

In the driver's seat of evolution

December 8 2015, by Darren Curnoe



Rice terraces reshape mountains in southern China. Credit: Wikimedia commons

Humans have had a profound influence over evolution; ours and the evolution of many other species.

So much so today that we are without doubt in the driver's seat of

evolution for many species, including our own.

We've sent hundreds, probably thousands, of species to extinction, and potentially millions more in the near future with the current pace of destructive environmental change.

The present era has been dubbed the 'Sixth Mass Extinction' in Earth's history with the average rate of loss of species around [100 times greater than the 'background' rate](#) seen over long timescales in the fossil record.

Extinction is, after all, the end of evolution, and the loss of one species can have unexpected spin-offs.

The disappearance of a single species changes the composition and functioning of an ecosystem, with its delicate balance between its constituent species and the physical environment, honed by thousands or millions of years of evolution.

But if it's a critical - 'keystone' or 'ecosystem engineer' - species that disappears, the entire ecosystem can be profoundly changed or even collapse.

A good example of [an ecosystem engineer is elephants](#), and in the past, mammoths and other extinct elephant relatives.

They destroy trees sometimes turning woodlands into grasslands, dig up huge amounts of soil in foraging and when drinking water and their dung can cover the ground in densities of up to 2 kg per square metre.

But, compared to humans, their impacts are significant only on local and regional scales, and globally unimportant.

Yet humans are clearly the greatest ecosystem engineer that has existed.

So widespread has the damage caused by us been, especially over the last couple of hundred years, that the planet itself may even have entered a 'state-shift' in which the [biosphere may be close to a 'tipping-point'](#).

Whole ecosystems are being transformed, many have collapsed, and all as a result of species loss and too little time and space for evolution to take its course, disallowing plants and animals to adapt to change.

Take plants: modelling suggests that [for roughly 30 percent of the planet](#), the pace at which species will have to migrate just to keep pace with projected climate change is much greater than in the past when we saw major shifts during the Ice Age.

In many cases they'll simply have nowhere to go as a result of human fragmentation of landscapes or because they occupy narrow zones like mountainous areas.

What might a state-shift in the planet's biosphere look like?

Well, we can look to the past to get some idea of what might happen, only this time, more dramatic.

The last great cold phase of the Ice Age - dubbed the Last Glacial Maximum - occurred between roughly 30,000 and 15,000 years ago.

After this time the climate became punctuated by a number of short and rapid changes before entering the modern climate phase.

A short warming occurred between roughly 14,500 and 12,500 years ago, followed by another cold phase lasting about 1,000 years, until the present warm period called the *Holocene* began around 11,500 years ago.

With these swings from cold to warm to cold and back to warm there

were dramatic changes in [weather patterns](#) at local and regional scales, and profound ecological shifts across the planet.

Rainfall and wind patterns, weather cycles, and humidity levels changed. Natural fire regimes altered.

There were major shifts in the distributions of plants and animals.

Many species were lost and ecosystems altered in composition, resulting in major shifts in biodiversity.

In short, the biosphere went through a turbulent time with around half of the planet's species of large-bodied mammals going extinct, as well as a number of species of large birds and reptiles, and a few species of small animals.

We've no idea how many plant or insect [species](#) were lost.

Whole ecosystems were transformed, [especially in higher latitudes](#), which were most vulnerable to climate change.

But even the [tropics went through major](#) and rapid climate shifts altering weather patterns like the East Asian Monsoon and the ecosystems dependent upon it.

At the same time all this was happening humans passed through a profound shift in population size and behaviour.

The population growth curve began its rapid exponential rise [between 15,500 and 11,500 years ago](#), beginning with around 10 million people and ending today at more than 7 billion, and [peaking at a little over 9 billion by 2075](#).

This time also ushered in the development of agriculture or the Neolithic period.

This construction of a new human ecological niche through cultural and technological change was one of the most profound events in the evolution of modern humans; more profound even than the changes that ensued when our kind first left Africa 60,000 years ago.

Yet, it led to changes in the human genome associated with changed diet and disease exposure, within a few thousand years of agriculture commencing.

It's even been suggested that the [lack of pigmentation in the skin of living Europeans](#) was only widespread well after farming began in the region after 7,000 years ago; so it even changed the way we look.

Agriculture saw large tracts of land being cleared, animals and plants domesticated, humans dramatically shifting their diets, big changes in the diseases suffered and their epidemiological patterns, many major migrations and population replacements, and people living a more sedentary life resulting in the beginnings of cities, states, extensive trade and warfare.

Many of these changes are familiar to us today, and are [becoming major issues again with global warming](#).

Ironically, the responses of the people living during the climatically tumultuous period between 15,000 to 11,500 years ago set the backdrop for the challenges we face today.

We can't blame them, they were just trying to survive, and of course had no knowledge of the path they were putting us all on.

Things are different now: we're only too aware of the havoc we're wreaking on the planet and ourselves, and understand the steps we need to take to change the future.

And meetings like COP21 are aiming to change things for the better.

Question is, are we really willing to respond quickly enough and make the changes we have to to derail the express train to evolutionary oblivion?

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