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There's basically no landscape on Earth that humans haven't altered, scientists say

By Chris Mooney and Brady Dennis June 6 at 3:00 PM

Implicit in much, if not all, modern environmental sentiment is the idea that the natural world has been despoiled by humans — and if we could just leave it alone, things would get better.

But new research suggests that in reality, humans have been altering the natural world for millennia, long before the 15th century dawn of the Age of Discovery, when European societies mastered long-distance ocean navigation and began to spread their cultures, animals, and diseases to new continents.

The result of these changes, accumulating over time, has been "the creation of extensively altered, highly cosmopolitan species assemblages on all landmasses," the authors write in a study published Monday in the Proceedings of the National Academy of Sciences. "'Pristine' landscapes simply do not exist and, in most cases, have not existed for millennia."

Conservationists often have the goal of "let's get back to that natural environment with humans out of the picture," said Melinda Zeder, one of the study's authors and an anthropologist with the National Museum of Natural History at the Smithsonian Institution. "And that's a chimera, that's a false hope, it's too late for that."

"People have been modifying their environments for tens of thousands of years," added Jon Erlandson, an archeologist, professor and director of the University of Oregon Museum of Natural and Cultural History, and another of the study's co-authors. "Humans have literally impacted everything from mammoths to microbes. Most people have no idea how heavily we've altered things – and for how long."

Erlandson said that it's tempting to think that people thousands of years ago weren't smart or technologically sophisticated, but that's not necessarily the case.

"The story we're putting together is that for many, many thousands of years, people have basically been like us," he said. "They were ingenious in developing new technologies and modifying their local environments."

But as humans have evolved and proliferated, that innovation – and the subsequent effect on the environment – has sped up.

"When anatomically modern humans appear about 200,000 years ago, there's what I think is a continual acceleration of technological change," he said.

As humans spread across the globe, he said, they invented things such as the bow and arrow, fishing spears, ceramics and agricultural advancements that made life easier but also impacted the environment.

Based on a large synthesis of archaeological, fossil and ancient DNA data, the researchers conclude that humans started dramatically changing the world's natural ecosystems well before 12,000 years ago. By that time, the species had emerged from Africa and colonized much of the globe. And already, mega-scale human impacts on the landscape and the creatures living in it included changing the regime of burning on landscapes from Africa to New Guinea, as early humans exploited fire for purposes of agriculture and hunting.

And that's only one type of change already afoot. By between 20,000 and 23,000 years ago, the study notes, one of the earliest human introductions of a species from one region to another had already occurred — when the northern common cuscus, a marsupial, was spread from New Guinea to Indonesia and other locations.

Also between 50,000 and 10,000 years ago, the researchers report, humans drove at least some extinctions of large megafauna in Australia, Tasmania and other locations. Whether our ancient ancestors are responsible for over-hunting and killing off these great beasts – and causing ecological upheaval through their extinction — has often been a contentious topic, but the paper comes down behind the idea that at least some of this is probably due to human incursions. "A lot of the megafaunic extinctions are probably not human related, but others are," Zeder said.

And still, this was only the beginning — merely what we could do to the Earth as hunter-gatherers. But as humanity entered the Holocene period, known for its mild climate, some 11,700 years ago, we learned to build societies dependent on agriculture — a development that only increased our footprint on the landscape.

At this point, the study explains, handpicked farm and human-friendly animal and plant species were favored, cultivated and spread. Meanwhile, clearing of forested land for agriculture and the mass planting of certain types of staple foods, such as rice, actually changed the greenhouse gas composition of the atmosphere between 4,000 and 1,000 years ago (although nothing like what happened after the industrial revolution — but wait, we're getting there).

Prime among humans' favored animals were ruminants — cows, sheep, goats. Their original domestication, the study says,

occurred near the start of the Holocene in the Near East, but soon they'd been transported all over the place. Ditto for chickens (which originated in East Asia).

Farming had sweeping implications for nature across large stretches of land. But perhaps the most special havoc was wreaked on evolutionarily unique island ecosystems once seafaring societies, such as the Polynesians, found ways to reach them. They didn't just bring along animals that would aid in agriculture — they accidentally also brought along pests.

"Pacific rats and black rats (Rattus rattus) were widely introduced to global islands as accidental stowaways on boats beginning in the Middle Holocene, as were housemice (Musmusculus), various commensal shrews and lizards, and numerous insects and land snails," the authors note.

And the pace just increased from there, as human societies and their transportation and trade systems became more and more advanced. The gist is that while we are radically impacting nature and landscapes in the present, this is just a stepwise development upon what we have been doing for thousands of years.

"Today isn't a radical right turn, and that all of a sudden we're having these impacts, which is sometimes the attitude, but it is part of the progression of this continuing ramping up of scope and impact that today is taken to ridiculous levels," Zeder said.

"The amazing array of cross-disciplinary work in archaeology and paleoecology described in this wide-ranging paper is revealing the surprisingly large extent of early human transformations of this planet," said William Ruddiman, a University of Virginia researcher who studies paleoclimatology but was not involved in the work, in commenting on the paper. "Yet very few scientists in other disciplines are aware of this emerging story, especially fields that emphasize physics and chemistry. This emerging evidence confirms large early agricultural effects on landscapes and on greenhouse-gas emissions."

Granted, human greenhouse gas emissions from the burning of fossil fuels still only show up much later in the story. While deforestation and agriculture changed the greenhouse gas composition of the atmosphere beginning thousands of years ago, it's still just a murmur compared to the sharp upward spike in atmospheric carbon dioxide concentrations from 280 parts per million prior to the industrial revolution to over 400 parts per million today.

To show just how extensive the modern impact has become, consider that now, even the one continent where nobody lives except for occasional teams of scientists — Antarctica — also shows a clear human impact. Lead pollution, carried by the air, reached the seventh continent before its first explorer Roald Amundsen did in 1911, recent research suggests.

The new research feeds heavily into a very big debate right now in the sciences and beyond. The question is whether we are in a new geologic epoch, the "Anthropocene," characterized by widespread and geologically detectable human impact on the planet — and if so, when that period started.

Many researchers believe the alteration of the atmosphere through major infusions of industrial greenhouse gases marks the start of the Anthropocene, placing that era's beginning within the last few hundred years. But the current researchers disagree. "The assertion that preindustrial societies had only local and transitory environmental impacts is mistaken and reflects lack of

familiarity with a growing body of archaeological data," they write.

Even more provocatively, the researchers argue not only that humans have been pervasively changing nature for about as long as there have been humans, but moreover, that it isn't always bad. In many cases, ancient humans also hit on innovative and sustainable ways of managing soils and landscapes, they say. And in any case, human management of ecosystems is inevitable.

"These findings suggest that we need to move away from a conservation paradigm of protecting the earth from change to a design paradigm of positively and proactively shaping the types of changes that are taking place," said Oxford's Nicole Boivin, the study's lead author. "This sounds scary, and it sounds very self-serving. But the reality is that there are 7 billion people living on an already heavily altered planet. It is a pipe dream to think that we can go back to some sort of pristine past."

Indeed, Erlandson said that while human impacts have only accelerated, the research has given him an optimism that humans will find a way to deal with climate change, in part because societies have risen to almost every quandary that has come before.

"There's a story of ingenuity built into this deeper time perspective," he said. "Humans have over and over again met challenges in different parts of the world, and they've found ways to meet those challenges. Every generation has its challenges But we have found ways to solve them."

"No matter how bad we screw things up," he added, "if we can find the collective will, we can overcome them."

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