Panarchy: Applying the Framework to a Prehistoric Socio-Ecological Case

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ABSTRACT

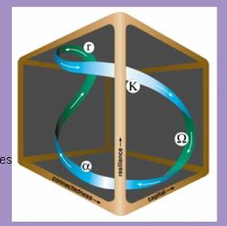
Panarchy is a new theoretical framework for investigating the interrelationships of coupled social and ecological systems. Arising from ecology, Panarchy purports to facilitate understanding of complex socio-natural interactions. In this poster, we examine the utility of Panarchy for understanding the drastic changes in Hohokam society from the Preclassic to Classic Period (AD 900-1200) in the Phoenix Basin. During the Preclassic, Hohokam socioeconomic interaction was expressed in a ballcourt network that extended for hundreds of kilometers across Arizona, and functioned to redistribute variable natural resources. In the Classic Period this network was abandoned, economic interaction and territorial extent contracted, and new, more hierarchically organized communities developed along major irrigation canals. Panarchy helps us relate these social changes to variable ecological and climatic conditions.

AXES ON THE ADAPTIVE CYCLE

Potential: the amount of accumulated energy, material, knowledge. In social systems, this is the ability to act- whether in terms of social power, technological capacity, investment in infrastructure.

Connectedness: degree of interdependencies between variables. Socially, the links/dependencies between individuals or organizations and accumulated potential.

Resilience: ability of system to maintain function/operation in the face of perturbations. In social terms, the ability of social structures to persist through time in spite of internal and external changes.



PHASES IN THE ADAPTIVE CYCLE

Exploitation (r): ecologically, rapid growth/colonization after disturbance. A social example is diverse, non-specialized production strategies

Conservation (K): storage/accumulation of energy and materials in ecosystem. Socially, specialized investment in limited number of strategies or products

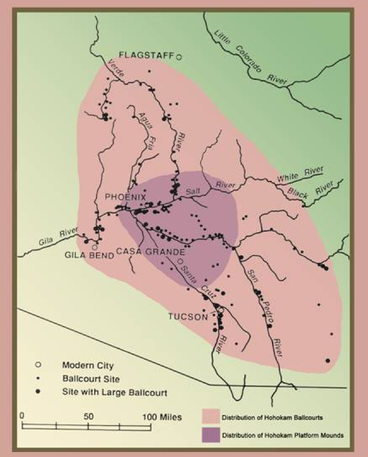
Release (Ω): release of stored energy/materials to more available form. Socially, economic collapse or crisis, release of capital

Reorganization (α): restructuring/reorganization of released energy/material. Socially, entrepreneurial experimentation with new strategies

Hohokam ballcourt

Platform mound community

THE HOHOKAM PRECLASSIC TO CLASSIC PERIOD TRANSITION



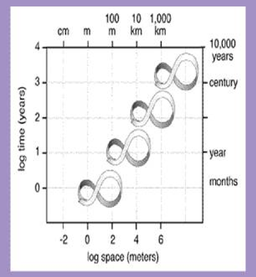
Archaeological data provide extraordinary breadth and time depth for investigating important periods of cultural transition. The Hohokam cultural system underwent a fundamental reorganization in the 12th century. Archaeologists identify the Preclassic transformation into the Classic Period by dramatic changes in the nature and distribution of material goods (the objects of daily and ritual use) and changes in economic interaction:

The spatial distribution of Hohokam ceramics, architecture and ritual items during the **Preclassic** period spanned from north of Flagstaff to south of Tucson. In the **Classic** Period, the distribution of these items shrinks drastically, centering on the Phoenix Basin around the extensive canal networks. This is illustrated in the figure to the left.

During the **Preclassic**, individual communities appear to have been hosts of periodic markets or feasts at ballcourts in their village. This was the foundation of an exchange network that distributed ceramic, ritual and subsistence goods throughout the region, across tens of thousands of square kilometers. In the subsequent **Classic** period, ballcourts fell into disuse, and exchange focused more locally within canal systems and newly established platform mound communities, an area of only tens of square kilometers.

PANARCHY

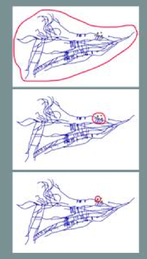
A panarchy is a nested set of adaptive cycles operating at different scales and different speeds. These cycles incorporate both natural and social processes, and are linked within as well as across scales. Connections across scales provide the possibility for reorganization at small scales to have a cascading effect on higher, more slowly moving processes. In turn, these slower processes can have a top-down effect on faster acting variables and processes at smaller scales.



