Have Poisonous Plants Helped Save Some of our Native Wildlife from Extinction?

Monofluoroacetic acid is a poisonous substance. Most people know this chemical, or at least a form of it, as compound 1080. It is used to kill "vermin" such as foxes and rabbits. Monofluoroacetic acid occurs naturally in many plants in Australia and most of them—a total of 33 poisonous species of *Gastrolobium* and *Oxylobium*—occur in Western Australia. Fluoroacetates can also be found in some plants in Africa and South America.

These plants are readily eaten by herbivores and have frequently caused livestock losses. Native animals also feed on them but many appear to be able to tolerate quite high dosages of fluoroacetate.

In their paper "The Adaptation of Some Western Australian Mammals to Food Plants Containing Fluoroacetate", D. R. King, A. J. Oliver and R. J. Mead have shown that the balance between the animal's tolerance of the poison and the fact the plants need it as a deterrent against being grazed is a delicate one. Native herbivores are able to eat plants with low levels of fluoroacetate. They are also able to eat small amounts of plants with very high levels of fluoroacetate. Those plants with the higher levels of fluoroacetate survive this grazing pressure as the others are eaten out. The two are in balance, and the levels of fluoroacetate in plants and the tolerance of animals to it have evolved together, here in Western Australia.

There is a great advantage, even for generalised herbivores, in being able to feed on *Gastrolobium* and *Oxylobium* species. These genera are legumes, members of the 'pea' family, and are very nutritious. They are also abundant. Unlike many of the shrubs in Western Australia which are coarse, tough, spiny or otherwise *physically* adapted to resist grazing pressure, some *Gastrolobium* and *Oxylobium* species are soft and succulent. Heart-leaf Poison (*G.bilobum*) and Box Poison (*O.parviflorum*), are particularly good examples of this, and they contain extremely high levels of fluoroacetate. Some species of *Gastrolobium* and *Oxylobium* contain up to 2 600 parts per million of the poison fluoroacetate. In many areas a large percentage of the shrub species are poisonous. They may, in some cases, be the dominant species. This is quite often the case after fire in the south-west of Western Australia. The forest ecosystems show evidence of a long-term association with fires. Several species of macropods, including Grey Kangaroos, are abundant on recently burnt areas, to which they are probably attracted by the newly regenerated ground vegetation.

The climate in south-western Australia is characterised by dry summers. Effective rainfall is rarely recorded between spring and the following autumn. Once the autumn rains start, and before the herb layer has started to grow, the dry herbage becomes spoiled and unpalatable. This is a critical time for herbivores, and they are more dependent on the shrub layer then than at any other time. At this time, the young foliage of the poisonous species of *Gastrolobium* and *Oxylobium* would be more attractive than the spoiled herb layer. The young shoots, following the autumn rain, and the flowers and young shoots in spring contain higher levels of fluoroacetate than other parts of the

Heart-leaf Poison (*Gastrolobium bilobum*)

This shrub ranges from 1 metre to over 4·5 metres in height. It occurs, typically, in association with granite rocks though it may also be found along the banks of streams as seeds are carried down after rains.

Box Poison (*Oxylobium parviflorum*)

This species assumes four distinct forms. Typically it is a shrub growing to about 2 metres high, though taller specimens can be found.

plant. They are most important to the survival of the plant, for if all the flowers are eaten the plants will not be able to reproduce. These high fluoroacetate levels at critical periods and in crucial parts of the plant appear to have survival value in providing additional protection against heavy grazing.

Although the Brush-tail Possums *(Trichosurus vulpecula)* from Western Australia can tolerate high levels of fluoroacetate, this tolerance would not allow them to browse exclusively for a long time on the flowers and young leaves of plants containing high levels of fluoroacetate. However, this degree of tolerance would allow a possum to include *some* of this material in its diet.

It would be possible for a two kilogram possum to eat 100 grams of fresh material per day, from a plant containing 500 parts per million of fluoroacetate, for several days without starting to avoid eating the plant. This would be approximately one-third of its daily intake of food. It could eat a smaller amount of the highly poisonous species for a longer period of time. Because animals, like possums, limit the amount of poisonous plant material they eat to that which their metabolism can cope with means that the plants have some protection from overgrazing.

The resistance to 1080 of macropods, phalangerids and rodents in the south-west of Western Australia, and limited unpublished data on birds and reptiles, indicate that the ability to tolerate some ingested fluoroacetate has evolved independently a number of times in the fauna of south-western Australia. Such resistance to fluoroacetate may also have evolved in fauna of other areas such as Africa and South America where the vegetation contains this poison.

