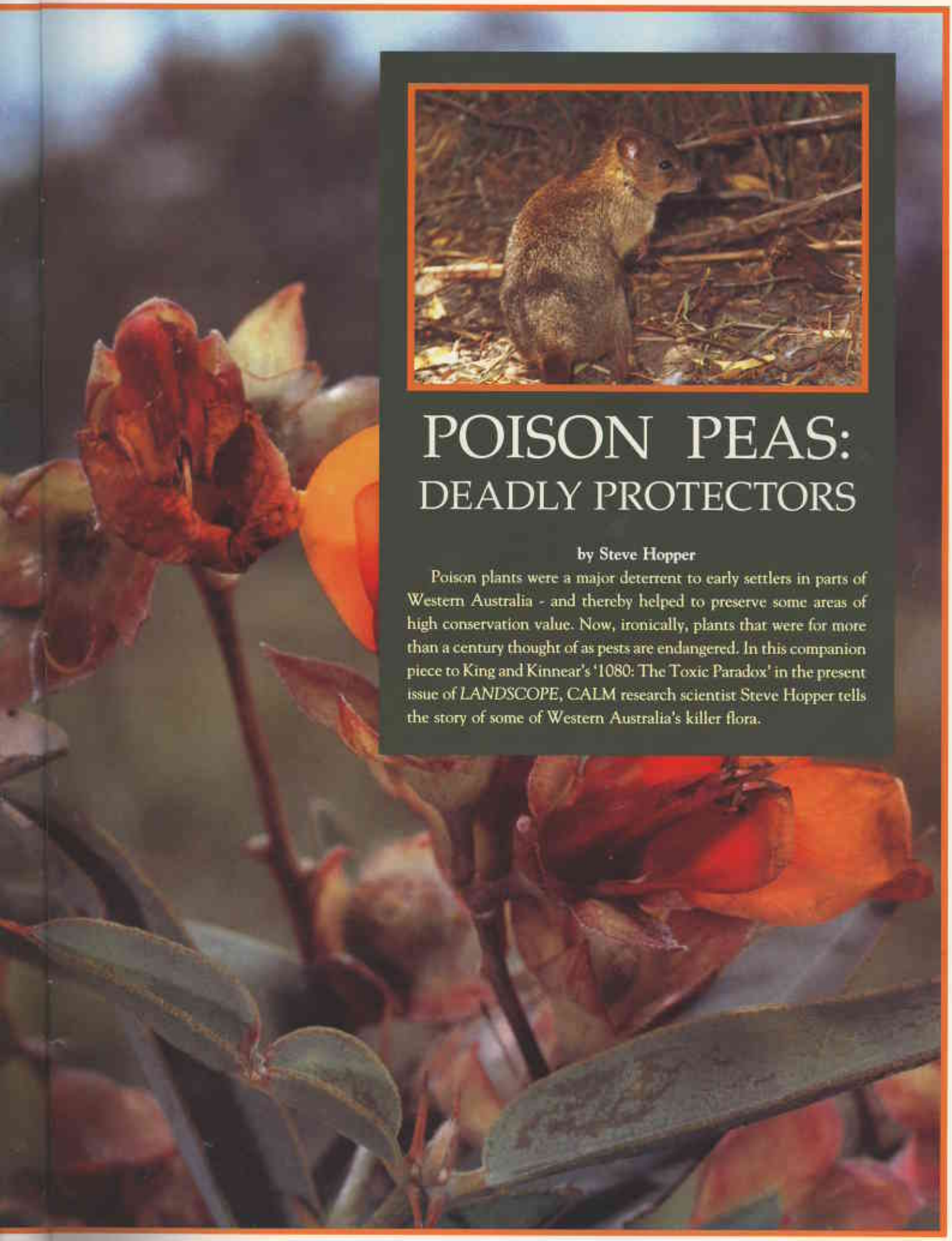

POISON PEAS:
DEADLY PROTECTORS

by Steve Hopper

Poison plants were a major deterrent to early settlers in parts of Western Australia - and thereby helped to preserve some areas of high conservation value. Now, ironically, plants that were for more than a century thought of as pests are endangered. In this companion piece to King and Kinnear's '1080: The Toxic Paradox' in the present issue of *LANDSCOPE*, CALM research scientist Steve Hopper tells the story of some of Western Australia's killer flora.

