

MEGAFUNA MIX-UP

Barry Brook, Richard Gillespie and Paul Martin find fresh evidence that humans were responsible for the extinction of Australia's megafauna.

Over the past 50 millennia, people living in Australia have witnessed the extinction of many species of marsupial mammals, including a rhinoceros-sized wombat, a kangaroo taller than the biblical Goliath, a lion-like possum and predatory goannas the size of crocodiles and ponderous flightless birds three times as bulky as emus. While the elimination of at least 18 smaller mammal species since European settlement can be shoved squarely in the jaws of the introduced fox and cat, what was the fate of the 50 or so large-bodied megafauna lost sometime in prehistory?

Debate about the possible cause of these late Pleistocene extinctions has continued for more than 150 years, capturing the imagination of palaeontologists, archaeologists, ecologists and dating experts alike. One of the crucial questions in this contentious debate is how long humans and megafauna coexisted in Australia. We need to know the overlap time in order to make an

informed choice between the two main ideas put forward to explain the megafauna extinctions – either climate change was the cause, or the arrival of people like us was responsible. This overlap problem has long been considered intractable due to the scarcity of informative fossil and archaeological sites and the difficulty of dating them accurately.

However, recent improvements in dating technologies, coupled with more sophisticated attempts to understand the ecology of interactions between humans, climate and megafauna, are changing this view. Many scientists now maintain that there is no reliable evidence for Australasian megafauna persisting any later than 45,000 years ago. Most sites that were once thought to preserve the remains of more recent megafauna have subsequently been revealed to be much older than originally suspected.

With the first human colonists arriving on Australia's shores about 48,000 years

ago, their period of overlap with megafauna was brief in geological terms. This coincidence in timing, along with other biological, anthropological and climatic evidence, led Tim Flannery in his book *The Future Eaters* to invoke Paul Martin's idea of a rapid "blitzkrieg" of hunting and landscape change as the cause of the Australian beasts' extinction. Blitzkrieg theory was developed to explain the North American megafaunal extinctions about 12,000 years ago. At that time, when humans arrived on the scene, North America was experiencing rapidly changing climatic conditions.

In contrast, Australia was colonised during a time when the climate was mild and stable. This supports the view that people, not climate change, caused extinction here.

In fact, there is an intimate relationship between prehistoric extinctions of terrestrial vertebrates throughout the past 50,000 years in the Americas, Australia, Madagascar, New Zealand, the oceanic islands of the Mediterranean, the Gulf of Mexico and across the South Pacific. In New Zealand the extinction of large endemic invertebrates called "wetas" coincided with the prehistoric spread of humans and their commensals, such as the Polynesian rat. Nowhere is there a convincing case that regional climatic change in the late Pleistocene caused regional extinctions.

Cuddie Springs

However Cuddie Springs, located in what is now semi-arid western NSW (see map), had apparently stood the test of time and technology by providing evidence of a much more protracted coexistence of humans with the



megafauna (*AS*, September 2001, pp.21–25). This dusty claypan holds within its sediments a rich cache of flaked stone and seed-grinding tools, and side-by-side with these clear signals of human culture are the bones of a dozen or more species of megafauna in sediments dated to 27,000–36,000 years ago.

Drs Judith Field and Stephen Wroe of the University of Sydney, who excavated the site, claim that it provides unequivocal evidence of a long overlap of humans and megafauna, thereby quashing thoughts of a rapid overkill and pointing to aridity leading up to the last Ice Age as the only reasonable explanation for the eventual demise of the large animals. In the long-standing explanation of the site at Cuddie Springs, the archaeological artefacts and extinct animal remains, as well as charcoal and other plant debris, were deposited over many thousands of years in an ephemeral lake. These preserved mate-

Springs published last month in *Archaeology in Oceania*, we have disputed the claim of protracted coexistence of humans and megafauna, instead suggesting that the site has been disturbed and that the artefacts and megafaunal fossils are unlikely to date from the same period. In doing this we have provided an alternative plausible explanation for the history of the site that does not require a long period of contact between man and beast – or indeed any interaction at all.

