

# A human perspective

As we face perhaps the biggest challenge in our species' history, Chris Stringer — a palaeoanthropologist at London's Natural History Museum and author of *The Origin Of Our Species* — tells *Nature Climate Change* how our hominid cousins battled past climate change.

## ■ How important has climate change been to human evolution?

Indian Ocean monsoon patterns have changed over the past few million years. There was also a continuing shift in land elevations — volcanoes in Africa, and the Himalayas rising in Asia — that pushed a general change in global circulation. In turn grasslands spread in Africa. This had been credited with driving the earliest stages of human evolution, pushing our ancestors into savannahs, where they began walking upright. However, there is now good evidence that several species of prehuman were already walking upright, even though they were still living in and around trees. The move to open environments may have come long after the ability to walk upright had evolved.

## ■ How did climate change influence human migration?

There is a push-and-pull effect with migrations. People are pushed to move because of some problem, such as overpopulation, famine or a volcano eruption; or they're pulled by some attraction elsewhere, such as a new food supply or a valuable resource such as flint for tool-making. In Africa, climate change pushed people around, predominantly because of rainfall changes. Every time the Sahara dried up, people and the animals they hunted perished or moved to wetter areas. People were living right across the Sahara 120,000 years ago, when it was wet and green. By 70,000 years ago, it was a dry desert — people that hadn't died of drought and starvation would have followed herds migrating out.

## ■ How much has the climate shifted during human history?

The North Atlantic started to cool significantly after 2.5 million years ago, initiating strong glacial cycles. And from 800,000 years ago, the climate went into extremes, where every 100,000 years the Earth experienced major ice ages: the sea level dropped over 100 metres and ice sheets covered large areas of land, especially in the north.



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## ■ How did that effect human populations and their dispersal?

Greatly. When it grew colder, low sea levels encouraged dispersions because there was more land available and land bridges formed across seas. Britain was joined onto continental Europe until the English Channel formed, but each time sea levels fell, the connection was re-established. Australia was joined to New Guinea, and whole parts of Southeast Asia connected up. So, in tropical and subtropical areas there was great potential for movement. In the north, however, there were large ice sheets and an extremely cold environment. This was bad news; there was little for people to eat and it was difficult to survive the winters in such extreme cold without the cultural buffering we've got now. We've got buildings and well-insulated clothes. These ancient people were living in caves or in the open, so they were very vulnerable.

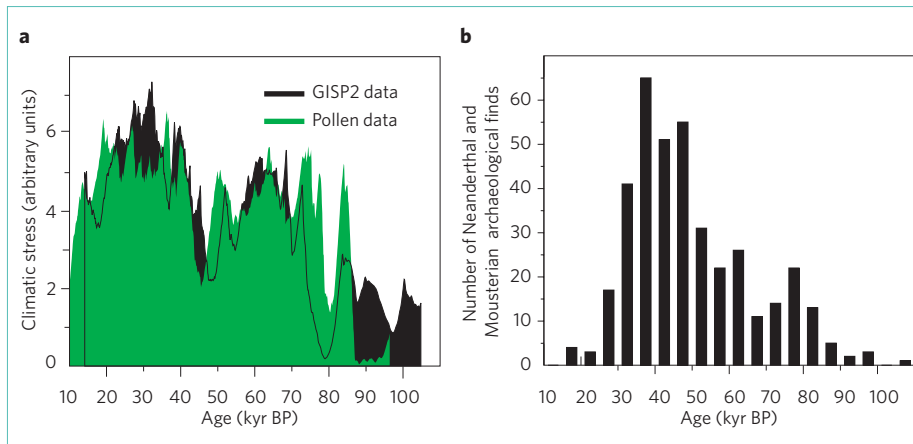
## ■ If it was so challenging in the north, why did humans migrate from Africa?

The first migrations out of East Africa and into western Asia may have been pushed by climate changes or pulled by scavenging

opportunities. We know that large predators such as sabre-toothed cats were in both Africa and Georgia, and these animals could dispatch megafauna such as elephants, leaving behind carcasses with plenty of meat still on the bones. So, we guess that humans followed these hunting cats — they were following their next meal.

