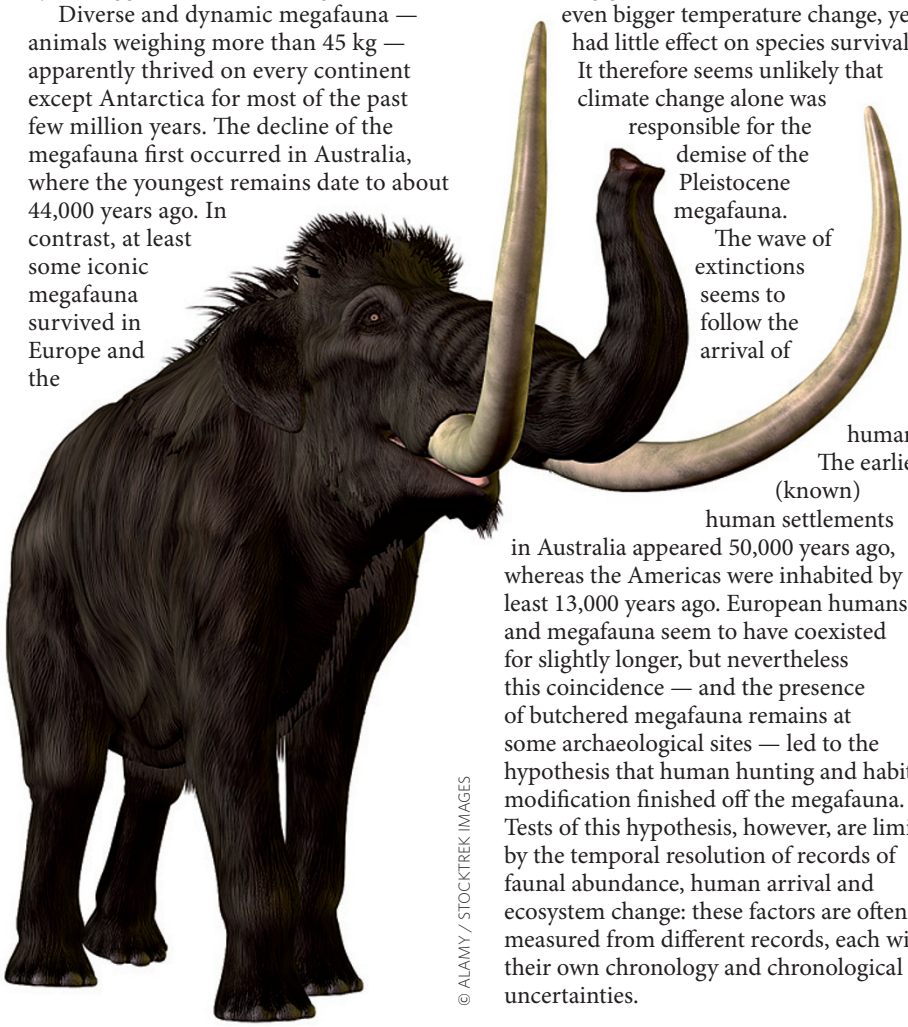
Landscape of the lost giants

The Pleistocene megafauna extinction erased a group of remarkable animals. Whether humans had a prominent role in the extinction remains controversial, but it is emerging that the disappearance of the giants has markedly affected the environment.

The ice-house Earth of the Pleistocene epoch was home to an amazing array of large wildlife. In Australia, ten-foot-tall kangaroos grazed on shrubby brush while avoiding the pointy teeth of their carnivorous rat-kangaroo cousins. Woolly mammoths and mastodons ranged throughout North America among Camelops and packs of dire wolves, and Europe was populated by giant polar bears and aurochs. Yet, by the time the ice sheets receded at the dawn of the Holocene interglacial period 10,000 years ago, the megafauna had largely disappeared. The demise of the largest animals may have profoundly altered the terrestrial nutrient cycle, suggests a Letter on page 761.

Diverse and dynamic megafauna — animals weighing more than 45 kg — apparently thrived on every continent except Antarctica for most of the past few million years. The decline of the megafauna first occurred in Australia, where the youngest remains date to about 44,000 years ago. In contrast, at least some iconic megafauna survived in Europe and the Americas until about 10,000 years ago, with some persisting even further into the Holocene interglacial on island holdouts. Only Africa and parts of Asia were spared from a massive extinction, although they too lost some species of large herbivore.



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The cause of the extinctions is debated. The disappearance of species occurred against a backdrop of striking climate change, as the Last Glacial Maximum gave way to Holocene warmth. Ice sheets retreated and forest biomes expanded towards the poles, precipitation patterns changed and, most obviously, temperatures climbed. But the dramatic environmental shifts were not as marked as those of the preceding glacial termination, which saw an even bigger temperature change, yet had little effect on species survival. It therefore seems unlikely that climate change alone was responsible for the demise of the Pleistocene megafauna.

The wave of extinctions seems to follow the arrival of humans. The earliest (known) human settlements in Australia appeared 50,000 years ago, whereas the Americas were inhabited by at least 13,000 years ago. European humans and megafauna seem to have coexisted for slightly longer, but nevertheless this coincidence — and the presence of butchered megafauna remains at some archaeological sites — led to the hypothesis that human hunting and habitat modification finished off the megafauna. Tests of this hypothesis, however, are limited by the temporal resolution of records of faunal abundance, human arrival and ecosystem change: these factors are often measured from different records, each with their own chronology and chronological uncertainties.

But, where these records can be tied together, it seems that the link between habitat change and megafaunal extinction might not be as straightforward as previously assumed[1,2,3]. Instead of a change in vegetation removing the herbivores' preferred food source, the loss of the extensively grazing animals may have allowed brush to build up. This excess brush would have provided fuel for fires, eventually promoting the establishment of a more fire-tolerant ecosystem. Whether the human propensity for brush burning helped in the establishment of this new regime is unclear[4].

The massive amounts of vegetation consumed by the herbivores meant that the animals would have also produced copious amounts of excrement and urine, rich in nutrients such as phosphorus and nitrogen. As discussed on pages 679 and 761, the megafauna were probably very efficient transmitters of nutrients throughout the landscape. By collecting nutrients in areas rife with vegetation and releasing them as they moved through their expansive habitat, the herbivores homogenized the nutrient distribution in the lands they roamed. The extinction of the large-bodied creatures allowed nutrient heterogeneity to develop. The effect is particularly notable in the Amazon Basin, where the herbivores previously carried nutrients from the fertile Andean foothills to the nutrient-poor soils of the eastern part of the basin.

We are only beginning to understand the ways in which the Pleistocene megafauna interacted with and fundamentally altered their environments, and it is even less clear how our early ancestors affected these animals. However, there is no doubt about the ongoing threat humans pose to the remaining megafauna. In light of what we are learning about their Pleistocene relatives, it is time to strengthen the modern animals' protection — not only for their own sake, but for that of the entire ecosystem in which they live. ❐

References

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