The amount of charcoal and stone tools found at the site is remarkable. Considering the densities reported in the excavated layers and the size of the archaeological site (100 metres in diameter), we estimate there are more than 3 tonnes of charcoal and more than 300 tonnes of stone buried there. Field and Wroe estimate that there are ~20 million artefacts. This plethora of stone tools is hard to reconcile with a

are actually very similar to implements that have elsewhere been reportedly in use only during the past few thousand years. Also of interest is that a deep drill core made a mere 60 metres from the archaeological excavations recovered no stone artefacts or fossil bones whatsoever.

These points together suggest strongly that the sediments have been mixed and some of the old charcoal has been re-deposited in younger layers. Indeed, one sample of cow bone found ~1 metre below the surface came from sediments known to have been disturbed, where charcoal dated at 6000 and 23,000 years old is mixed with 17,000-year-old sand. The megafauna bones themselves have not yet been dated directly, although new technological developments make this a tantalising possibility in the near future.

And what of the apparently clinching evidence of hair and blood found on

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rials have remained in place and undisturbed until the present day.

There is no disputing the close association of bones and stones at Cuddie Springs 1–1.7 metres below the modern surface, and the dating of these layers is robust. Ages for the sediments were obtained through radiocarbon dating of charcoal fragments (revealing when the organism was alive) and luminescence dating of sand grains from the same levels (revealing when a sample was last exposed to sunlight). Intriguingly, some of the stone tools show surface features and starch residues indicating their use for processing plants, and a few even have well-preserved blood and hair residues suggesting they were used in butchering animals.

Reliability Questioned

But is the case proposed by the excavators really so clear-cut? In a reanalysis of the scientific data from Cuddie

site that was only available for occupation when the lake was dry. Furthermore, no cultural features such as hearths or oven pits (found in other Murray-Darling basin archaeological sites) have been reported at Cuddie Springs.

If the three sediment layers of most interest have remained undisturbed since being laid down, as Field and Wroe contend, then the ages of those sediments should increase with depth. However, our analysis of 16 radiocarbon and four luminescence dates published for these layers reveal a number of inconsistencies.

First, the measured ages on all the charcoal samples are statistically indistinguishable, being roughly 36,000 years old. Second, sand in the two upper levels proved to be considerably younger than charcoal from the same horizons. Third, Field and Wroe say that the flaked tools and grindstones used for plant and animal processing are ancient, yet they

some of the stone tools? If the megafauna bones were the same age as the bloodied tools, they too should have contained preserved protein – but they did not. The excavators have assumed that the people who made those meat-processing tools must have been using them on the megafauna, yet our chemical analysis of Cuddie Springs bone samples turned up no evidence of protein in any of the megafauna samples. Hair and blood proteins break down over long time periods, and because protein in hair and blood is no more resistant to degradation than protein in bone, the discrepancy suggests that the bone is considerably older than the stone tools.

The Alternative

Based on features of the immediate and surrounding landscape and historical records of site use, a quite different reconstruction of the site's history can plausibly explain the published evidence

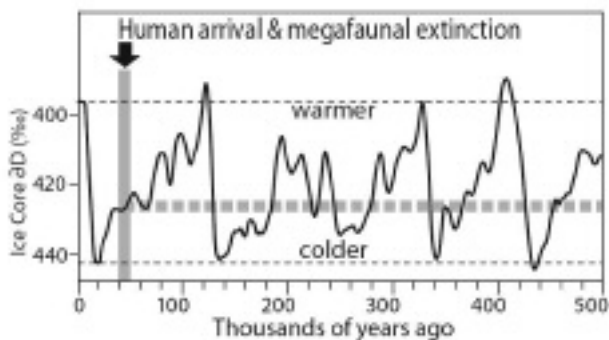


Fig. 1. Global climate change recorded in Antarctic ice cores. The dotted horizontal line shows when Australian megafauna lived, with extinction occurring about 45,000 years ago – shortly after humans arrived. Source: EPICA Community Members (2004). Eight glacial cycles from an Antarctic ice core. *Nature*, 429, 623–628.

outlined above. We propose that the archaeological excavations have actually been sampling the debris carried by ancient flood channels that underlie the modern claypan, including charcoal transported from bushfires that intermittently occurred within the catchment. Flood events more likely explain the accumulation of megafauna remains, and could have mixed old bones with fresh deposits.

