

EGU21-12908, updated on 01 Dec 2022

<https://doi.org/10.5194/egusphere-egu21-12908>

EGU General Assembly 2021

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Looking for the present in the past: Paleoenvironmental analyses and Social-ecological memory to explore changes in the mangroves of the Ciénaga Grande de Santa Marta - Colombia

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Compound anthropogenic pressures are driving critical mangrove degradation worldwide, threatening the wellbeing of coastal human populations historically associated with these systems. The Ramsar and Biosphere Reserve, Ciénaga Grande de Santa Marta (CGSM) is located in the northern of Colombia and is the largest coastal lagoon-delta in the Caribbean. It is inhabited by stilt communities that have developed intricate livelihood and cultural relationships with the mangroves. The CGSM has experienced sustained social and ecological degradation during the last six decades, triggered by land-use change and disruption of hydrological connections. This study integrates Social-ecological Memory from fishing communities and Paleoenvironmental frameworks to develop a historical perspective of the biophysical and social dimensions of environmental change in the CGSM. Integrating X-ray fluorescence (XRF) geochemical sediment analysis, C¹⁴ radiocarbon dating, and demographic inferences from archaeological evidence revealed three distinct periods over the last ~5000 years where sea-level rise and hydroclimatic variability shaped the transition between freshwater to prevailing marine conditions and modulated human occupation patterns in the area. Specifically, the period with the highest hydroclimatic variability and precipitation minima (4000 – 2500 yr BP) is consistent with the lowest human population estimates, whereas sea-level increase (~ 2000 yr BP) corresponds with a sustained increase in estimated population growth. In connection, participatory oral reconstructions conducted in the stilt-house communities of Buenavista and Nueva Venecia, offered nuanced descriptions about the spatial, temporal, and contextual aspects generating and reinforcing hypersalinization of the system, and their profound social-ecological consequences over the past several decades. The interdisciplinary approach of this study indicates that the CGSM

is a highly dynamic socio-ecological system that has been changing and reconfiguring across different time scales in response to both natural and human-induced processes. Finally, it reveals the relative effects of biophysical and social drivers on driving social-ecological change on millennial to decadal time scales.