

# Can climate change humankind?

## This may have happened 450,000 years ago during a long climate-temperate period

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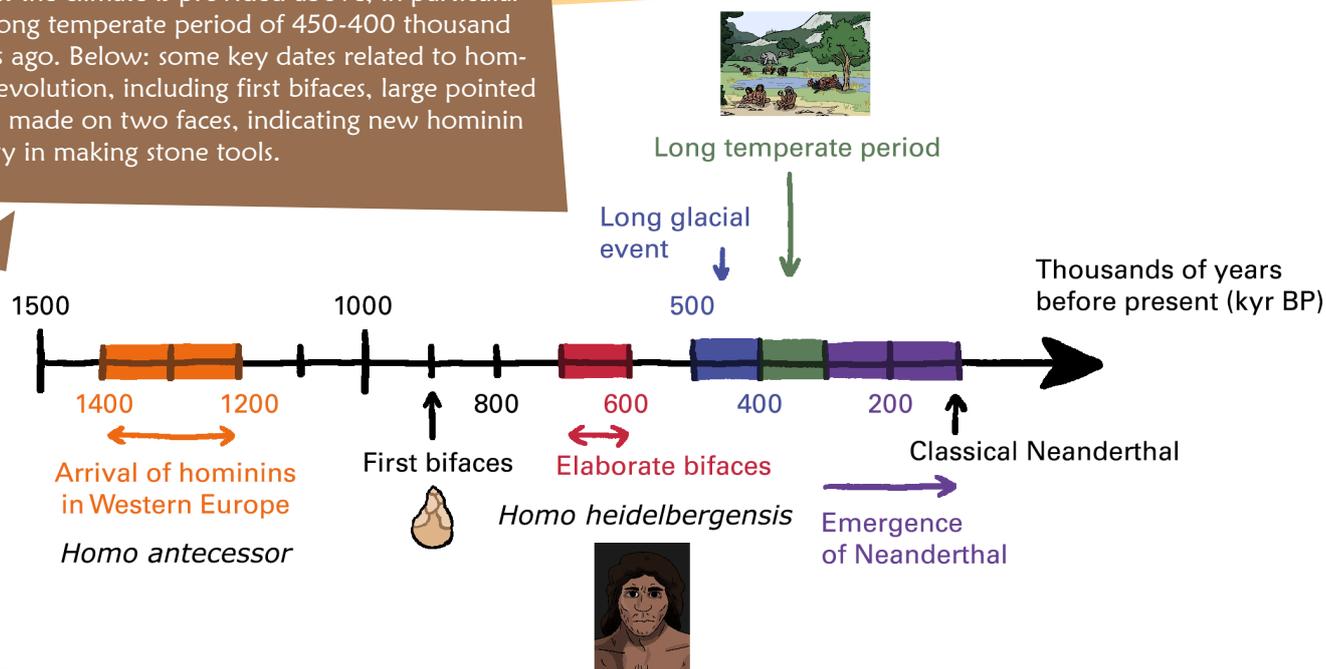
450,000 years ago, a long period of temperate climate (relatively warm in comparison to the current one) took place and lasted about 50,000 years. During this time interval, major changes in the anatomy of hominins occurred, with the appearance of Neanderthal. Hominins living in Europe developed stone tools and hunting methods among other cultural adaptations. Their population probably doubled in size, and they occupied larger territories. This long temperate period, also known as Marine Isotope Stage 11, appears to have been a time where innovative behaviors (such as stone tools) flourished and promoted expansion of populations across Europe. The impacts of climate on human culture is currently a very hot topic, and understanding how our ancestors adapted their culture in response to climatic variability is highly relevant to how we evaluate our own ability to adapt to present-day climate change.

