Crowdsourced archaeology shows how humans have influenced Earth for thousands of years

August 29 2019

Gordion, Sakarya Valley, Yassıhüyük, Turkey. Credit: Lucas Stephens

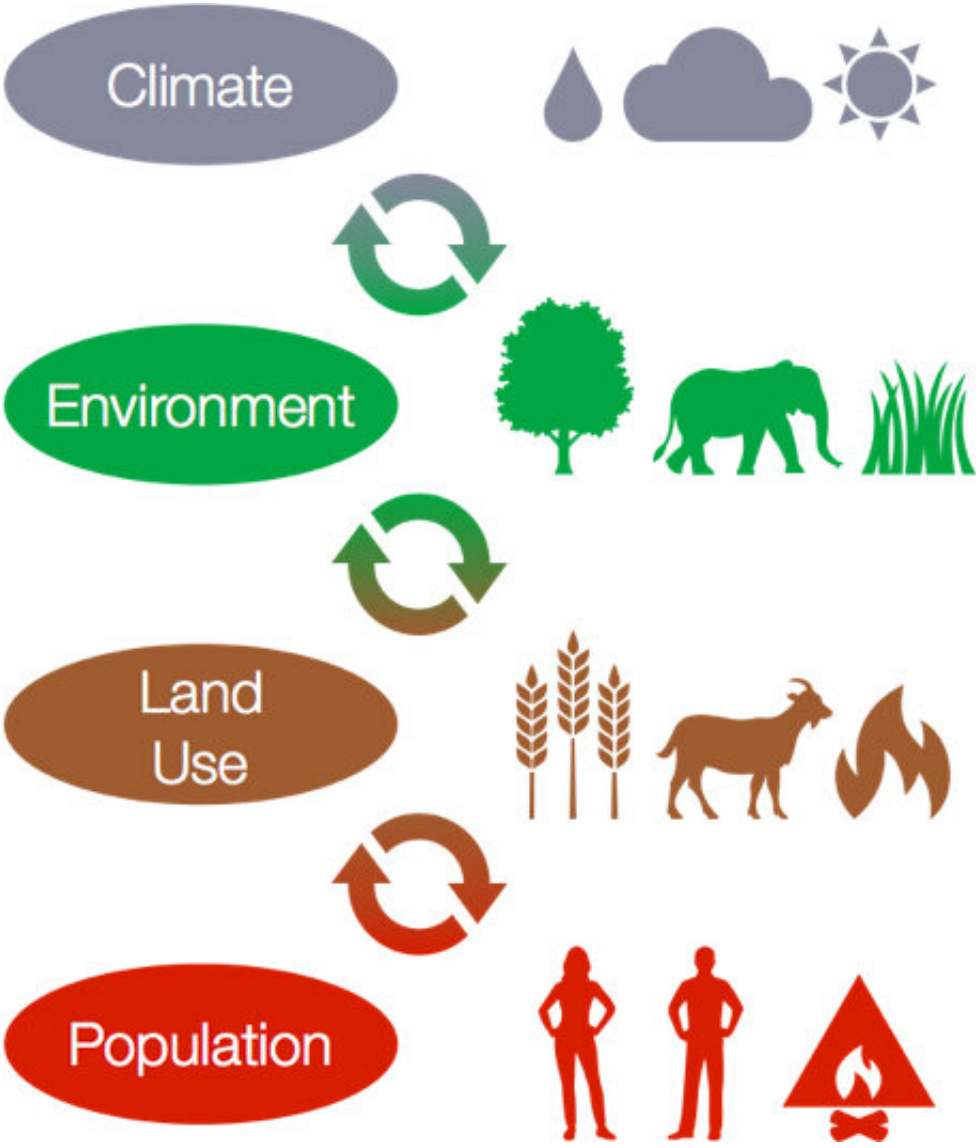
Humans' ability to transform the natural environment is often considered a modern phenomenon, from increasing deforestation, soil erosion and

greenhouse gas emissions. This year, an international group of geologists deemed the start of the Anthropocene—the time of humans' most far-reaching effects on the Earth—to be the middle of the 20th century.

But what constitutes transformation, or even significant human activity, is still debated, and many researchers challenge the relatively recent frame placed around history.

A new map synthesized from more than 250 archaeologists worldwide argues that the human imprint on our planet's soil goes back much earlier than the nuclear age. A core group of those researchers, including the University of Washington, the University of Maryland Baltimore County and the Max Planck Institute for the Science of Human History, illustrate in an Aug. 30 study in *Science* how foragers and, eventually, farmers fundamentally altered the land on the planet by 3,000 years ago.