Because of their toxic effects on stock, poison peas have had to be eradicated during much of Western Australia's agricultural development.
Photo - Jiri Lochman ▲

Previous page: York Road poison (*Gastrolobium calycinum*): the first poison plant identified by James Drummond in 1840 as being toxic to stock.
Photo - A. G. Wells

A woylie (*Bettongia penicillata*), one of several south-west Australian mammals tolerant to the toxin of poison peas, and protected by them.
Photo - Jiri Lochman

Imagine the disillusionment of the earliest European settlers of Perth when some of the few cattle and sheep they had brought with them on a long, cramped and unpleasant sea voyage died suddenly from unknown causes.

This began to happen as soon as farmers moved their animals off the Swan Coastal Plain up into the Darling Range and eastwards towards the fertile valleys near York and Newcastle (later renamed Toodyay). In May 1835, for example, Joseph Harris, pioneer of the Williams district, drove a mixed herd from Guilderton to York; 93 sheep, 14 goats and three bullocks died on the journey. Speculation as to the cause included disease, but Harris was of the view that poisoning was more likely. In November 1836, a certain Captain Whitfield borrowed a number of bullocks to help clear the new route to Toodyay; when they died suddenly on the road, the post-mortem he conducted revealed an abundance of a pea-flowered shrub in their stomachs.

Such stock losses were causing greater problems to the settlers than any other calamity with which their unfamiliar and harsh new land threatened them. Fire, drought, floods, and clashes with Aborigines were all overcome with some difficulty, but replacement of domestic stock was more difficult by far.

The solution to the cause of death of so many animals was resolved, though acrimoniously, in a dispute between the two major plant collectors of the infant Swan River Colony - James Drummond and Ludwig Preiss. Drummond, a Scot, had come with Captain Stirling's first group of settlers to the Swan River in 1829, and ultimately established a farm at Toodyay. His first love was botany, and he delighted in collecting specimens of the diverse south-western flora, many of which were shipped back to England for classification and description by professional botanists. Preiss, a young German botanist, collected extensively in the South West between 1839 and 1841, and sold his specimens to various herbaria in Europe. Between them, Drummond and Preiss discovered the majority of the toxic species.

In October 1840, Drummond and Preiss botanised together around Albany, and apparently fell out. They were called north to Balgarup near Kojonup to investigate yet another case of massive death of sheep. At the time, Drummond suspected Woodbridge poison (*Isotoma hypocrateriformis*), a fleshy annual herb. Preiss disputed this, and no doubt was pleased when no effect at all was seen in sheep that were fed the plant. Next, a pea-flowered plant was tried, which Preiss also believed to be harmless. Drummond did not agree, but departed for home. Shortly afterwards, other members of the party witnessed the sheep die suddenly.

Travelling north to Williams, Drummond stayed with Joseph Harris, who had suffered substantial stock losses. Drummond recognised that the same pea as at Balgarup was present where Harris's sheep had been feeding. This pea was fed to a goat, which died within 14 hours.