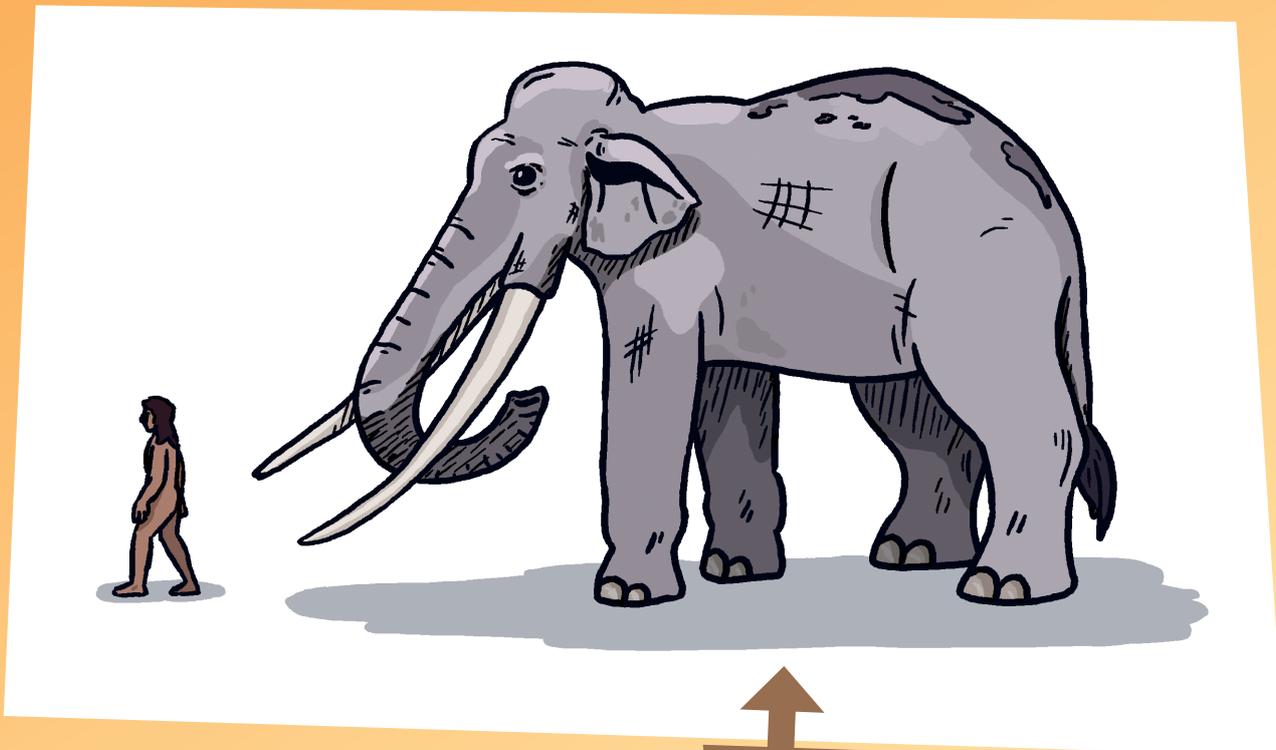
## Beginning of human presence in Europe

The earliest traces of humans in Europe are often compared to those observed in the African archaeological records, where tools have been found and dated to 3.3 million years ago. In Europe, the earliest tools have been dated to around 1.4–1.2 million years ago (Fig. 1). Because humans migrating from Africa to Europe would have brought tools (or at least the knowledge of how to create tools!) with them, it is likely that small groups of hominins entered Europe from the Near East at this time, when the climate was temperate and humid. These groups mainly stayed in southern Europe, but there are indications of occupations at higher latitudes, for example in southern England, earlier than 900,000 years ago, when continental conditions were milder and allowing hominins to survive and thrive in this area. This part of England has never been covered by ice sheets\*, even during glacial events\* when ice sheets in other parts of the world were larger and thicker than today, and some traces of early humans have been preserved.

Paleoanthropologists have assigned the name of *Homo antecessor* to these first Europeans.

Figure 1. Timeline of the prehistory of Europe. The dates are approximate, due to uncertainties in the dating methods that were used. Information about the climate is provided above, in particular the long temperate period of 450-400 thousand years ago. Below: some key dates related to hominin evolution, including first bifaces, large pointed tools made on two faces, indicating new hominin ability in making stone tools.





Human fossils from this period are, however, very rare, with only some teeth and fragments of bones recovered from archaeological sites. Nevertheless, remains of stone tools that they abandoned provide evidence that they once inhabited these areas. More than 1 million years ago, these hominins used blocks and pebbles of various stones from which they removed cutting stone fragments to cut the meat from the carcasses of large herbivores, such as elephants, that were present at that time in Europe. These elephants were adapted to the European climate, both in the southern and northern latitudes (Fig. 2). Hominins ate the meat of animals that died naturally, or that were killed by large carnivores such as saber-toothed tigers.

Figure 2. *Elephas antiquus*, one of the largest elephant species living in Europe at the time of *Homo heidelbergensis*. Its height at withers (the ridge between the shoulder blades) was on average 4 m (13 ft), compared to the hominin who was ~1.60 m (~5 ft 3 in) in height.

## Appearance of new tools

Around 700,000 years ago, hominins' toolkit evolved to include more complex tools such as bifaces, large pointed tools made on two faces (Fig. 3). These new tools were either introduced in Europe by newly arrived groups of hominins named *Homo heidelbergensis* (Fig. 4), or they were developed by *Homo antecessor*.

These new hominins seem to have been more adapted to temperate and cold climatic conditions

in terms of anatomy and behavior, because artifacts indicating their presence have been found at archeological sites both in southern and northwestern Europe. For instance, some of the hominins lived in the Somme Valley in northern France around 670,000 years ago, when the climate was colder, with open vegetation that supported herds of large mammals.