European graziers also disturbed the site in 1876 by constructing a well to provide a permanent source of water for their cattle. Given the expense of well-digging, we speculate that the graziers made sure it was well protected from the churning damage caused by cattle hooves, lining the surrounding surface with conveniently-sized “gravel” collected from further afield, such as stones concentrated in prehistoric quarries and other archaeological sites. This idea is consistent with the thin layer of stones spread over a large area, with cattle occasionally breaking through the gravel surface and forcing stone and even cattle bones deeper into the water-logged soil.

Imperceptible Overkill and Climate Change

Blitzkrieg is an evocative but possibly misleading term for what actually happened. Cast aside the mental image of well-armed waves of hunters systematically moving through the landscape and slaughtering all the large beasts that they encounter. In fact, recent studies using population models based on the biology of modern-day large mammals combined with observations of people who still practice a traditional hunter-gatherer lifestyle reveal an unexpected paradox.

A group of 10 people taking out only one juvenile *Diprotodon* (a rhinoceros-sized wombat) each year would be sufficient to bring about the extinction of that species within 1000 years. Juvenile *Diprotodon* would have been easier to kill without the need for a specialised big game hunter’s toolkit. Under such a low level of predation, the decline in the abundance of megafauna would have been all but imperceptible to

any single generation of people. Yet when speaking of events 11 times older than the pyramids, a mere 1000 years appears all but instantaneous using our dating methods.

Over a human lifetime, climate change would not have been obvious if you happened to be living in Australia 45,000 years ago (there were none of the rapidly-changing continental-scale ice sheets that complicated life in North America and Eurasia). Long suspected of reflecting major climatic change, the record of global extinctions in the past 50,000 years is far more intimately tied to the spread of our species than to any unique climatic pulse or pulses. For instance, from deep-sea and ice cores and the distribution of fossil bones we know that the Australian megafauna survived four of the past five glacial cycles.

Yet the megafauna became extinct about 45,000 years ago when global climate was midway between the extremes of glacial and interglacial periods (Fig. 1), so it is most unlikely that conditions then were either too hot, too cold or too dry for the large animals. Indeed, lakes in the Murray–Darling basin and elsewhere in Australia were full at that time, with greener and wetter environments than those of the same regions today. The extinction did not occur during a climatic spike but during a cultural event – the initial arrival of humans.

Conclusion

There is no reliable evidence upon which to base a claim that extinct Australian megafauna coexisted with or were butchered by Aboriginal people at Cuddie Springs, or that people living there used the sort of seed-grinding technologies that were only adopted elsewhere in Australia 20,000 years later. Instead the site represents a confused juxtaposition of stone tools, charcoal and bones of quite different ages, brought together by a sequence of natural landscape processes and European disturbance.

The fossil record at Cuddie Springs conforms with a global model reflecting numerous examples in radiocarbon time of anthropogenic extinctions. Deleting Cuddie Springs from the list of archaeological sites showing a long overlap between humans and megafauna leaves a revised tally of zero.

This seriously undermines the assertion that climate change was responsible for the extinction of Australia’s spectacular menagerie of megafauna. Most (and perhaps all) extinctions of native fauna, and even a few cases of plant extinctions, appear to be caused by humans. Indeed, wherever and whenever one chooses to look – from Australia and North America to Madagascar, New Zealand and the islands of the Pacific and Mediterranean – the arrival of colonising humans in virgin lands proved to be a volatile combination in which large animals consistently fared badly.

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