## ■ When did people make it as far north as Britain?

Britain was at the edge of the inhabited world, but we know that people were living there about 900,000 years ago from stone tools in Norfolk, attributed to a species called *Homo antecessor* ('Pioneer Man'). However, Britain was only reached and visited every time the climate was reasonable for people and there was a land bridge. And each time it got really cold, everyone living there disappeared or died out. So at least eight times, humans came into Britain, colonized it and then disappeared again. We're now in the ninth phase and we're still here. So it's only in the last 11,500 years — in the Holocene — that people came into Britain and stayed through to the present day. All of the previous colonizations failed,



**Figure 1** | The peak of climate stress. The 'climate stress' curve (a) — based on ice-core data from the Greenland Ice Sheet Project 2 (GISP2) and pollen data from a site in Italy for the past 100,000 years — peaks around 30,000 years ago. This peak corresponds to a sharp and terminal decrease in dated Neanderthal sites (b) for this period (those dated younger than 30,000 years ago are probably unreliable).

people didn't stay. The Holocene has been climatically very stable and hospitable to modern humans.

#### ■ How did humans cope with the ice ages?

Every time it warmed up, Neanderthal populations expanded and moved north. We find them in Germany, Poland and in Britain, now and again. Every time it got extremely cold, the populations vanished off the northern landscape and hung on in southern refugia, in France, Spain, Italy and Greece. When modern humans arrived in Europe about 45,000 years ago the same thing happened to them. Populations were regularly chopped to a quarter or less, reducing genetic diversity. Every time it got really cold, both populations of humans were stressed, they would shrink to their southern refugia and try to survive. Climate data for the past 100,000 years — used to calculate low temperatures and rapidity of temperature change — reveals that there was a peak of climate stress about 30,000 years ago (Fig. 1). Modern humans got through these stresses, Neanderthals did not. Gibraltar, as far south as they could get, was probably one of their last refuges.

#### ■ Why did we make it, when the Neanderthals didn't?

When modern humans and Neanderthals co-existed, they competed for resources and food: they would have hunted the same species and eaten the same plants. But we were probably slightly better at adapting to rapid climate change. Modern humans had larger groups and social networks, and there were also technological differences.

Neanderthals might have worn ponchos or fastened skins together with thongs, whereas modern humans wove and had needles. Sewing allows you to make well-insulated clothing and tents. If modern humans were even 1% better at coping with this climatic stress, such as through better infant survival, they were more likely to get through the bad times.

#### ■ Does that make us the most successful humans?

It depends how you look at it. *Homo erectus* is known from at least 1.8 million years ago in East Africa and Dmanisi in Georgia, so it was already quite a widespread species and may have been the first to make the migration out of Africa and into Asia. Brain size was only about half that of a modern human, and they made quite basic stone tools, but despite that *H. erectus* spread rapidly to China and Java. We don't know why *H. erectus* eventually died out — it was probably around in China until about 300,000 years ago, and controversial dating from a site at Ngandong in Java puts it there only 50,000 years ago. But even if it died out 300,000 years ago, *H. erectus* still survived for more than one million years, which is considerably longer than we have managed so far.

#### ■ So when did we *Homo sapiens* finally get left alone?

Neanderthals disappeared around 30,000 years ago, although we know their DNA lives on in people outside of Africa. The last good evidence of the Flores 'hobbit' (*Homo floresiensis*) is from about 17,000 years ago. The ancestors of this

creature may have been in Flores more than one million years ago, and evolved in isolation for all of that time. Then, the island of Flores was devastated by a volcanic eruption 17,000 years ago, which must have destroyed the vegetation and the animals relying on it, including the dwarf elephant-like stegodon (*Stegodon floresiensis*) on which the hobbit may have depended. So, either the hobbit itself or its food supply was devastated, and it went extinct. It's a very sad end to an evolutionary story that may have lasted two million years.

#### ■ We've only been around for about 200,000 years — do you think we're safe?

One of the most worrying things is permafrost melting. If it continues to melt as we think it's already doing in some regions, we may well have a runaway greenhouse effect. We're also very dependent on a few staple crops, such as wheat and rice. If they get hit by climate change, we're in trouble. We're medium- to large-size mammals, we take a long time to grow up, we only produce one child at a time and we're demanding of our environment — this type of mammal is the most vulnerable. So, no, we're not immune from extinction.

#### ■ How might we go extinct?

You maximize your chances if you're in large numbers and spread widely, as we are now, and *Homo erectus* was, in relative terms. But the danger is that climate change will drive us into pockets with the best-remaining environments. The worst-case scenario could be that everyone disappears except those who survive near the North and South poles — maybe a few hundred million, if the environment still supports them — and those will be the remaining humans. The problem is that once you've got humans isolated in small areas, they are much more vulnerable to extinction through chance events. That was the problem for the hobbit, and also for the Neanderthals. At the end of their time the Neanderthals were probably only in very small areas of Europe and Asia, and thus vulnerable to events such as rapid climate change, famine or natural disasters.

INTERVIEW BY GAIA VINCE