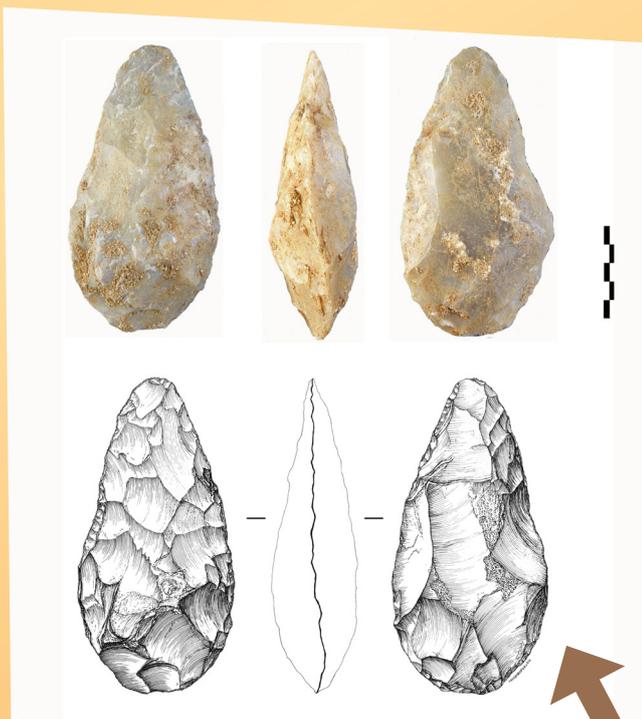


Figure 3. Flint bifaces dated to 700,000 years ago from the French site of la Noira (central France) and made by *Homo heidelbergensis* (photo by M.-H. Moncel; drawings by A. Theodoropoulou).



Figure 4. Reconstitution of *Homo heidelbergensis*, living in Europe.

However, there is no evidence of fire, though the hominins had probably found alternative solutions to survive during winters (for example, clothes from animal skins and habitats protected against cold wind by screens made of animal leather).

Europe, however, was possibly not continuously populated during this period. As the European climate changed over time with alternating periods of cold and temperate conditions, the vegetation and fauna also changed accordingly. This variability could have led to successive depopulations, or extinctions, of small hominin groups, with subsequent recolonizations when the climate was more favorable and temperate, similar to the present-day. This was the case until approximately 450,000 years ago when large, thick ice sheets covered a large part of northern Europe during a long glacial event, which reduced the land area available for hominins to live on. This glacial event of about 100,000 years is considered to have recorded profound changes in human occupation of Europe because afterwards we can observe across Europe new stone tools and new methods to make these tools, increase of herbivore hunting and ability to replicate/make fire.

## Towards Neanderthal

Following the glacial event 450,000-350,000 years ago, a 50,000-year-long interglacial\* is recorded in ice-core climate records. From then on, the numbers of traces of hominins, and archaeological sites, increased in Europe. However, this increased

number is not due to better site preservation. Rather, populations grew in size due to improved environmental conditions that favored such a demographic expansion (Fig. 5). New behaviors, such as an improved ability to control fire, aided this population increase and allowed groups to expand once again into northern latitudes, such as northern France and southern England. More controlled use of fire allowed them to cook meat and protect themselves against large carnivores. Scientists associate these new behaviors with the evolution of the Neanderthal species.

Neanderthals were our close relatives. Anthropological analyses of these more numerous human fossils (since populations were larger) show that the Neanderthal anatomical features (such as certain properties of the skull, body size, and robustness of the skeleton) emerged in European populations between 450,000 and 400,000 years ago among local human groups of *Homo heidelbergensis*. During this interglacial period, anatomical evolution took place at a rapid pace, even though genetic data show that the process actually started hundreds of millennia earlier, around 600,000 years ago. The severe glaciation dated at around 450,000 years ago is considered to represent a major crisis for hominins, explaining the profound populational changes that followed, not only with respect to anatomy but also for cultural behaviors. In addition to fully mastering fire and occupying northern territories, these hominins also planned more and more hunting of large herbivores, while scavenging of carcasses decreased (Fig. 6).

