

Tolerance to 1080

The highly toxic compound fluoroacetate was first synthesised in 1896 and is used widely as a vertebrate pesticide in Australia and New Zealand in the form of Compound 1080. Only many years later did scientists discover that fluoroacetate occurs naturally in some Australian and African plants and this has interesting implications for wildlife conservation.

In Australia, some 35 plant species, in three legume genera, are known to produce fluoroacetate. The poison is mostly concentrated in the flowers, seeds and young leaves, acting as a chemical defence against over-browsing by herbivores. These toxic plants are most prominent in the south-west of Western Australia, but less toxic species also occur in parts of northern Australia.

Laurie Twigg, the late Dennis King, Gary Martin, and others, from the Department of Agriculture Western Australia, have shown that many native animals in such regions, especially plant-eating ones, have evolved a marked tolerance to fluoroacetate, having co-existed with the toxic vegetation for thousands of years. Introduced pests like foxes, rabbits and feral pigs are generally quite sensitive to fluoroacetate, effectively making the use of 1080 baits more target-specific in many areas of Australia. Dingoes and rodents are also quite sensitive to the toxin.

Following a recent study into the sensitivity, or otherwise, of various native animals to 1080 in north-western Australia, Martin and Twigg

concluded that birds of prey are unlikely to be adversely affected by 1080 baiting programs, with the possible exception of the highly toxic meat baits sometimes used against feral pigs. However, some grain-eating birds, such as ducks and corellas, in northern Australia, were less tolerant of 1080 than expected and may face some potential risk of poisoning if baiting campaigns are not carried out carefully.

The lower tolerance of some northern Australian bird species may have resulted from the lower levels of fluoroacetate in toxic plants in the north of the state than in the south. Earlier work by Twigg and other colleagues also showed that herbivores are generally more tolerant of the toxin than carnivores, with omnivores intermediate in their tolerance.

Martin GR and Twigg LE (2002) Sensitivity to sodium fluoroacetate (1080) of native animals from north-western Australia. *Wildlife Research* 29:75-83.

Steve Davidson

Mossies and malaria

MALARIA kills more than one million people every year, and infects between 300 and 500 million. The disease is present in more than 90 countries and is set to spread, thanks to global warming, El Niño events and international travel.

Attempts to control the disease using insecticides have failed because the mosquito vectors (*Anopheles* spp.) which transmit the disease to humans are so numerous and recover from

control operations so quickly. A method to prevent mosquitoes from carrying malaria could provide a solution however.

Dr Stephen Davis from CSIRO Sustainable Ecosystems, and Dr Nicholas Bax and Dr Peter Grewe from CSIRO Marine Research, have modelled a hypothetical system which could see populations of mosquitoes that transmit malaria replaced by populations that don't.

The model hinges on two theoretical genetic constructs that could be inserted into the mosquito genome. The constructs would contain genes (say A and B) which, if inherited together, would produce a viable mosquito that was unable to transmit malaria. Mosquitoes that inherited either A or B alone however, would die.

'The genes used in the construct could be malaria resistance genes from other mosquito species that don't carry the disease, or some other gene that produces a similar result,' Davis says.

If the genetically modified mosquitoes containing the A and B genes were then released in malaria endemic regions, matings with wild mosquitoes would produce offspring carrying both the A and B genes. When these hybrid individuals mated with other wild mosquitoes however, fifty percent of their offspring would carry only the A or B gene, and would die.

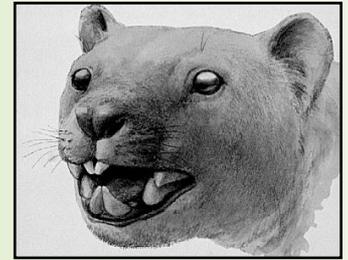
Using population modelling techniques, Davis and his colleagues showed that if three genetically modified mosquitoes were released for every 100 wild mosquitoes, 'introgression' or establishment of the A and B genes in the mosquito gene pool would begin.

The release of genetically modified mosquitoes could stop once about one third of the population carried the A and B genes. According to Davis, once this gene frequency threshold was reached, the genes would continue to 'drive' into the population, eventually replacing the wild type genes that enable malaria transmission.

Davis S Bax N and Grewe P (2001).

Engineered underdominance allows efficient and economical introgression of traits into pest populations. *Journal of Theoretical Biology* 212: 83-98.