The ArchaeoGLOBE project analyzes land use from roughly 10,000 years ago, the time of hunters and gatherers, to the year 1850, after the Industrial Revolution. The new study adds an archaeological perspective to existing models of historical land use. Based on researchers' expertise of land use on six continents, the crowdsourced map shows that agriculture—an extraction of environmental resources that leaves a complex mark on the landscape—began earlier, and in more parts of the world, than more recent studies have reported.



Feedback cycles. Credit: Andrea Kay

"There are archaeologists working all over the world, but they aggregate data differently, and it can be difficult to find larger patterns," said co-author Ben Marwick, an associate professor of anthropology at the UW. "By asking archaeologists a series of questions rather than combining datasets, we've created a brilliant workaround—essentially, what were people doing, and how much, in different parts of the world?"

Commonly cited recent studies have used statistics and maps to estimate human behavior and environmental change prior to modern times. For the ArchaeoGLOBE project, the research team spent months developing the survey and considering how to divide up the Earth into analytical regions, said Lucas Stephens, who led the global collaboration of archaeologists while a doctoral student at the University of Pennsylvania and a postdoctoral researcher at the University of Maryland Baltimore County. In the end, the team split up the Earth (excluding Antarctica) into 146 regions and sought archaeologists' input on human activity in those regions at 10 different points in time. Some 700 responses came in.

Among their findings:

- Foraging, defined as hunting, gathering and fishing, was common in most parts of the world 10,000 years ago, but was declining in more than half the world's regions by 3,000 years ago.
- Pastoralism—the raising of livestock—by 8,000 years ago had spread from some of its origin areas in Southwest Asia to arid environments like North Africa and Eurasia, where it was common by 4,000 years ago.
- By 6,000 years ago, some form of agriculture was being practiced in nearly half of the world's regions, and by 3,000 years ago, was widespread.
- Farming is generally thought to "replace" hunting and gathering as a means of food production, but in some areas, agriculture occurred simultaneously with, or as a complement to, foraging.

"This type of work causes us to rethink the role of humans in environmental systems, particularly in the way we understand 'natural' environments," said Stephens, now a research analyst with the Environmental Law & Policy Center in Chicago and an affiliate at the Max Planck Institute. "Many people have realized for some time now

that the study of long-term human-environment interactions must include archaeological knowledge, but our research and dataset really open the door to this sort of collaboration at global scale for the first time."

"Many people have realized for some time now that the study of long-term human-environment interactions must include archaeological knowledge, but our research and dataset really open the door to this sort of collaboration at global scale for the first time."

