

## SIMULATING THE PAST TO EXPLORE THE FUTURE

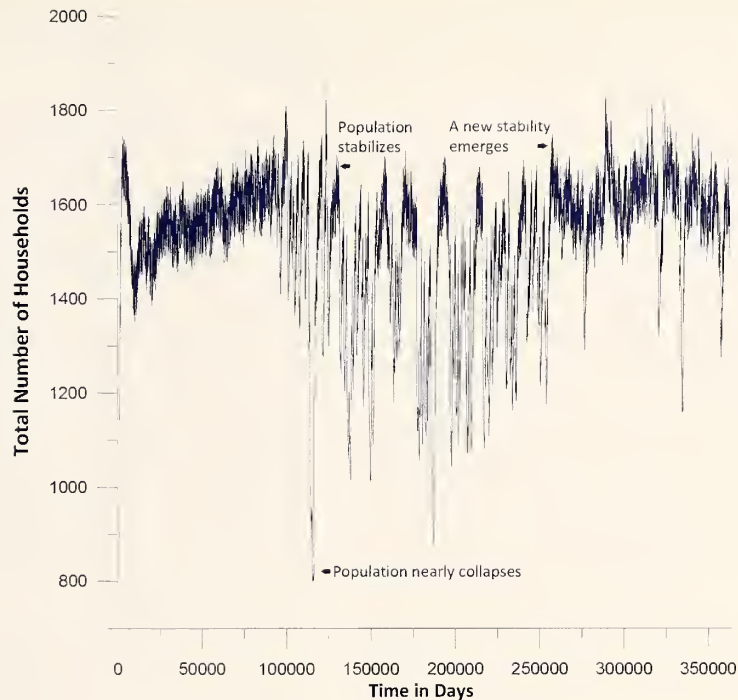
by J. Daniel Rogers



Throughout Earth's history there have been long periods in which the climate was relatively stable and other periods in which it was constantly changing, sometimes rapidly. Climate, as part of the environment, always has a deep impact on how people live. For a very long time, but especially since the beginning of the Industrial Revolution, people have played a significant role in climate change. As we ponder our options for developing a sustainable future, there is a profound need to understand how people around the world may be able to cope with change. But there is a problem; our information from the past is fuzzy and incomplete. The climatologists, for instance, who build projections for understanding future changes, may have quality weather data extending back only a few decades. Sometimes this

information is not enough when we seek to understand trends occurring over the course of centuries.

At the National Museum of Natural History some of the scientists are turning to a new way to use the past to see into the future. It is called *Agent-Based Modeling*, a kind of computer simulation that builds virtual societies in which each individual person, or family, in the simulation behaves according to social norms, but also in autonomous ways, much as real people do. Working with social and computer scientists from George Mason University, Smithsonian anthropologists devised a model of the societies that herd sheep, goats, camels, yaks, and horses on the steppe lands of Central and Inner Asia. Like an elaborate computer game, the agents (people) are born, get married, have



children, visit their friends, share with family members who are in trouble, remember their ancestors, and participate in social groups. The agents also deal with problems, like droughts, snow storms, and climate change.

Using archaeological, historical, and ethnographic information on herding societies from around the world, each characteristic of the artificial society was painstakingly programmed into the simulation using software called MASON and Java. The first objective was to create an artificial society inspired by the Bronze Age (2000 to 500 B.C.) of Inner Asia. The people of the Bronze Age were members of clans and had leaders we might call chiefs, but not kings. Later, vast empires would emerge from the Inner Asian heart land, culminating in the great Mongol Empire under Genghis Khan in the 13<sup>th</sup> and 14<sup>th</sup> centuries. The Bronze Age ancestors of the Mongol Empire are the starting point, a kind of baseline on which to build a history that never happened, but could have.

The second objective was to take the replica of the Bronze Age society and actually put time in motion—the clock starts ticking and does not stop for a thousand years. On a very powerful computer this process takes about 2 actual days. The graph on this page shows the population changes for one of the simulated histories. One

thing to note right away is that a huge amount of variation and change is the norm. The human population is not even remotely stable, nor does it decline or increase in a gradual way. Change is abrupt and sometimes catastrophic. The thing that accounts for most of this change is weather—snow storms and droughts. In Inner Asia these weather events sometimes kill nearly all of a herder's animals. When the animals die, the families cease to exist. This catastrophe nearly happened around simulated year 330 (120,000 days) when the population dropped by 50% due to back-to-back winter snow storms and summer droughts.

Even when climate is changing relatively quickly, as today, what people must adapt to are the extremes. Herders today, just as in the Bronze Age, must find ways to buffer against catastrophes. They can do this by developing a resilient economy. Although they cannot stop the snow storms, they can migrate, share resources, and use other strategies. One of the keys for the herders is having flexible social networks that allow change, rather than adhering to rigid behaviors—a good lesson for us all.

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