These poisonous plants may have helped save some of our native animals from extinction—animals such as the Woylie or Brush-tailed Rat Kangaroo (*Bettongia penicillata*).

Woylies used to be found in most parts of southern Australia but were last recorded in New South Wales in 1857 and South Australia in the 1920s. The species is now confined to three forest and woodland areas in south-western Australia—Tutanning Nature Reserve, Dryandra State Forest, and Perup State Forest. Another population of Woylies has recently been found in Queensland.

Scientists studying the Woylie believe it requires areas of bush with a thick understorey to survive. It uses this thick understorey for shelter and nests. Frequent fires in most of our forests have destroyed this dense vegetation. These fires together with the introduction of the Fox *Vulpes vulpes* have caused the numbers of Woylies to decline. The Woylie is reasonably easily caught by the fox and except for running into the thick scrub it does not have any way of defending itself—that is, except in parts of Western Australia.

In their paper "Fluoroacetate Tolerance, a Genetic Marker in some Australian Mammals", A. J. Oliver, D. R. King and R. J. Mead have shown that of all our native mammals, Woylies have one of the highest levels of tolerance to the poison 1080.

They can tolerate levels of fluoroacetate in plants of more than 100 mg per kilogram, while the Tammar Wallaby *Macropus eugenii* can only tolerate levels of 5-10 mg per kilogram and the Western Grey Kangaroo *Macropus fulginosus* can tolerate levels somewhere in between these two.

The Woylie (*Bettongia penicillata*) is also known as the Brush-tailed Bettong and Brush-tailed Rat-kangaroo.

Photo A. G. Wells

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This high tolerance to fluoroacetate in the Western Australian Woylie as well as other mammals has evolved over the 30 000 years the animals have been exposed to the fluoroacetate bearing vegetation.

In Western Australia, Woylies still survive where poisonous species of *Gastrolobium* and *Oxylobium* are abundant. Woylies have evolved a tolerance to the fluoroacetate and they are able to feed on these plants. But foxes are very susceptible to fluoroacetate. Therefore when a fox kills a Woylie which has been feeding in these *Oxylobium* and *Gastrolobium* dominated plant communities, the fox will die of 1080 poisoning within a few hours of eating the Woylie. This could be one way predation pressure on the Woylie is reduced. Even so, in recent years fox numbers have increased, and this is putting considerable pressure on what few Woylies are left.

Although the reasons for the decline of the Woylies can be blamed fairly conclusively on frequent fires and predation by foxes (and probably on the occasional outbreak of disease), the role that poisonous *Gastrolobium* and *Oxylobium* species have played in Woylie survival in these three areas of Western Australia has yet to be proven. However, since Woylies are now extinct in New South Wales and South Australia where there are no poisonous *Gastrolobium* and *Oxylobium* species, and where foxes abound, and because they can only be found in three areas of Western Australia where poisonous *Gastrolobium* and *Oxylobium* species are abundant, circumstantial evidence certainly leads one to suspect that poisonous plants have played a vital role in the survival of Woylies in Western Australia. (The Woylies that have been found in Queensland recently are believed to be in an area where foxes have not yet penetrated).

Attemps to manage habitats for Woylies have centred around control of wildfires and poisoning programmes for the eradication of foxes. Colonies of Woylies are also being re-established in areas where they have become extinct, but perhaps before they are released into these areas wildfires should be prevented so that large numbers of *Gastrolobium* and *Oxylobium* plants can become established and the Woylies can take advantage of their natural tolerance to 1080 at the expense of the fox.

References

D. R. King, A. J. Oliver and R. J. Mead, *The adaptation of some Western Australian mammals to food plants containing fluoroacetate.* Australian Journal of Zoology Vol. 26, Number 4, 699-712 (1978).

A. J. Oliver, D. R. King and R. J. Mead, *Fluoroacetate tolerance, a genetic marker in some Australian Mammals.* Australian Journal of Zoology Vol. 27, 363-372 (1979).

S. D. Hopper, A. A. Burbidge, A. J. Hopkins, J. E. Kinnear, J. A. K. Lane, N. L. McKenzie and R. I. T. Prince, *Establishment and management of Nature Reserves for threatened vertebrates in Western Australia.* 49th ANZAAS Congress (A Vanishing Heritage), 158-177.