Beyond Blue Past Economies: An Ecological Framework for Understanding Complex Coastal Adaptations and Marine Resource Exploitation along the Atacama Coast

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Abstract

The Atacama Desert represents one of the most extreme environments for resilience, yet the coastline sustained long-term hunter-gatherer-fisher populations throughout the Holocene, supported by the exceptional productivity of the Humboldt Current ecosystem.

However, coastal archaeological studies remain comparatively understudied than terrestrial archaeological studies despite the importance of marine ecosystems in shaping coastal lifeways in hunter-gatherer-fisher populations.

The project *bluePALEOeconomy* will fill this gap by analysing blue economies and identifying patterns of anthropogenic impact and resource consumption in marine ecosystems, integrating both environmental and social dimensions.

This study applies an ecological and computational approach to investigate patterns of consumption through marine faunal assemblages from 17 archaeological sites located along the Atacama coast throughout the Holocene. The research aims to identify regional patterns of resource use and evaluate the interplay between environmental conditions and human decision-making by analysing the composition of the archaeofaunal assemblage. By combining an ecological framework with archaeological data, this study identifies consumption patterns across archaeological sites. Similarities and differences in marine

resources use can help explain how environmental constraints and local interactions shaped subsistence strategies and reveal distinct trajectories of coastal resource management.

Results show that marine faunal assemblages along the Atacama coast are structured rather than randomly distributed. The ecological framework identified three recurrent archaeofaunal environment configurations reflecting different patterns of marine resource exploitation along the Atacama coast. The cluster configurations detected are associated with different ways of resource exploitation, suggesting a more diversified exploitation of coastal environments.

Our results indicate a complex scenario where coastal subsistence practices emerged from the interaction of environmental opportunities, local ecological knowledge, social organisation, and long-term cultural traditions. Rather than reflecting a homogeneous economic system, the Atacama coast appears as a mosaic of interconnected coastal adaptations characterised by different strategies of fishing, intertidal harvesting, and diversified marine resource exploitation. The persistence of these configurations across sites spanning different periods of the Holocene suggests remarkable continuity in certain forms of coastal adaptation and highlights the capacity of hunter-gatherer-fisher populations to develop resilient and culturally differentiated socio-ecological systems in hyperarid environments.