The Anthropocene and the Evolution of the Human-Environment Relationship

SOS 510: September 18
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What is the Anthropocene?

Discuss within your group what you think the Anthropocene is.

Come up with a one-sentence definition to share.
What is the Anthropocene?

The period during which human activity has become a dominant influence on climate change and the global environment.

Roberts, 2019
What is the Anthropocene?

Are we in the Anthropocene? If so, how long have we been? How long have humans been the “dominant influence”? 
Outline

I. Geologic Epochs
II. Human-Environment Relationship
III. Key Takeaways from Readings
IV. Sustainability in the Anthropocene
I. Geologic Epochs
Geologic epochs and eras are defined by specific rock layers deposited in the Earth. They provide a stratigraphic record of the geological past and can be utilized to understand a vast history. Humans have existed for a relatively brief, but important, part of this history.
Presenting the Anthropocene

Some scientists and geologists suggest we have entered a new geologic age: the Anthropocene.

While human impact on the environment is undeniable, in order to be in the Anthropocene this impact must be fundamentally different and leave a geologic record.
Are we in the Anthropocene?

We must consider how to differentiate between the Anthropocene and anthropogenic change of nature

Waters et al. (2016) suggest our current era is stratigraphically different than the Holocene because of manufactured materials in sediments, spikes in fallout radionuclides and particles from fossil fuel combustion, as well as other fundamental climate, environmental, and biotic changes

However, humans have been inducing socio-ecological changes on landscapes for a long time
Development of the Anthropocene

Maslin, 2017
When did the Anthropocene begin?

Thousands of Years Ago - “Early Anthropocene”: advent of agricultural, animal domestication, extensive deforestation, and increases in atmospheric carbon dioxide

1492 - Columbian Exchange

Late-18th Century - Industrial Revolution

Mid-20th Century - Beginning of Great Acceleration

Waters et al., 2016
The Great Acceleration

Rise in human population

Strengthening of nation states

Global transfer of inventions and values

Beginning of industrialization and rise of global communications

Dramatic modifications of land use and biodiversity, hydrological and energy flows, and key ecological processes

Schimel et al., 2007
The Great Acceleration

Great Acceleration

- Population
- Real GDP
- Foreign direct investment
- Water use
- Paper production
- Fertilizer consumption
- Motor vehicles
- Primary energy use
- Telephones
- Tourism
- River dams
- McDonald’s restaurants
- Atmosphere: CO2
- Atmosphere: N2O
- Atmosphere: CH4
- Atmosphere: ozone depletion
- N hemisphere surface temperature
- Loss of tropical rainforest & woodland
- Domesticated land
- Great floods
- Fisheries fully exploited
- Flood frequency
- Coastal nitrogen
- Species extinction
II. Human-Environment Relationship
Selected Indicators of Human and Environmental History
How do human activities impact landscapes?

<table>
<thead>
<tr>
<th>Past</th>
<th>Present</th>
<th>Future</th>
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<tbody>
<tr>
<td>Transformation of land use</td>
<td>Intensification of land use</td>
<td>Involution and crisis?</td>
</tr>
<tr>
<td>-Agriculture</td>
<td>-Climate change</td>
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<tr>
<td>-Deforestation</td>
<td>-Urbanization</td>
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<td>-Urban settlements</td>
<td>-Ecosystem destruction</td>
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Ellis et al., 2013
Land-use intensification is the adaptive response of human populations to demographic, social, and economic pressures leading to the adoption of increasingly productive land-use systems.

Although the process tends to result in a general increasing trend in land productivity with population density, the relationship between any given population and the productivity of its land-use systems is dynamic and responsive not only to demographic forcing but also to the social and economic processes regulating resource demand, land availability, technology adoption and availability, environmental variation, and the potential for intensive use of land to degrade its potential productivity over time.

Ellis et al., 2013
Land-Use Intensification

Changes in the productivity of land-use systems, and especially productivity per area of land, has likely been the main long-term driver of change in human impact on the terrestrial biosphere. The pace of agricultural intensification is, therefore, also likely to remain a major determinant of future land change and our ability to meet societal demands for food, feed, housing, and energy.

How we think about, care for, and act concerning land is a key element of the human-environment relationship.

Ellis et al., 2013
Summary of Global Land-Use Trends

Stephens et al., 2019
Summary of Global Land-Use Trends

Stephens et al., 2019
Regional Onset of Extensive Agriculture

Stephens et al., 2019
Regional Onset of Intensive Agriculture

Stephens et al., 2019
Regional Onset of Pastoralism

Stephens et al., 2019
Regional Onset of Urbanism

Stephens et al., 2019
Human-driven Changes in Earth’s Land Cover

Roberts, 2019
Land Use through History - HYDE
Land Use Through History KK10

Ellis et al., 2013
Anthropogenic Biomes (2000)

