Agent-based modelling of the Icelandic
Landnám deforestation

…ok, ABMs are useful, but what is it that really makes them cool?

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Agent-based modelling

• Simulates behaviour and interactions between individual agents and their effects on a certain system as a whole + where applicable, effect of a system on agents.

• Becoming increasingly popular method for investigating human ecodynamics of the past

• Used for both local and regional scale explorations

• Variety of temporal scales: from seasonal to multi-centennial
Some of the icons of the ABM world

• Artificial Anasazi (Dean et al. 2000)

• Village Ecodynamics Project (Kohler and Varien 2012)

• Hominin Ecodynamics (Barton and Riel-Salvatore 2012)

• Hominids ABM (Griffith et al. 2010)

• MayaSim (Heckbert 2013)
• Variety of periods covered

• Successfully investigate social-ecological systems

• Validated & unvalidated (exploratory devices)

• Confirm and/or refute our assumptions of human-environment interactions of the past

• Suggest which areas (locations)/periods may be of interest for future research projects
• Models deal with temporally bounded environments
  …at the same time, their outcomes provide a good starting point for research
  of the subsequent periods
  (Model of Settlement period grazing in Hörgárdalur can produce results
   interesting for study of Commonwealth period grazing)

• Usually, one or few subjects in focus
  ...while many others are barely tackled, even though they provide important
  results which can be used as an appropriate starting point for variety of
  empirical research studies
  (Model of animal husbandry can produce results interesting for study of overgrazing,
   vegetation replacement, abandonment / reorganization...)
models

• Explain the process of Icelandic Landnám deforestation (late 9th and 10th centuries)

• spatially- and temporally explicit:
  - recreated environments
  - monthly time steps / AD 871 - 1000

• sample study areas (ideally country-wide coverage, but…)

• agents are farms:
  - they clear forests for pastures in order to meet the needs of their livestock herds
  - they compete for space (landnám!) / their actions are limited by natural environment and landowner - tenant relationships; vicinity to household location as the most significant factor
Study area: Mývatn

- 58 agents / Norse farms
- 209,557 patches - 2095.57 km²
- 1 patch – 1 hectare
In brief:

- 3 phases of clearance

- Deforestation significant but not drastic

- Livestock herds reached their maximum size within few decades

- Overgrazing, regrowth and replacement effect played significant role
• result of application of deliberate strategy to establish and develop animal husbandry economy as soon as possible

• applied without a full awareness of potential and fragility of local environments

• It was possible to make it with less negative environmental signature
  - Prevention of winter grazing & shepherding,
  - Higher degree of culling and lower intrinsic rates of growth
→ slow growth of the animal husbandry economy

• Fast rate of growth was chosen → considerably degraded natural environment
...some other benefits of the *ICELANDEF* ABMs

- Produce incredible amount of information useful for research studies of the post-Viking Age periods

- Suggest areas interesting for a variety of future research projects with regards to:
  a) Vegetation changes (variations in utilisable biomass & replacement of grasses by grazing tolerant species)
  b) **Overgrazing**
• Overgrazing and replacement less significant than in Vestur-Eyjafjallahreppur...

• Scattered around the farms and shieling sites

• Degree of overgrazing varies from one location to another
• Each simulation suggests:
  - which locations around the farms suffered from initial impact and
  - which locations experienced the highest degree of overgrazing
    (vary from one simulation run to another – sometimes high number of
    locations)

• Clear the picture:
  (narrow down the choice of locations interesting for future research)
  - multiple simulation runs + filtering based on information on altitude (280 –
    371 m), slope etc

• Useful precursor to future research projects