Utilizing Agent-Based Modeling to Gain New Insights into the Ancient Minoan Civilization

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1. ABSTRACT

In this paper we develop an agent-based model to study land use, settlement and social organization patterns at a particular region of the island of Crete during the Bronze Age. Considering farming as the main activity for sustaining the early Minoan civilization, we evaluate the impact of different social organization models and agricultural strategies on population viability and spatial distribution of settlement locations over a 2000 year period. Interestingly, one of the social models examined promotes the targeted redistribution of wealth, and is inspired by a recent framework for self-organizing agent organization models, which are based on archaeological studies, but are not biased towards any specific assumption. Results over a number of different simulation scenarios demonstrate an impressive sustainability for settlements adopting a socio-economic organization model based on self-organization; while the emerging “stratified” populations are larger than their egalitarian counterparts. This provides support for theories proposing the existence of different social strata in early Bronze Age Crete, considering them a pre-requirement for the emergence of the complex social structure evident in later periods. Moreover, observed population dispersion agrees with existing archaeological evidence.

2. AGENT-BASED MODELING

• Increasingly used in Archaeology during the past decade.
  • Tool for assessing the plausibility of alternative hypotheses regarding ancient civilizations, their organization and social and environmental processes at work in past ages [5, 4].
  • Ability to represent individuals and societies, and to encompass uncertainty inherent in archaeological theories.
  • Unpredictability of interaction patterns within a simulated agent society, with strong possibility of emergent behaviour.

3. THE AGENT-BASED MODEL (ABM)

• Agents are completely autonomous and can build and maintain complex social structures, in contrast to most existing ABM approaches in archaeology.
  • Though inspired by existing case studies, the ABM is quite generic and does not aim to prove or disprove a specific theory.

4. MODELING THE ENVIRONMENT

We use NetLogo modeling framework to develop the ABM.

5. AGENTS

Agents correspond to individuals and societies, and to organize agent organizations in the ABM.

6. SELF-ORGANIZATION ALGORITHM

A decision making mechanism achieving decentralized structural adaptation. Agents reorganize and adapt their relations based on the relative difference of resources transferred among the agents within a year

7. RESULTS

A self-organized behavior is better at sustaining the Minoan civilization through time. Moreover, we observe that agent settlements are concentrated near actual archaeological sites in the coastal region or at the Lasithi plateau.

REFERENCES