Modeling the Resilience of an Archaeological Irrigation Society: Challenges of Scope and Scale

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As part of panel: Types of Social Ecological Systems and the Role of Place Based Resilience

For more than a millennium the Hohokam maintained and operated an extensive irrigation system around the rivers of what is today central and southern Arizona. Their large-scale canal system allowed them to extend their fields across the plains along the large river valleys, actions that altered their landscape in both dramatic and subtle ways. The archaeological record of these centuries gives us a remarkable opportunity to study a long-term socio-ecological system as it evolved and responded to stresses that varied through time. It is clear from this record that Hohokam society underwent significant reorganization over the course of this long trajectory, changing not only in size but in the character of its internal dynamics, until eventually undergoing a disintegration that caused the irrigation works to be abandoned. Recently, portions of this trajectory have been interpreted by several archaeologists through the lens offered by resilience theory. Building on this work, a complementary approach- the one to be discussed here- is to explore the possibilities raised by the Hohokam case via a computer simulation model. This work, now being undertaken at Argonne National Laboratory, has involved extending a simulation from a single-processor desktop model to one designed to be run on Argonne's Blue Gene/P supercomputer. The exceptional computing power available on the BG/P will allow the simulation of a much wider array of possible scenarios, including hypothetical and counterfactual ones; this offers the ability to ask a broad collection of new questions about the Hohokam system. However, fundamental theoretical issues must be addressed. Even with the expanded array of possible simulations, the number of simulations that can actually be run pales in comparison with the number that could be constructed from all of the permutations of all of the model's components; what is needed is a guide to how the vast possibilities of the model can be explored. Three areas of specific concern are: the scope of the system to be simulated, and, specifically, where its boundaries are drawn and what components are considered inside the system vs. outside; the means of determining the structures that enable the system’s resilience, and of measuring the system’s capacity for transformation that arises from these; and, understanding which collections of permutations represent only different points along a continuum vs. those that represent genuinely different types of systems. These parallel similar concerns in other resilience studies and reflect the themes of the panel. Although a modeling approach differs from other approaches, it is argued that the kinds of questions that it faces are also those that are encountered in other resilience studies.