Wendy Pyper



Pleistocene marsupial lion.

Not-so-fearsome fossils

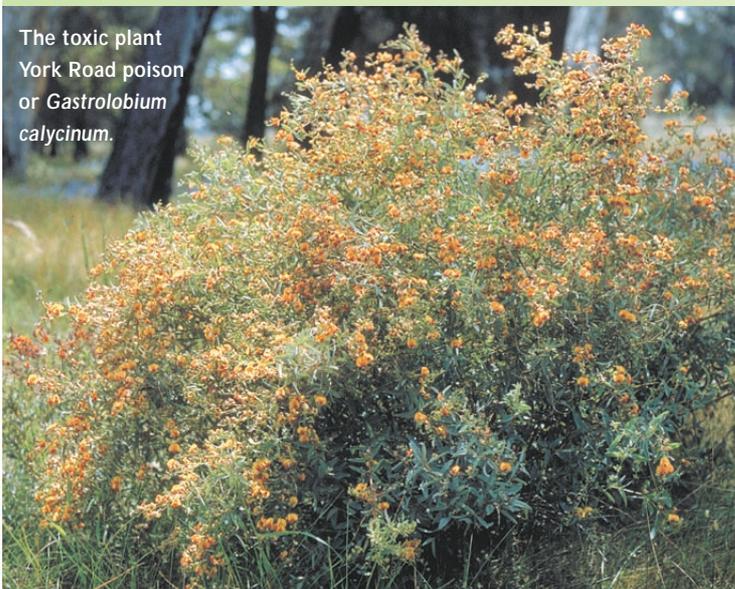
BY THE 1990s, many palaeontologists held the view that reptiles had dominated the large, land, carnivorous fauna of Australia millions of years ago, in the mid-Tertiary to Pleistocene period. But did fearsome reptiles really dominate the southern continent and prey on the gigantic, now extinct, plant eaters of the time? One hundred years earlier, scientists thought that 'large and powerful' marsupial predators, such as the marsupial lion, were the scourge of herbivorous, four-legged mammals of the Pleistocene, much as in Africa or Asia today.

Dr Steve Wroe, of the University of Sydney and the Australian Museum, has reviewed the science behind this reversal of opinion. He argues that the contention that big, fierce reptiles dominated Australia's terrestrial carnivore niches is exaggerated, if not wrong.

For a start, Wroe has downgraded the size estimates of several big fossil reptiles. The giant snake, Wonambi, reputed to kill wallaby-sized animals, is now thought to have had a skull, teeth and neck too small and delicate to take large prey, and possibly only ate fish. Some scientists deduced that the giant goanna *Megalania prisca*, perhaps resembling the Komodo dragon, had a maximum length of seven metres and a body mass of 600-620 kg, or even 2.2 tonnes. However, another scientist now estimates that the maximum length of the species was probably 4.67 m, while the average specimen may have been 3.3 m long. Using a different method, Wroe puts the average weight of adult *Megalania* at 97 kg. He reckons that on the limited data now available, the best estimate of average weight for adults is 97-158 kg.

The marsupial lion, *Thylacoleo carniflex*, probably had an average body mass of 101-130 kg. So which was the more significant predator

The toxic plant York Road poison or *Gastrolobium calycinum*.



during the Australian Pleistocene: the marsupial or the lizard? On evidence to date, Wroe posits that much of the diet of the giant goanna consisted of carrion in the form of table scraps from marsupial lion kills. The marsupial was probably the fearsome top-order predator; the lizard a mere scavenger.

There are other doubts about reptilian domination. It has been alleged that several species of land-dwelling crocodiles also stalked the continent, but Wroe argues that this is a myth and that these crocodiles were essentially semi-aquatic, like their living relatives. Discovery of new, albeit extinct, large, mammalian carnivore species is accelerating, while it would seem that large reptiles of the day were uncommon and not widely distributed. Being ectothermic, or 'cold-blooded', reptilian predators also consume much less than similar-sized mammals.

In conclusion, Wroe says the parable of a continent, 'wherein diminutive mammals trembled under the footfalls of a menagerie of gigantic ectotherms, appears to be a castle in the air'. Others may disagree.

Wroe S (2002) A review of terrestrial mammalian and reptilian carnivore ecology in Australian fossil faunas, and factors influencing their diversity: the myth of reptilian domination and its broader ramifications. *Australian Journal of Zoology*, 50:1-24.