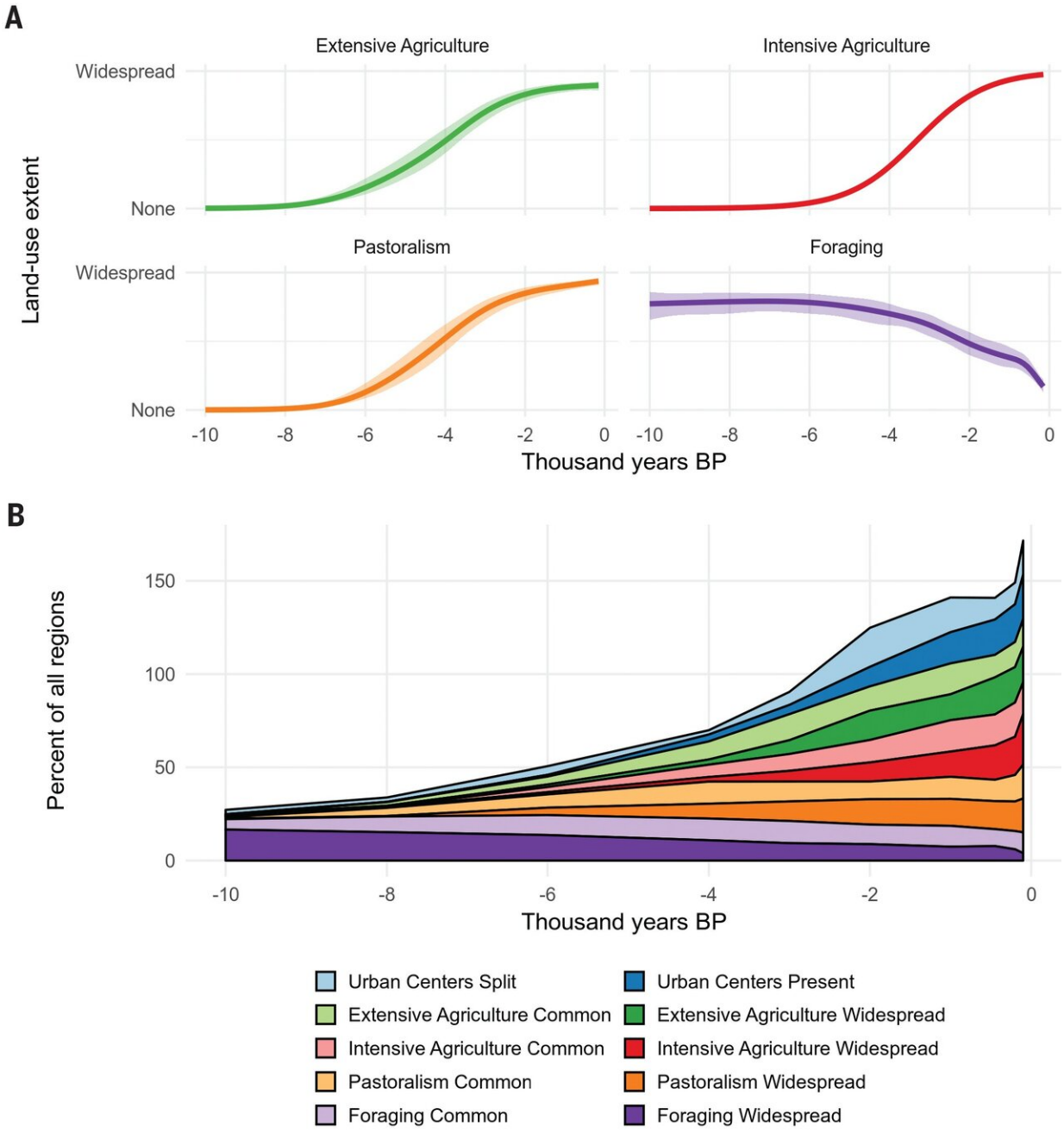
Understanding the history of human impact on the environment has implications for addressing climate change, the authors say. With the release in early August of a report on land use from the United Nations' Intergovernmental Panel on Climate Change, it's clear that human impact is a critical issue for the future of the Earth, Stephens said. "But there is also a deep history of anthropogenic changes to the planet that has yet to be meaningfully incorporated in these discussions."

"It's time to get beyond the mostly recent paradigm of the Anthropocene and recognize that the long-term changes of the deep past have transformed the ecology of this planet, and produced the social-ecological infrastructures—agricultural and urban—that made the contemporary global changes possible," said co-author Erle Ellis of the University of Maryland Baltimore County, who initially proposed and helped design the study.

