Criticality, fragmentation collapse and potential impact to ecosystem services in spatial landscapes. Case study: "Abras de Mantequilla" wetland in Ecuador.

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Abstract

Ecuador is experiencing the adverse effects of intensive land-use change, resulting in the reconfiguration of landscapes at all spatial levels. This process has led to land fragmentation, a consequence of the gradual clearing of native and secondary forests and the introduction of plantations in open grasslands and sensitive ecosystems. The fragmentation of habitats

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results in the isolation of the remaining habitat patches, reducing biodiversity, forest biomass, and changes in nutrient cycling (Scanlon et al., 2007; Saravia et al., 2018). The impact of fragmentation is not limited to ecological effects but also affects human activities, as ecosystem services are deeply influenced by landscape fragmentation. Therefore, it is crucial to assess land-use change and criticality analysis at a wetland scale.

Our case study focuses on the "Abras de Mantequilla" wetland, located in the province of "Los Ríos" in Ecuador, which is part of the "Municipal Association for the Sustainable Management of the AdM wetland" territory. The AdM wetland is a RAMSAR site in the middle of the Guayas River Basin, one of the main riverine ecosystems in Ecuador. The AdM wetland was declared a RAMSAR site in 2000, with an area of 54,486 ha and an estimated population of 210,000. The AdM wetland is a lagoon complex comprising seasonal or eutrophic lagoons fed by the winter floods of the Vinces River and which regulates the hydrological system through its groundwater accumulation. These water bodies are fundamental for the economic, social, cultural, and environmental development of the inhabitants in the middle and lower basins of the Vinces River. The AdM wetland territory's native tropical forests have been dramatically reduced due to the pressure for land and the extension of the agricultural frontier, leading small farmers to take refuge on the river's banks and estuaries, intending to take advantage of the courses of the floods to plant seasonal crops while looking for product alternatives.

In this study, we assess the influence of fragmentation and criticality in the change of different land cover types observed at the AdM wetland territory and its evolution from 2000 to 2018, conducted at scales relevant to social

processes and decision-making, such as the municipality level. We will use satellite images from Landsat 5 TM, 7 ETM+, and 8 OLI/TIRS, to analyze the change of different land cover types observed at the AdM wetland territory using image classification for change detection. The resulting land cover maps will help to calculate the fragmentation and criticality indices using the criticality analysis algorithm (McGarigal and Marks, 1995; Echeverría et al., 2006). Criticality analysis is crucial in identifying the potential points of collapse in ecological systems, and it is essential to establish whether the AdM wetland ecosystem has reached its critical state. Finally, this research aims to provide a comprehensive understanding of the relationship between fragmentation, criticality, and the potential impacts on ecosystem services in spatial landscapes, which is necessary for policymakers, conservationists, and the local population to develop effective strategies for sustainable land-use management and conservation.

Keywords: criticality, fragmentation, ecosystem services, Abras de Mantequilla, wetland.

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