APPLYING PANARCHY TO A SOCIO-NATURAL SYSTEM?

The prehistoric Hohokam provide a useful case study for the application of Panarchy. The hub of this complex social and natural system was located in the Phoenix Basin. The extensive irrigation network initially developed in the AD 700s persisted for over 6 centuries, and is the template upon which central Arizona's modern aqueduct and canal system is based. Archaeological data provide hundreds of years of information in which various scales (e.g., household to region) of analysis are available for studying the various cycles and relationships between the political, economic and social systems of the Hohokam and the natural ecological system. Variation in precipitation, climate, vegetation and other environmental variables can be traced from prehistoric to modern times and allows for the study of change and adaptation in a tightly coupled socio-natural system.

DECISION-MAKING AT VARYING SOCIAL SCALES

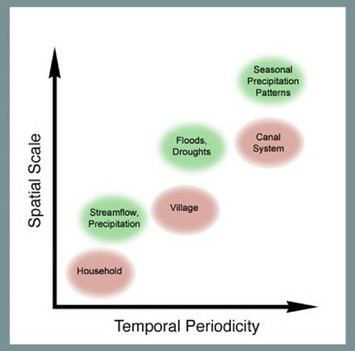


Canal System:
Head gate repair after floods/downcutting
Regulate exchange of goods
Design/construct canals/field systems
Defend/expand territory

Village:
Allocate irrigable lands to villagers
Communal storage/distribution of goods
Hosting village feasts/ballgames

Household:
Where and how much to plant
Whether to produce surplus goods
Abandonment or migration

CLIMATE AND SOCIAL SCALES



Examples of different spatial and temporal scales for agriculture and for social decision-making groups among the Hohokam.

CROSS-SCALE LINKAGES: CLIMATE VARIABILITY AND BALLCOURTS

In Panarchy theory, linkages across scales can be as important as the operation of cycles at a given scale. The operation of the Hohokam ballcourt system provides an example of the importance of multiple-scale participation. At any of the proposed social scales, participation or non-participation can have a cascading effect disrupting the ballcourt system at any other scale.

Decision Making Group	Environmental Effect	Impact to Ballcourt Network Participation
Canal System	Downcutting as a result of climate changes	Reconfiguration of canal system imposes extreme labor demands, villages unable to host events
Village	Flood	Village loses crops, unable to pool resources for hosting ballcourt event
Household	Reduced streamflow	Decision not to produce surplus goods, no contribution to village's pooled resources

In the chart above, decisions are made at a single scale. The impacts of (in this case) climatic variation affects decisions on at least one level. Each of these levels is hypothesized to have a potential effect on other scales of social organization. For instance, if all households perceive reduced streamflow and decide not to contribute resources to hosting a ballcourt event, this effects higher level scales as well. In turn, labor demands by higher level scales of social organization can have a top-down effect on the ability of households to contribute resources.

CONCLUSIONS: PANARCHY AND THE HOHOKAM TRANSFORMATION

The Panarchy framework is useful for linking ecological change to social processes. While archaeologists have proposed climatic changes at different scales to explain the transformation of the Hohokam during the 12th century A.D., there is little research into the mechanisms that link these changes to relevant scales of social decision-making. Panarchy facilitates the investigation of these mechanisms, without lending primacy to single external "drivers" of change or to any particular scale of interaction. By stressing the importance of interactions within and across social and natural scales, the framework promotes identification of the loci of change, whether this is a cascading effect from lower to higher scales, or a top-down effect from higher scales.

Changes in Hohokam society occurred in several domains: economic, social, political, and ideological. These changes were the result of decisions made at a variety of social scales and in a variety of contexts: at larger community as well as smaller, household scales. Thus, we suspect that cascading effects may be important to understanding the transformation of Hohokam society at the end of the Preclassic Period. Our intention in this poster is to illustrate the application of Panarchy to a complex socio-natural system. Ongoing research by faculty and students at ASU focuses on developing mechanisms and linkages to explain the Hohokam transformation, as well as further refinement of the Panarchy framework for the investigation of prehistoric culture change.

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