Drummond was convinced, identifying York Road poison (*Gastrolobium calycinum*) as the culprit. He published his observations, and immediately was attacked by Preiss and by settlers interested in promoting the

Prickly poison (*G. spinosum*)
Photo - T.E.H. Aplin

River poison (*G. forrestii*)
Photo - T.E.H. Aplin

Thick-leaf poison (*G. crassifolium*)
Photo - T.E.H. Aplin

York Road poison (*G. calycinum*)
Photo - T.E.H. Aplin

A NEW CLASSIFICATION OF GASTROLOBIUM, OXYLOBIUM, CALLISTACHYS AND NEMCIA

The botanical classification of poisonous Western Australian peas was substantially revised in 1987 by Dr M.D. Crisp of the Australian National Botanic Gardens, Canberra, and Dr P. H. Weston of Sydney's Royal Botanic Gardens. They proposed that all poison peas should be placed in the genus *Gastrolobium*, while related non-toxic species were best placed in *Oxylobium*, *Callistachys* or *Nemcia*. Traditionally, *Gastrolobium* was distinguishable from *Oxylobium* in having only two ovules in the pod, whereas *Oxylobium* has four or more ovules. Defined in this way, both *Gastrolobium* and *Oxylobium* had toxic and non-toxic species within them.

West Australian botanists C.A. Gardner and T.E.H. Aplin were the first to suggest that this approach was unsatisfactory. This view was supported by Crisp and Weston, who argued that placing unrelated species in the same genus and keeping closely related species apart, simply because of differences in ovule number, was undesirable. If all the poisonous species are grouped together in *Gastrolobium*, a more satisfactory classification results. Apart from containing monofluoroacetate, this group of species also have three-lobed bracts, the leaf-like structures subtending the flowers, a bell-shaped calyx, and small egg-shaped or elliptical pods. Thus, Crisp and Weston transferred seven poisonous species of *Oxylobium* into *Gastrolobium*, and removed 20 non-toxic species of *Gastrolobium* to the genus *Nemcia*.

Oxylobium remains a genus of non-toxic species, the classification of which requires further research. The distinctive large shrub of swamp margins, *Oxylobium lanceolatum*, was placed in a genus on its own as *Callistachys lanceolatum*. As now recognised, *Gastrolobium* contains the following 40 species (with thanks to Dr M. Crisp and Mrs S. Patrick for advice):

WESTERN AUSTRALIA'S POISONOUS GASTROLOBIUMS

Scale-leaf poison (*Gastrolobium appressum*)
Cluster poison (*Gastrolobium bennettsianum*)
Heart-leaf poison (*Gastrolobium bilobum*)
Rock poison (*Gastrolobium callistachys*)
Gastrolobium brownii
York Road poison (*Gastrolobium calycinum*)
Thick-leaf poison (*Gastrolobium crassifolium*)
Mallet poison (*Gastrolobium densifolium*)
Wodjil poison (*Gastrolobium floribundum*)
River poison (*Gastrolobium forrestii*)
Spike poison (*Gastrolobium glaucum*)
Wall-flower poison (*Gastrolobium grandiflorum*)
Granite poison (*Gastrolobium graniticum* - was *Oxylobium graniticum*)
Hook-point poison (*Gastrolobium hamulosum*)
Slender poison (*Gastrolobium heterophyllum* - was *Oxylobium heterophyllum*)
Breelya or kite-leaf poison (*Gastrolobium laytonii*)
Sandplain poison (*Gastrolobium microcarpum*)
Runner poison (*Gastrolobium ovalifolium*)
Gastrolobium aff. *ovalifolium*
Champion Bay poison (*Gastrolobium oxylobioides*)
Box poison (*Gastrolobium parviflorum* - was *Oxylobium parviflorum*)
Gastrolobium aff. *parviflorum* (Grass Patch-Salmon Gums)
Gastrolobium aff. *parviflorum* (Fitzgerald River-Ravensthorpe)
Berry poison (*Gastrolobium parvifolium*)
Horned poison and Hill River poison (*Gastrolobium polystachyum*)
Hutt River poison (*Gastrolobium propinquum*)
Round-leaf poison (*Gastrolobium pycnostachyum*)
Net-leaf poison (*Gastrolobium racemosum* - was *Oxylobium racemosum*)
Rigid-leaf poison (*Gastrolobium rigidum* - was *Oxylobium rigidum*)
Gilbernine poison (*Gastrolobium rotundifolium*)
Roe's poison (*Gastrolobium spectabile* - was *Oxylobium spectabile*)
Prickly poison (*Gastrolobium spinosum*)
Narrow-leaf poison (*Gastrolobium stenophyllum*)
Brother-Brother (*Gastrolobium tetragonophyllum* - was *Oxylobium tetragonophyllum*)
Woolly poison (*Gastrolobium tomentosum*)
Bullock poison (*Gastrolobium trilobum*)
Gastrolobium truncatum
Stirling Range poison (*Gastrolobium velutinum*)
Crinkle-leaf poison (*Gastrolobium villosum*)
Gastrolobium sp. (Albany-Esperance).

