Did Humans Cause Ecosystem Collapse in Ancient Australia?

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Massive extinctions of animals and the arrival of the first humans in ancient Australia may be linked, according to scientists at the Carnegie Institution, University of Colorado, Australian National University, and Bates College. The extinctions occurred 45,000 to 55,000 years ago. The researchers traced evidence of diet and the environment contained in ancient eggshells and wombat teeth over the last 140,000 years to reconstruct what happened. The remains showed evidence of a rapid change of diet at the time of the extinctions.

The researchers believe that massive fires set by the first humans may have altered the ecosystem of shrubs, trees, and grasses to the fire-adapted desert-scrub of today. The work is published in the July 8, issue of *Science*.

The scientists plotted diet changes over 140,000 years of two species of large, flightless birds--the now-extinct Genyornis and the surviving emu (*Dromaius*)--in three Australian locations. They then corroborated their findings by analyzing ancient wombat teeth. â€œWhat your mother told you is true: You are what you eat,â€? stated co-author of the study Marilyn Fogel of Carnegie. â€œEggshells and teeth both contain evidence of these animalsâ€™ diets in different forms of carbon. All three animals were plant eaters. Different types of plants metabolize different forms of carbon in distinctive ways from the CO_2 they take up during photosynthesis. The tell-tale carbon varieties were preserved in the eggshells and teeth and told us what types of plants the animals ate. We saw a sudden shift in plant type coincident with the arrival of

humans. The shifting diet shed light on the extinctions. The animals that relied mostly on the more palatable plant forms died out, such as *Genyornis*, while the animals that adapted to the less nutritious plants survived, including the emu.â€?

There are three isotopes, or varieties, of carbon found in nature--^{12}C, ^{13}C and ^{14}C. They differ in the number of neutrons in the nucleus. By far the most abundant variety is in the lightest, ^{12}C. About 1% is ^{13}C, a heavier sibling with an additional neutron. There is even less ^{14}C, the unstable, radioactive heavyweight of them all.

â€œ13C is the key,â€? Fogel explained. â€œThere are two main ways plants metabolize ^{13}C . About 85% of plants belong to what is known as C3 photosynthesis group. This group incorporates less 13C than plants belonging to the second most common class, C4. Thus, the differences in 13C that we detected in the eggshells and teeth pointed to the type of plants that were consumed. Although, both types of plants were present before the extinctions, we saw a quick shift in dominance from C4 drought-resistant trees, shrubs and grasses, to C3 desert plants. â€?

Why did the scientists point to humans as the instigators of the ecological changes? First, they ruled out the other usual suspect--global climate change. They looked at their data in 15,000-year intervals back to 140,000 years ago. The period included dramatic climate changes, but no changes in the diet and environment until an abrupt transition was noted that corresponded to the arrival of humans. â€œHumans are the major suspect,â€? commented Fogel. â€œHowever, we donâ€™t think that over-hunting or new diseases are to blame for the extinctions, because our research sees the ecological transition at the base of the food chain. Bands of people set large-scale fires for a variety of reasons, including hunting, clearing, and signaling other bands. Based on the evidence, human-induced change in the vegetation is the best fit to explain what happened at that critical juncture.â€?

The study was funded by the National Science Foundation. Co-authors include Gifford Miller of University of Colorado, John Magee and Mike Gagan of the Australian National University, Simon Clarke, a student at Carnegieâ€™s Geophysical Laboratory, and Beverly Johnson at Bates College.

Source: Carnegie Institution of Washington