Ellis et al., 2010
Production of New Anthropogenic Materials

Waters et al., 2016
Production of New Anthropogenic Materials

Waters et al., 2016
Human Drivers of Stratigraphic Change

Accelerated technological development

Rapid growth of the human population

Increased consumption of resources

Waters et al., 2016
Anthropogenic Markers of Functional Changes

New anthropogenic materials

Modification of sedimentary processes

Changed geochemical signatures in recent sediments and ice

Radiogenic signatures and radionuclides in sediments and ice

Carbon cycle evidence from ice cores

Climate change and the rates of sea-level change

Biotic change

Waters et al., 2016
We are “deepening the Anthropocene”

Stephens et al., 2019
## Environmental Problems Facing Society

<table>
<thead>
<tr>
<th>Loss of habitat and ecosystem services</th>
<th>Energy limits</th>
<th>Alien species introductions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overfishing</td>
<td>Freshwater limits</td>
<td>Climate change</td>
</tr>
<tr>
<td>Loss of biodiversity</td>
<td>Photosynthetic capacity limits</td>
<td>Population growth</td>
</tr>
<tr>
<td>Soil erosion and degradation</td>
<td>Toxic chemicals</td>
<td>Human consumption levels</td>
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Diamond in Schimel et al., 2007
The Path Ahead

Given that most of the terrestrial biosphere is now anthropogenic, the future of all species, including ours, will depend on our understanding and modeling the past, present and potential future ecology of our anthropogenic biosphere as we continue to directly alter and manage it.

Ellis et al., 2010
A full understanding of the challenges facing humanity requires knowledge of the evolution of the roles of technology, population expansions, cultural mores, climate, disease and warfare in changing human attitudes and responses through time. This is especially the case if the past is to be used in more sophisticated ways than a simplistic analogue of projected future conditions.
III. Key Takeaways from Readings
Key Takeaways

Schimel et al. (2007) - We cannot comprehend the present without a nuanced understanding of historical narratives and contexts that also encourage us to recognize that our current actions will have long-term consequences.

Ellis et al. (2013) - Changes in the productivity of land-use are the main long-term driver of change in human impact on the environment, but even as our efficiency increases our impact does as well.

Roberts et al. (2019) - New models and evidence help to determine that anthropogenic changes began earlier and spread faster than previously estimated.
**Key Takeaways**

*Stephens et al. (2019)* - There are deep roots of anthropogenic global change that challenge the notion of the beginning of the Anthropocene, but also suggest the importance of sustainable land use.

*Ellis et al. (2010)* - We must maintain, enhance, and restore ecological functions in remnant, recovering, and managed ecosystems that have been formed by anthropogenic land use and its legacies.

*Waters et al. (2016)* - Increased signals of changing climates, landscapes, biomes, and life cycles suggest the Anthropocene is stratigraphically distinct from the Holocene and earlier eras.
IV. Sustainability in the Anthropocene
The Anthropocene is fundamentally different.

It is creating pathways that challenge planetary boundaries.

Human influence must be determined and potentially altered to avoid dramatic futures.

Figure 3
A timeline of increasing human influence on the Earth system, with some proposed start dates for a start date for the Anthropocene.

Mahli, 2017
Planetary Boundaries

Rockstrom et al., 2009
Sustainable Development

Raworth, 2012
What Stories Will We Tell in the Anthropocene
Lessons Learned

Humans have modified their environments, in ways both sustainable and unsustainable, for a longer period of time than we might typically acknowledge.

We are deeply connected to and shaped by the past, but we have the ability to contribute to a more sustainable future by understanding our history and its consequences for the present.

The Anthropocene will be defined by how we use and think about land, resources, technology, knowledge, morality, and compassion.
Our tools are better than we are, and grow better faster than we do. They suffice to crack the atom, to command the tides, but they do not suffice for the oldest task in human history, to live on a piece of land without spoiling it.

Aldo Leopold


Discussion Questions
Which discoveries or trends described in the readings, surprised you the most? Why were they surprising?
How can we differentiate between anthropogenic-induced change and the characteristics of the Anthropocene?
How can historical understanding contribute to creating sustainability in the present and future?
Why is land-use change such an important indication of the quality of the human-environment relationship?
What strategies can we utilize to improve land-use and curb, or reverse, the trends of the Anthropocene?
Hope (and Comedy) for the Future
Recent geological epochs:
- Pleistocene
- Holocene
- Anthropocene

A figure shows a progression from early humans to modern times, with a person falling into a cliff, symbolizing the Anthropocene era.
Welcome to the ADJUSTOCENE
you just won't know what temperature is!

COOLIN' YER PAST
WARMIN' YER FUTURE
Fossils from the Anthropocene

- SUV parts (Brachipod - brake pad)
- Factory farm chicken (Disgustus ingestum)
- Small arms (Proliferus absurdum)
- TV remote (Distractum colossus)
- Climate-change denier (Cranium impenetrus)
- Conference ID (Pressurus globalum)
You are now leaving the Holocene.

Thank goodness for all the electronic gadgets that keep them occupied on these long trips!
Who's the most alarming of us all?

Ooo... I know this one...

ANTHROPOCENE

NARCISSSCENE