The most toxic form of prickly poison, *Gastrolobium spinosum* var. *grandiflorum*, showing the small elliptic pods characteristic of all poison peas.
Photo - S.D. Hopper ◄◄

Kite-leaf poison (*G. laytonii*) may grow 6 m tall on granite outcrops in Murchison pastoral station country.
Photo - S. D. Hopper ◄

farming districts where the poisonous pea occurred. Preiss agreed that the pea could kill, but argued that its prickly leaves, hairy pods and woody stems irritated stomachs rather than contained a poison.

The dispute was resolved in May 1841 before a committee of members of the Agricultural Society, with Drummond present but Preiss declining an invitation. Pounded extracts from another gastrolobium (*oxylobioides*, Champion Bay poison) were fed to sheep and goats, all of which died within three hours.

Rica Erickson, in her book *The Drummonds of Hawthornden*, succinctly relates the aftermath:

Following these experiments shepherds sometimes carried branches of the poison plants to help them identify those which must be avoided. Whenever stock became sick while travelling, the drovers searched in the vicinity for unfamiliar pea-flowered shrubs. Before long, parties of men were occasionally employed to clear the poison plants for a chain or so either side of the main roads.

Thus began the selective eradication of poison plants, the bane of agricultural development in south-western Australia throughout much of its short history.

GOLD, PEOPLE AND POISON

Thanks to gold rushes and a population explosion in the nineteenth century, agriculture became a major government focus. By 1880, Western Australia had a small colonial population of 29 500, and public revenue was a mere £180 000 p.a. The discovery of gold brought greater prosperity (£3 000 000 p.a.), and a sixfold increase in population of European descent by 1900.

Consequently, massive expansion of the wheat and sheep industry through government-assisted settlement schemes was undertaken in the 1890s and early 1900s. But poison plants were encountered in most new agricultural districts, and continued to account for heavy stock losses.

The identification of poison plants, weeds and forage species was of sufficient economic importance to warrant the appointment of a succession of government botanists attached to the Department of Agriculture and its predecessor, the Bureau of Agriculture. Constituted in 1894, the Bureau appointed Dr Alexander Morrison in 1897 as its first botanist to catalogue and describe the poison plants of WA for a chapter in a book entitled *The West Australian Settlers' Guide and Farmers' Handbook.* Morrison was retrenched in 1906, but remained active in Western Australian botany until he left the State in 1912. In 1909, he steered to publication Bulletin No. 32 of the WA Department of Agriculture, entitled *The Poison Plants of Western Australia.* Thus Morrison pioneered botanical understanding of the poison plants in the context of rapid agricultural development.

Constant encounters with poison plants by pioneer wheat farmers made it necessary to look for successors to Morrison. One of them, Desmond Herbert, produced a new Bulletin (No. 96) in 1921, entitled *Plants Poisonous to Livestock in Western Australia*. This was revised in 1926, after which two of the editors, Charles Gardner and H.W. Bennetts, worked together on poison plants for 30 years, culminating in the publication in 1956 of a major book, *The Toxic Plants of Western Australia*. This appeared at the start of another major wave of agricultural development arising from the widespread introduction of the bulldozer to rapidly clear land, and the discovery of trace element deficiencies in light sandy soils. More farmers than ever were encountering poison plants on new lands, and needed a ready reference to assist in their identification.