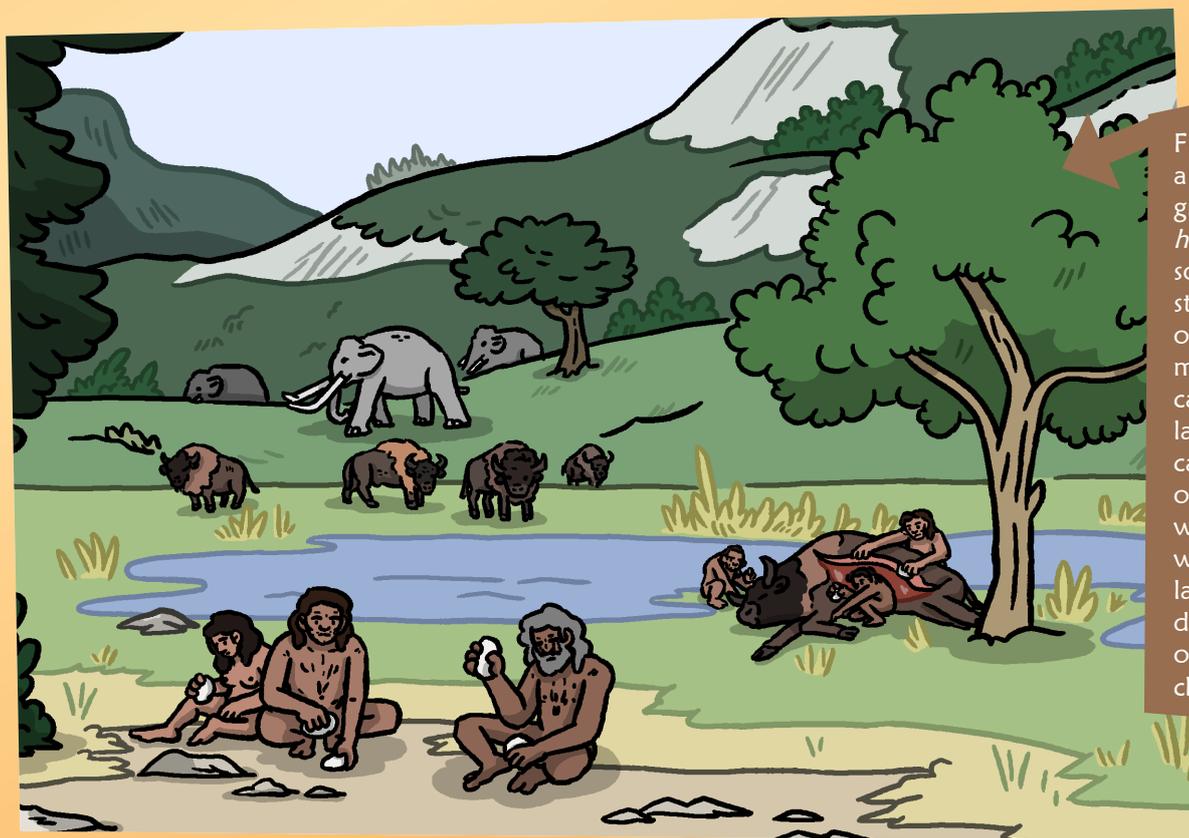


Figure 5. View of a life scene of a group of *Homo heidelbergensis*, some making stone tools and others cutting meat from a carcass. The landscape is typical of the habitat of early humans who co-existed with herds of large herbivores during periods of temperate climate.



Figure 6. Hunting scene of a cervid (deer) by *Homo heidelbergensis*. The deer is stuck in a swamp, enabling the prehistoric humans to hunt it.

available) with forests and meadows providing a habitat and food for various herbivores. This large number of animals across Europe allowed human groups to be more mobile and, thus, expand demographically. It was easier for human groups to occupy larger areas of Europe and exchange innovations, such as stone tool technology.

Large tools like bifaces became less common, and hominins began to produce smaller stone tools produced with complex methods and long successions of gestures (Fig. 7). Similar behaviors are observed between human groups living within the same regions, indicating that there were regional traditions.

This 50,000-year-long interglacial period, which followed a harsh glacial period, would have been beneficial to hominin occupation in Europe. Vegetation during this temperate period led to higher biomass availability (quantity of animals and plants

Neanderthal anatomy stabilized around 100,000 years ago, and their populations expanded across Europe until the arrival of Modern Humans (*Homo sapiens*) in Europe around 40,000 years ago.

The reasons underlying these behavioral changes at 450,000–400,000 years ago have yet to be identified in detail, and identifying the factors and understanding these processes is the aim of the Neandroots project, which brings together the expertise of numerous European scientists from various disciplines. Questions on how populations of the past adapted to changes in climate mirror the challenges we face today, even if the societies are completely different.. However, understanding how hominins found solutions by changing how they interacted with plants and animals to overcome environmental change, may serve as a proof-of-concept for studies of human–environment interactions today. About half a million years ago, very small groups of hominins adapted to climatic changes that were happening much more slowly compared to today, by moving to favorable territories or modifying their survival strategies and stone tool technologies. Today, however, climatic conditions are changing very quickly – will we be able to adapt?



Figure 7. Flint tools dated to 450,000 years ago from the French site of la Noira (center of France) and made by the ancestors of the Neanderthals (scale: 5 cm = 1.5 in) (photo credit: M-H. Moncel).