Agent Based Modeling (ABM) experiments help evaluate hypotheses about niche separation in early Pleistocene hominin species in East Africa

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ABM is a powerful approach to modeling the types of dynamic ecological and social processes central to many questions about the subsistence adaptations of Pleistocene hominins. ABM allows simulating of multiagent systems (directly or indirectly) with each other and their environment over time. The agents have asychronous goals, but their behavioral outcomes are interdependent. ABM is particularly useful for exploring how small perturbations and change can shape behavioral patterns in space and time.

HOMINIDS ABM: Hungry Omnivores Moving, Interacting, and Nesting in Independent Decision-making Simulations
Our goal is to evaluate the relative performance of different morphological and behavioral traits combinations for the sympatric species Australopithecus boisei and Homo ergaster in east Africa. We model yearly spatial activity for:

- Landscapes with varied geophysical and environmental ranges of food resources, empirically based on wild plant food surveys and literature on scavenging opportunities in riperian habitats analogues to the Pleistocene sites.
- Populations of hominid agents who live on this simulated landscape. These are very small, omnivorous, and physiologically. They do not die. They have no demographic variability. They lead the day and rest at night. They follow simple foraging rules, but differ in energetic conditions, social and cognitive abilities.

**Empirical Landscape**

**JAVA Program Implementation**

- ABM simulation requirements:
  - Agents for each species are divided into groups and individual agents: on, respectively.
  - Agents move in a continuous, bounded, grid-based environment.
  - Agents forage and consume resources from the landscape.
  - Agents interact with other agents and the environment through agent-to-agent and agent-to-environment interactions.

**CARAGAS Agents**
- Carregar Agentes em GPS (Global Positioning System)
- Geradores de Agente (Agents Generators)
- Agentes que se deslocam aleatoriamente

**Model Design: Agent Cycle within Landscape Cycle**

- Agents can change their foraging behavior
- Landscapes provide opportunities for varying food resources
- Agents have individualistic and social interactions
- Agents forage for and consume resources
- Agents interact with each other and the environment

**Tools for Testing**
- Aiding behavior patterns through simulations
- Environmental changes on agent performance
- Analyzing agent interactions

**Emergent Land-use Patterns: Foraging with Tools**

Our results suggest that in and habitats, in particular, H. ergaster agents would have fixed foraging areas to support their dietary breadth. This experiment compared single-year simulations of H. ergaster agents, esperic either as an individual agent or as a group agent, with dietary choices enabled by technology, digging, and discovery tools.

**Individual vs Group Nesting**
- Group agents are more sensitive to changes in daily activity range
- Nesting locations for group agents are more clustered in space than either

**An Ozoresis of the Eesee**
- Adding complex technology to the diet of H. ergaster agents, making them more omnivorous
- Analyzing agent interactions
- Enhancing agent performance
- Evaluating the capacity of emergent agents, and technology (or lack thereof) to sustain living.