Did animals control woody weeds?

Lochman Transparencies

Long-deserted nesting and burrowing sites offer evidence that malleefowl and burrowing bettongs once roamed the semi-arid woodlands of Australia. Ecologists say fertile burrows and nesting patches provided an oasis of nutrients that were critical to regenerating growth in the rangelands.

In 1986 Dr Jim Noble noticed two kinds of strange, circular, often eroded, soil depressions at the Lake Mere CSIRO research facility, near Louth in north-west New South Wales. Speculation about their origin poses two interesting questions. Is it possible that extinct native animals kept woody weeds in check? Did the weeds prosper following the animals' local extinctions?

The 48 smaller depressions in the 200 hectare paddock were about 10 m in diameter, varying in depth from almost flat to 15-20 centimetres deep, all containing small pebbles. The four larger depressions were 30 m in diameter and about one metre deep, with a hard 'calcrete' sub-surface layer partially exposed. Noble was intrigued: what were they?

Analyses revealed that the top few centimetres of the 'older' depressions which had been filled with soil, were unusually high in nutrients, with double the nitrogen and carbon of surrounding and deeper soil. The circular shape of both depressions suggested an animal origin. Neither physical processes (such as weathering or shrink/swell), tree roots, nor Aboriginal activity are likely to have been responsible for these surface features.

The depressions were probably animal nests, but which animals?

The pebble sizes of the smaller depressions rule out two possibilities: pebble-mound mice use smaller pebbles than seen at Lake Mere, and those moved by the stick-nest rat are bigger. But malleefowl, scraping up material for nest-mounds with their feet, accumulate a range of pebble sizes the same as in the Lake Mere sites, and the nest mound sizes match. Carbon-dating evidence from Melville Island in the Northern Territory shows that other bird mounds can last 8000 years.

Noble thought that the bigger mounds and depressions resembled those of Mima prairie in Washington State, US. One of the five explanations for the American features is that they are remnants of pocket gopher (*Thomomys* spp.) burrows. Might the large Lake Mere features have also been produced by burrowing animals?

Noble thought this very likely. But only two animals native to the region were big enough to have made the 'burrows' at Lake Mere.

One, the northern hairy-nosed wombat (*Lasiorhinus krefftii*), probably constructs burrow complexes of 100-150 m^2, the same size as its southern hairy-nosed cousin (*L. latifrons*), which effectively rules it out. The only candidate left is the burrowing bettong (*Bettongia lesueur*).

Burrowing bettongs and malleefowl are now endangered species. Bettongs are found only on three islands and one peninsula on the Western Australian coast, while malleefowl are confined in diminishing numbers mainly to a few semi-arid areas of mallee in southern Australia. Habitat clearing, domestic stock, and feral exotic predators (fox and cat) have contributed to both species' demise.

Both species, however, used to be widespread. Bettongs lived throughout the arid zone, and malleefowl were common across southern Australia. The nest remains of both species have been found throughout their former ranges.

These species may have had a surprising effect on rangeland ecology. One of Noble's colleagues at the Division of Wildlife and Ecology, David Tongway, has shown that the concentration of nutrients in patches is critical to rangeland vegetation growth. Plants have a threshold value of water and nutrients, below which growth will not occur. Nutrients and water, scarce in arid lands, would not reach the threshold level if they were distributed evenly. This spatial concentration of nutrients and water drives the biological activity.

One of the key concentration processes is animal nesting. Faeces and urine, together with surface soil and organic matter, accumulate in these depressions, promoting plant growth, especially in older deserted nests and warrens. This growth enhances biological activity in the soil so that it can retain water, encouraging further plant growth. The fertile patches recycle nutrients and water within themselves, accumulating more of each as they evolve.

Perennial grasses thrive on these patches during favourable seasons, and can prevent shrub seedlings from establishing. After the bettongs' and malleefowls' local extinctions, there was no further nesting.

The bettongs' diet is extremely varied, and includes plant roots and shoots. Other bettong species have also been known to eat tree seedlings. Did the burrowing bettong eat young seedlings of woody weeds and control their abundance throughout semi-arid and arid Australia? Certainly, the widespread increase in woody weeds density in NSW coincided with the local extinction of the bettongs and the malleefowl.

The United States experience also adds weight to this idea. Tree and shrub recruitment in Texas was very limited while prairie dogs (*Cynomus ludovicianus*), ecologically similar to bettongs, were present. When they were gone, woody weeds (especially mesquite, *Prosopis* spp.) took over.

While it's extremely difficult to scientifically 'prove' historical events, Noble believes it highly likely that the bettongs and wildfire together kept woody weeds at bay before European settlement.