substrate with yeast applied on the day of sowing; Untreated seeds and substrate with yeast applied on the day of sowing and 7 days later; Treated seeds and substrate without yeast; Treated seeds and substrate with yeast applied on the day of sowing; Treated seeds and substrate with yeast applied on the day of sowing and 7 days later. Seed treatment was performed by soaking in *Rhodotorula spp.* culture for 24 hours. Substrate treatments were carried out with 25 mL per pot. Pots of 5L with sterilized substrate were used. The plants remained in the agricultural greenhouse with automated irrigation. At 21 days after transplanting, the following parameters were evaluated: plant height, number of leaves, and leaf width and length. The results obtained were subjected to analysis of variance and mean comparison (Scott Knott $p < 0.05$). Differences between treatments were observed, with a beneficial effect of yeast application on plant height and leaf length, with better performance in treatments where yeast was applied on the day of sowing and 7 days later. Thus, it can be concluded that *Rhodotorula spp.* application enhances the initial growth of beet plants, especially when applied directly to the cultivation substrate.

Keywords: Beneficial microorganisms, *Beta vulgaris*, *Rhodotorula spp.*