



IMPACTS OF THE 2020 PANTANAL WETLANDS MEGAFIRES ON ZOOPLANKTON TAXONOMIC AND FUNCTIONAL DIVERSITY

Jonatham Hercules da Silva Maciel¹, Diogo Ramos Pacheco², Dieison André Moi³, Ronnilda Maria Gonçalves Araujo¹, Larissa Carrara Gonçalves², Bruno Rech⁴, Marcia Teixeira de Oliveira¹, Thais Xavier Melo¹, Bruno Renaly Souza Figueiredo^{1,2}

¹ Universidade Federal de Mato Grosso, Cuiabá, Mato Grosso, Brasil.

² Universidade Federal de Santa Catarina, Florianópolis, Santa Catarina, Brasil.

³ Universidade Estadual de Campinas, Campinas, São Paulo, Brasil

⁴ Instituto de Pesquisas Espaciais, São José dos Campos, São Paulo, Brasil

E-mail: brsfigueiredo@gmail.com

Extreme wildfires, known as megafires, are becoming increasingly frequent and intense worldwide due to climate change and human activities, with profound consequences for biodiversity and ecosystem functioning. In 2020, the Pantanal, the world's largest tropical wetland, experienced unprecedented fires that burned approximately four million hectares (~30% of its area) and caused the death of an estimated 17 million vertebrates. Despite these dramatic impacts, the effects on aquatic biodiversity remain poorly understood. Here, we evaluated how fire severity influences zooplankton taxonomic and functional diversity by altering water physicochemical conditions, using a structural equation modeling (SEM) approach. Fire severity around each sampling site was quantified using the delta Normalized Burn Ratio (dNBR) derived from Sentinel-2 imagery within a riparian buffer based on Brazilian conservation guidelines. We sampled zooplankton communities and environmental variables at 29 sites along the Cuiabá River during the fire period (September 2020, prior to major rainfall-driven ash inputs) and seven months later (April 2021, post-fire). Our results show that low-severity fires exhibited weak relationships with limnological parameters and no significant direct or indirect effects on functional dispersion or species richness, indicating limited ecological impact under mild disturbance. In contrast, high/moderate-severity fires were strongly associated with shifts in physicochemical water parameters (e.g., increased ionic content and reduced water transparency), which in turn negatively affected both species richness and functional dispersion. These results highlight that the impacts of severe fires are largely mediated by changes in environmental conditions rather than by the direct effects of ash inputs alone. Overall, our findings suggest that intense fires act as environmental filters, simplifying both the taxonomic and functional structure of zooplankton communities, with potential consequences for ecosystem resilience and recovery in tropical floodplain rivers.

Keywords: *Fire severity; Wildfire ash; Structural equation modeling; Functional dispersion; Freshwater ecosystems.*