



ECOLOGICAL RECOVERY OF AN AMAZONIAN LAKE IMPACTED BY BAUXITE MINING IS DRIVEN BY CONNECTIVITY TO IGAPÓ FOREST

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Amazonian freshwater ecosystems are exposed to multiple anthropogenic pressures, among which mining is a major source of pollution. Batata Lake is a clear-water Amazonian lake that received large inputs of bauxite mining tailings for ten years, causing intense siltation of the lake and adjacent flooded forest. This process altered water quality and directly affected aquatic communities, resulting in distinct impacted and non-impacted regions within the lake. This study aimed to analyze and quantify the ecological recovery of Batata Lake following the cessation of the impact. A long-term limnological dataset from Batata Lake was analyzed using an integrated multivariate metric. A Principal Coordinates Analysis (PCoA) was performed, followed by hypervolume estimation. Three metrics were calculated: hypervolume overlap (O), centroid distance (Cd), and minimum distance (Md), and combined into an Ecological Recovery Index (ERI) = $\frac{((1 - Cd) * \frac{e^O}{e^{Md}}))}{e^1}$, ranging from 0 to 1, where higher values indicate greater similarity to reference conditions. The threshold of 0.5 separates poor and good conditions. The results indicate a gradual ecological improvement of Batata Lake following the cessation of mining discharge. The ERI increased from an initial value of 0.42 to 0.58 at the end. Temporal analysis revealed a significant positive trend, with a slope of 0.007 ($p < 0.05$) and $R^2 = 0.64$. The improvement of Batata Lake is driven by the hydrological connectivity between the lake's pelagic zone and the adjacent flooded forest, which facilitates the input and incorporation of allochthonous organic matter in the suspended solids. This process is enhanced by



restoration actions in impacted forest areas. Additionally, variations in hydrological phases influence the recovery process due to hydrodynamics, providing better conditions at phases with higher water flow, enhancing oxygen levels, and improving water clarity. However, climate change can hinder lake recovery, particularly during extreme droughts, thereby delaying ecological recovery.

Palavras-chave: *recovery; Amazon; freshwater; lake Batata; mining tailing.*