Are humans extinction-proof?

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Does climate change seriously threaten to wipe out the human species if left unchecked? Examining our evolutionary past suggests it might once have been the perfect catalyst for our extinction. But now?

On January 14 of this year, the Bulletin of the Atomic Scientists moved the hands of its Doomsday Clock one minute further from midnight (it's now six minutes to midnight), encouraged, it was announced, by the "progress seen around globe in both key threat areas: nuclear weapons and climate change".

First published in 1947, the bulletin was founded by scientists, engineers and other experts involved in the Manhattan Project. The clock continues to serve as a metaphorical countdown to the apocalypse – the annihilation of humanity – set for midnight.

Today, the bulletin's Board of Sponsors, comprising no less than 18

Nobel Laureates, almost every one of them a physicist or chemist, sets the hands of the clock based on their reading of “threats to the survival and development of humanity from nuclear weapons, climate change, and emerging technologies in the life sciences”.

They’ve a much wider brief now, a longer list of threats, and, I guess, more reasons to be pessimistic.

Around 500 million years ago, animal life was almost non-existent on Earth. Today, biologists recognise up to 6 million animal species.

Humanity – Homo sapiens – is just one among the 4,500 living mammal species; and some understanding of where we might be headed can be gleaned from where we’ve been – our evolutionary journey.

Our starting point as a group of two-footed, small-toothed, weakly-muscled, brainy “have-a-chat” apes is the ancestor we share with living chimpanzees some 7 million years ago.

(The two chimpanzee species are endangered, incidentally, because of the environmental destruction caused by us, their closest cousin).

Our evolutionary group – the hominins – diversified quickly after the split from the human-chimp ancestor, and through its multiple evolutionary iterations natural selection produced 25 or 30 two-footed ape species – undoubtedly with more to be found as anthropologists discover more fossils. All of these are now extinct, except us.

Those 7 million years represent only the last couple of minutes on a 24-hour clock of Earth’s 5 billion year history. The culling of 30 species to 1 in this short timeframe, or a more than 95% loss of hominin biodiversity, is worse than the worst mass extinction episode recorded in the fossil record: the Permian event some 250 million years ago.

But these mass events obscure the fact that, in the history of life, extinction has been a dominant theme, a continuous process. Evidence from the last 600 million years shows roughly one-third of existing animal species going extinct every 10 million years.

Seen in this context, the rate of extinction in the human evolutionary tree is striking, about three times faster than normal. This strongly suggests that we hominins are a highly extinction-prone mammal.

Why the dramatic loss of hominin diversity? What caused all these species to disappear? These are difficult and complex questions, but the answer may in part centre on the dramatic changes in climate that provided the backdrop for much of our evolution.

The last half million years or so in particular represent an episode of especially severe climate fluctuation, with intensely cold periods followed by warm phases, flip-flopping between the two on timescales of hundreds or thousands of years – in short, the worst bit of the 2.6 million-year Ice Age or Pleistocene Epoch.

The archaeological record of Europe suggests that vast areas were largely emptied of hominins during cold phases only to be recolonised during warm periods.

Hominins, pre-dating our own species, were living in Europe at latitudes as high as 53° north by 700,000 years ago.

The 53rd parallel runs from the United Kingdom east through the Netherlands, Germany, Poland, Belarus, Russia, Kazakhstan, China (Inner Mongolia), United States (Alaska), Canada and Ireland.

Many places at this latitude today experience temperatures as low as -40° Celsius. But the climate at that time was Mediterranean in character.

Soon after, the planet plunged into another cold phase lasting 100,000 years, with vast areas of Europe covered by ice.

Biologists have identified various intrinsic features of mammal species that increase their chances of extinction. They include traits such as:

• large body size;
• narrow ecological breadth (i.e. specialist feeders);
• low abundance, or sparse numbers of individuals, in the landscape as well as fluctuation in population over time.

Hominins are large mammals. Estimates of mass and stature for many Ice Age species would easily qualify them for spots on the front row of a rugby team … and that's just the females!

Large mammals are slow to mature and reproduce, and normally have one offspring at a time. While many extinct hominins were, like our own species, omnivorous, those living in cold climates relied heavily on animal food, as have recent hunter-gatherers such as the Inuit. This represents a narrowing of dietary niche on a par with many carnivores.

Estimates of population size from this period are remarkably low, with perhaps only 5,000 individuals in warm phases, plummeting to 1,000 or less during the cold stages, probably for the whole of Europe.

If around today, these individuals would be part of an endangered species, vulnerable to rapid extinction. And all of this applied to our own species as well for all but the last little bit of our brief evolutionary history.

Around 10,000 years ago, something unprecedented occurred that altered the course of our evolution: we invented farming. This massive change in dietary, social and economic behavior, a cultural shift known

as the Neolithic Revolution, shaped the future course of our own, and the planet's, evolution in remarkable and unpredictable ways.

It resulted in anatomical, physiological and genetic changes that massively altered our evolution.

Our domestication of plants and animals, and the large-scale clearing of land, altered the history of many others as well. It paved the way for a rise in infectious disease, and social changes such as occupational specialisation, writing, standing armies and empires, long distance trade, money and markets.

But the most profound shift of all was an explosion in human population, the result of greatly improved food security resulting in a dramatic lowering of infant and childhood mortality.

In Europe, from a base of perhaps only 5,000 Ice Age hunter-gatherers, the take-up of farming from approximately 8,000 years ago sharply increased population growth to an estimated rate of 3% per annum, from a long-term average of zero.

This is roughly three times today's global annual growth rate. From a population of less than 100,000 people worldwide, we have grown in less than 10,000 years to almost 7 billion.

Seen in its broadest context, the history of life on Earth soberly demonstrates that the vast majority of organisms that ever lived, perhaps 99% of them, no longer do. It also shows that mammal species normally last 1-2 million years before extinction inevitably bumps them off.

Yet, unlike most mammals, including our dozens of extinct hominin cousins, we have escaped the vulnerabilities of a small and massively fluctuating population.

The simple, but profound act, of growing our own food delivered us the food security that ensured most of our children survived and our population grew.

In effect, farming gave our species level assurance that the biological isn't always inevitable. The odds have shifted to such a degree that we may now be, with or without climate change, extinction-proof.

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