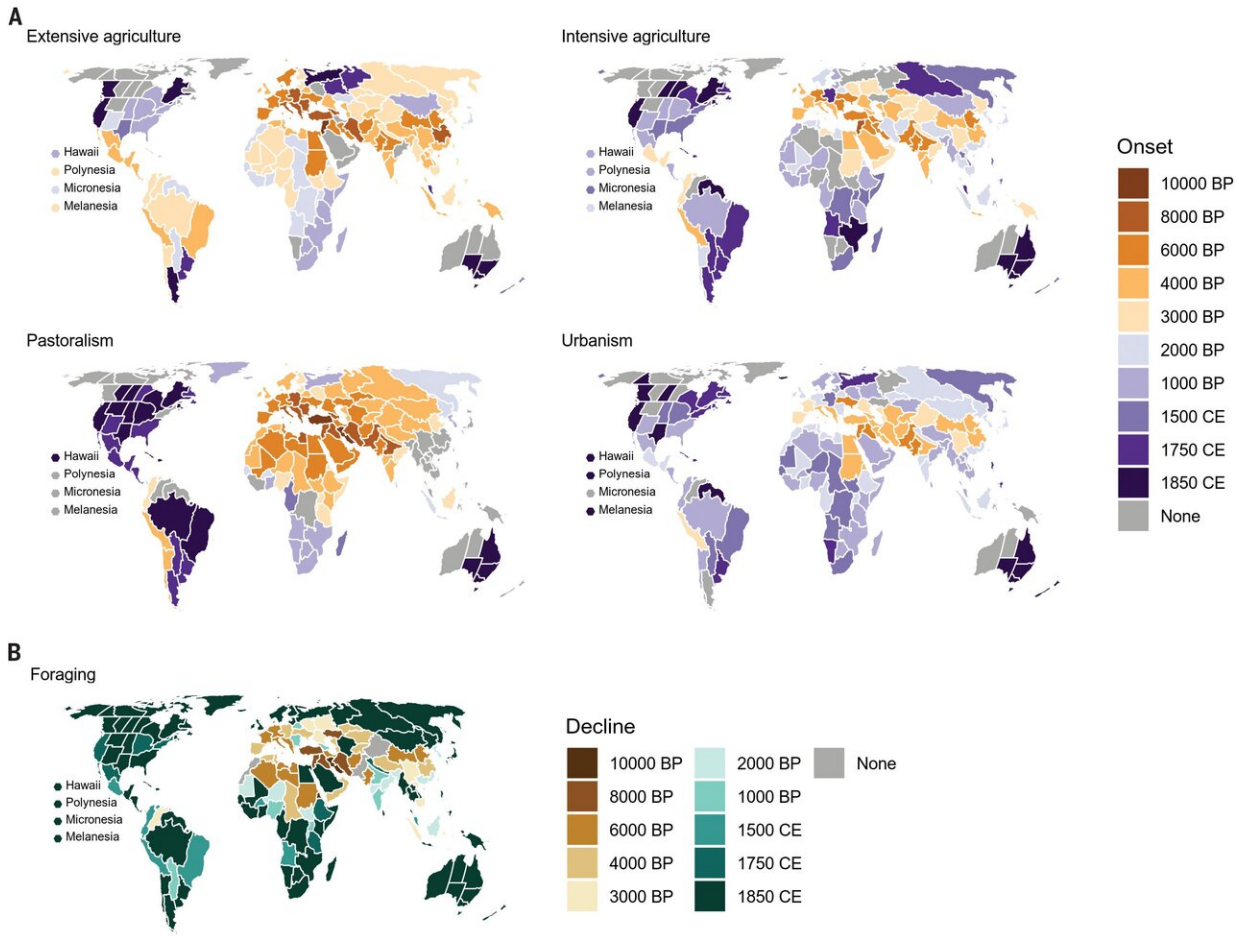
The ArchaeoGLOBE maps contain more information about some regions of the world than others, reflective of where much archaeological attention has been directed, researchers point out. That's due partly to the expertise of the archaeologists who participated in the current study, as well as the availability of resources and support for study in various locations. While extensive data was available from the Western and Northern hemispheres, study authors say, less-investigated

regions clearly warrant more research.

"That can be facilitated by making information available," said Marwick, "who contributed expertise on Southeast Asia and assisted with putting all of ArchaeoGLOBE's materials online, accessible to anyone."



A) Generalized additive mixed model trends for the extent of each land-use type across all regions, with 95% confidence intervals. B) Cumulative summary of regions per land-use category based on consensus assessments (Common > 1% to 20% regional land area; Widespread > 20% regional land area), with presence or absence of urban centers. Categories are non-exclusive, resulting in plot values >100% of all regions. Credit: Reprinted with permission from: ArchaeoGLOBE Project, SCIENCE, August 30 2019 (DOI: 10.1126/science.aax1192)



A) Onsets represent the earliest time step assessed at the "common" prevalence level (1-20% land area) for extensive agriculture, intensive agriculture, and pastoralism; the earliest time step assessed as "present" for urbanism. B) Decline

represents the latest time step assessed at the "common" prevalence level for foraging. Credit: Reprinted with permission from: ArchaeoGLOBE Project, SCIENCE, August 30 2019 (DOI: 10.1126/science.aax1192)

"A global dataset like this invites lots of interesting follow-up investigations that have not been possible before now. With all our data openly available, anyone anywhere can freely dig in and test out new ideas on a global scale," Marwick said.

More information: L. Stephens el al., "Archaeological assessment reveals Earth's early transformation through land use," *Science* (2019). science.sciencemag.org/cgi/doi … 1126/science.aax1192

C. Roberts at University of Plymouth in Plymouth, UK el al., "How humans changed the face of Earth," *Science* (2019). science.sciencemag.org/cgi/doi … 1126/science.aay4627

Provided by University of Washington