Steve Davidson

Burning rubber

RUBBER vine is regarded as a 'weed of national significance', but that's not meant as a compliment. A woody weed introduced from Madagascar, it has the potential to invade most of northern Australia. In Queensland, alone, it is already a problem in 87% of shires and cities north of the Tropic of Capricorn. Rubber vine has a lifespan of about 80 years, produces vast amounts of seed, and is deleterious to livestock and the environment.

Drs Faiz Bebawi and Shane Campbell, of the Tropical Weeds Research Centre, Queensland Department of Natural Resources and Mines, say that while many control methods have been developed, fire is considered the



By 1890, cats inhabited almost all of mainland Australia.

'best-practice' option where vine infestations exceed 2000 plants per hectare. Following up an earlier study, they compared the impact of fires on vine mortality when applied during the early (Aug-Sep) and late (Oct-Nov) dry season in both riparian and subriparian habitats near Charters Towers, Queensland. Fire treatments were burnt annually for two years so that the effect of first and second fires on rubber vine survival could be compared.

Rubber vine tends to initially infest riverbanks, smothering native vegetation, before invading surrounding open woodlands and pastures. The riparian infestations comprise mostly climbing vines growing over native vegetation, while in subriparian areas the plants are usually freestanding. The weed costs Queensland's primary industry about \$18 million a year.

'Our study yielded two key results,' says Bebawi. 'First, late dry-season fires were better than early dry-season fires at reducing the density of rubber vine to low levels. Secondly, two fires are needed for adequate control.'

The researchers conclude that the usual fire-management practice in northern Australia of burning early in the dry season, when the country is still moist and fires tend to burn cooler, may kill some rubber vine plants, but may take a long time to reduce populations to a satisfactory level – and may never do so.

They see a need to integrate various methods of rubber vine control, including fire, mechanical and chemical treatments and biological control with agents such

as rust, to achieve good control of rubber vine with minimal harm to native species and the environment.

Bebawi FF and Campbell SD (2002) Impact of early and late dry-season fires on plant mortality and seed banks within riparian and subriparian infestations of rubber vine (*Cryptostegia grandiflora*). *Australian Journal of Experimental Agriculture*, 42:43-48.

Steve Davidson

Cat chronicles

SOME believe that the domestic cat arrived in Australia before European settlement along the coast, which occurred between 1788 and 1886. Suggested agents for such introductions include: Aborigines (as early as 50 000, or as recently as 3500 years ago), Indonesian trepangers, Dutch shipwrecks, European navigators, or early whalers and sealers. Others argue that cats arrived much later with early European settlers.

Dr Ian Abbott of the Western Australia Department of Conservation and Land Management has reviewed numerous historical documents to determine which hypothesis is correct. He says this is important in evaluating the actual role of feral cats in the decline of native mammals and birds.

Abbott found no mention of cats in the journals of early navigators, such as Dampier, Cook and Flinders, nor were they encountered in unsettled country by explorers who ventured inland after 1788. But there were numerous detections of feral cats by the 1890s and 1900s.

There was no single point of entry for cats. They spread from each coastal town as settlers dispersed. Abbott's maps indicate that, in 1820, cats were restricted to a region around Sydney but, by 1890, cats inhabited the whole mainland, bar perhaps the far north of the Northern Territory and a small part of northern Western Australia.

The author suggests that historically the fox has had a much greater impact on native mammals than the feral cat. In Tasmania, cats have co-existed with all mammal species for nearly 200 years and, in south-western Western Australia, broad-scale baiting of foxes has led to rapid recovery of many native mammals, despite the presence of feral cats. In other recovery programs though, feral cats have wiped out small populations of native animals following fox removal. However, in early times cats were probably less numerous and native animals more abundant than nowadays.

The picture is complicated by the difference in timing of the arrival of the rabbit, fox and cat in the various regions of Australia in the 19th century. It is difficult to tease out the roles played by each feral species, and many other factors such as pastoralism and crop farming, in the decline and extinction of so many of our native animals.

Abbott I (2002) Origin and spread of the cat, *Felis catus*, on mainland Australia, with a discussion of the magnitude of its early impact on native fauna. *Wildlife Research*, 29:51-74.

Steve Davidson