More recently, responsibilities for poison plant botany were assumed largely by Bob Royce and then T.E.H. (Ted) Aplin at the Western Australian Herbarium. Aplin published a number of articles on poison plants over the period 1966-1971, which were collated in a colour booklet, *Poison Plants of Western Australia*, published in 1973 as Bulletin No. 3772 by the Department of Agriculture.

Staff of the Western Australian Herbarium continue to help farmers identify poison plants, but much more of their research these days is directed at conserving native flora. Indeed in 1988, after 91 years of association with the Department of Agriculture, botanists of the Western Australian Herbarium were transferred to the Department of Conservation and Land Management (CALM). The transfer reflected changing community attitudes towards native flora and the need to conserve it. In fact, the succession of government botanists employed by the Department of Agriculture played a big part in achieving recognition of the intrinsic conservation values of wildflowers. Charles Gardner, for example, who was Government Botanist 1929-60, published widely on the flora, and was central to the creation of such important conservation reserves as Kalbarri, Fitzgerald River and Cape Arid National Parks, Jilbadji Nature Reserve, and the Beekeepers' Flora Reserve.

CHANGING ATTITUDES

Even poison plants are now perceived as worth conserving, from several perspectives. In recent years, gastrolobiums have had a more benign public profile. It is now realized that many outstanding conservation reserves of the Wheatbelt would have been cleared long ago were it not for the presence of these toxic shrubby peas. Surveyor A.C. Gregory, for example, in a letter to the Surveyor General in October 1850, described the route chosen for droving stock from the drought-afflicted York and Toodyay areas north to the newly opened pastoral district of Champion Bay (Geraldton):

On the 28th Mr L. Burges came up with his cattle and on the following day we started to decide the best manner of avoiding the Gairdner Range which is impracticable for carts from the rocky nature of the ground and at the same time abounds with a variety of the poisonous plant which renders it unsuitable for travelling with sheep. [The route chosen] involves a detour to the south of the Gairdner range and increases the distance 20 miles but the poisonous plant is so abundant on that part of the range of hills on which Mr Drummond has taken up his licence near Mt Lesueur that stock cannot be driven through it with safety.

Thus, the presence of poison plants was one of the major factors that spared the now famous Mt Lesueur area from agricultural development, and has enabled belated appreciation of its internationally important plant and animal life. A similar story could be repeated for the Stirling Range, Tutanning Nature Reserve near Pingelly, and many other significant areas of remnant native vegetation in the Wheatbelt. Even hilltops, normally too rocky for cultivation but suitable for grazing, were protected from disturbance by the presence of poison plants.

Apart from their important contribution to conservation, poison plants offer a rich palette of stories of intrigue and botanical folk-lore, and a bizarre link to the safe poisoning of introduced feral animals without fear of dispatching native fauna (see box). Moreover, attitudes have changed so much that the active eradication so long practised against poison plants has recently been replaced by growing concern for the conservation of several species now considered endangered.

THE POISON PLANT SURVEY

In 1989 the World Wide Fund for Nature (WWF Australia) and the Department of Conservation and Land Management (CALM) funded a survey for 14 species of the rarest poison plants. Dr Jane Sampson, the part-time coordinator, enlisted 47 volunteer individuals or groups to help in the search.

Fifty-one new records were made by this team, adding substantially to the 200 sites previously recorded for the 14 species. The survey revealed the occurrence of one or possibly two new species. It clarified the identity of previously misidentified populations. And it led to a much enhanced understanding of the conservation status of the species surveyed.

A significant outcome was the recommendation that three species should be added to the State's list of Declared Threatened Flora - rock poison (*Gastrolobium callistachys*), granite poison (*G. graniticum*), and hook-point poison (*G. hamulosum*). Rock poison was found in only three small populations on granite outcrops or laterite ridges between Watheroo and Kellerberrin. Similarly, granite poison was found in only three populations with an aggregate total of less than 50 plants, all near Coolgardie. Hook-point poison was found to be in dire circumstances, with only

Moresby Range, near Geraldton. Remnants of native vegetation on hilltops throughout the Wheatbelt were often left uncleared because they contained poison plants.
Photo - Robert Garvey

Broad-leaf form of York Road poison grows on gravel or granite between Watheroo, Ballidu and Wannamal to the north-east of Perth.
Photo - M. & I. Morcombe

four plants located on a weed-infested road verge near Wongan Hills.

The recommendation for special legal protection of these three species was implemented by the Minister for the Environment by a notice placed in the *Government Gazette* of 1 June 1990. The three newly listed poison plants joined three others that had been so protected earlier - scale-leaf poison (*G. appressum*) from the Watheroo district, spike poison (*G. glaucum*) from Wongan Hills, and woolly poison (*G. tomentosum*) from near Narrogin. As an additional safeguard to protecting wild populations, collections were made of seed of 10 of the species surveyed, then passed on to Kings Park and Botanic Garden and the CALM Seed Centre for long-term storage.

The survey highlighted the plight of the rarer members of this remarkable group of plants. Protection and active management of remnant vegetation in the Wheatbelt will be essential to ensure their conservation in perpetuity.

Some of the additional collections made during the survey have also helped in the naming and classification in progress on these plants. Since the survey, three new species of gastrolobium have been recognised as well as several species of *Nemcia* (the genus to which the non-toxic members of *Gastrolobium* and *Oxylobium* now belong). Our knowledge of this interesting group of plants is by no means complete, which is another reason to conserve them.

Poison plants, for so long an important concern in the affairs of farmers of this State, deserve conservation. They are truly part of our cultural as well as biological heritage. The lessons they have to teach would be sorely missed should they ever disappear entirely from the Wheatbelt. ⊡

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POISON PLANTS HELP CONSERVE NATIVE MAMMALS

All the toxic gastrolobiums are confined to south-western Australia except the northern Australian *G. grandiflorum*. *Acacia georginiae*, found only near the Queensland/Northern Territory border, is the only other native Australian plant known to contain the toxin called monofluoroacetic acid. The sodium salt of this toxin is Compound 1080, a widely used pesticide.

South-west Australian populations of herbivorous mammals such as the western grey kangaroo, the bush rat and the brush-tailed possum have been shown to have tolerances of 1080 intoxification well above the normal range of eastern populations. For example, it takes on average 35 times as much 1080 to kill south-western bush rats as it does for eastern Australian bush rats, and more than 150 times as much for south-western compared with eastern brush-tailed possums. High levels of tolerance are now known to occur in a wide range of south-western animals, including insects, reptiles, birds and both marsupial and eutherian (non-pouched) mammals.

Researchers with the Agriculture Protection Board of Western Australia have proposed that these high tolerances in south-western populations have evolved due to grazing on gastrolobiums. Being legumes, these poison plants are highly nutritious. Some are also abundant, especially after fire (e.g. heart-leaf poison *Gastrolobium bilobum*, and box poison *G. parviflorum*). Many gastrolobiums are soft-leaved and succulent, and produce new growth in autumn at a time when herbivorous forage is limited in south-western Australia. The inclusion of some gastrolobium material in the diet of native mammals would be highly advantageous if resistance to their toxicity has evolved. Presumably, natural selection has followed this path in south-western Australia.

Poisoning of rabbits and secondary poisoning of cats and foxes can occur, therefore, with little risk of adverse effects on indigenous fauna.

It also appears that native fauna is not only largely resistant to the undesirable effects of poison plants, but also benefits by their provision of habitat and shelter from predators such as foxes. So poison plants have an important role to play in conserving native mammals.