

Orchids in peril

PHIL SEATON interviews orchid conservationist Zoe Smith about her work, and reintroducing *Diuris fragrantissima* to the wild

Where in Australia were you born?

I was born in Melbourne, but spent my childhood in the countryside of central Victoria, in the region of the 19th century gold rush called the Golden Triangle. Plants were our toys. Grandad was a primary school headmaster, and taught us how to make bush whistles from *Eucalyptus* saplings.

We used to love carrying our tent through the backyard, over some fences and up an Aussie 'mountain' (less than 400m above sea level). We could watch kangaroos grazing at dawn and look for barking geckos (*Underwoodisaurus miihi*). They have transparent skin, and literally bark at you. But they are tiny, so it is more like a little cough.

When did you first become interested in science?

I have wanted to be a scientist for as long as I can remember. I could not decide whether I preferred animals or plants – until the day we had to dissect parasites from dead fish. Later, I went to the University of Melbourne, and majored in botany. My honours research project involved examining the genetic and morphological diversity of a very rare daisy (*Olearia pinnosa* subsp. *cardiophylla*). I only discovered later that it grows outside the mud brick house built by my parents in the small town of Wedderburn.

And conservation?

The area where I was brought up is still being deforested today. To see the bush where I used to play – dry eucalypt woodland with a low under-

story of a few acacias – being stripped for mining and agriculture is very sad.

Why did you want to study orchids?

I am really an orchid person because they are ecologically complex. It was the enthusiasm of my supervisor Cas McLean, a mycorrhizal biologist, that first fired my interest. I am particularly interested in networks and patterns.

What was your PhD topic?

The biology and re-introduction of a rare orchid, *Diuris fragrantissima*, the sunshine diuris. It used to be abundant among the kangaroo grass, *Themeda triandra*, but has declined dramatically since the 1930s, particularly in the last 20 years. At one time, no *Diuris* plants

at all were recorded, and it was thought to be extinct. In some seasons between 1980 and 2004, six plants or fewer were observed in the single population. But in 2005, it suddenly increased to 23 plants. The upsurge was probably due to comprehensive management of the remnant site. The species had to be physically guarded in the flowering season because a newspaper printed the locality of that sole remnant site.

Is that population still guarded?

No, possibly because no plants were observed in flower for a number of years. However, I have had anecdotal reports from volunteers and the management authorities that plants have gone missing overnight, and that suspicious characters were seen leaving in a hurry.

Are other orchids in Australia rare?

Yes. In Victoria, 208 of the 372 orchid taxa are either Threatened or Extinct according to the IUCN 2001 Red List categories and criteria. In the last 150 years, more than 60 percent of the state's land has been cleared for urban development or agriculture. *Calochilus richiae* has been reduced to fewer than 20 plants in Victoria, and *Caladenia amoena*, *Pterostylis aenigma* and *Paracaleana disjuncta* are known from single populations of less than 100 individuals.

What has caused the dramatic decline of *D. fragrantissima*?

Agricultural, industrial and urban development. Less than 1 percent of its habitat, the Western Basalt Plains grassland of Victoria, remains. More

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than 99.5 percent of Australia's native grasslands have been destroyed. Remnant native grassland is now restricted to small, fragmented areas, such as roadside and rail reserves, which continue to be threatened by disturbance and invasion by weeds.

Urban Melbourne, where the *Diuris* remains by the side of a railway line, is very industrial. At one time, railway lines were home to many relict orchid populations. Parts of Australia have a fire ecology, and the seeds of many species require heat or smoke treatment to break dormancy before they will germinate. Many *Eucalyptus* species have epicormic buds that resprout from under the bark after a fire. The occasional railside fires caused by stray sparks from the steam engines of the past would have removed any scrubby vegetation and helped to maintain suitable habitats for the orchids. Also, fire was used as a management tool to keep railway reserves clear. Sadly, today it can be hard to convince people of the need for regular burning, and herbicides are used to keep vegetation down instead, with all-too predictable consequences for the orchids.

What have you been doing to try to halt this decline?

First I had to ensure *D. fragrantissima* was a good species. Was it sufficiently different from related *Diuris* species to merit individual species status, rather

than just being a variety? In other words, was it worth the conservation effort? With limited resources, no-one wants to spend time on an orchid that turns out not to be endangered after all.

Diuris fragrantissima was raised to species level in 1989, having previously gone through a number of nomenclatural changes. At one time it was known as *D. punctata* var. *alboviolacea*, for example. Happily, or unhappily, a combination of genetic fingerprinting and morphometric analysis proved that *D. fragrantissima* is a valid species.

What is morphometric analysis?

It is good old-fashioned measurement of physical characteristics. I chose 80 floral and vegetative characters, then sat in the field for up to 12 hours a day for about 30 days measuring randomly selected plants. With such a small population I could not remove plants from the wild. Results were recorded as either presence or absence of a particular character, or as measurements for parameters such as leaf length, and then analysed using several computer programs. When all the data is finally presented in graph form, the individuals with the most similarity group together, while those that differ form separate groups. Some groups overlap, but there are distinct boundaries between others. *D. fragrantissima* formed a group clearly related to, but distinct from *D. punctata*.

Once you knew it was deserving of your attention, what did you do?

In the 1980s a number of plants were removed from the wild to establish an *ex situ* collection. Rather than confining them to an orchid zoo we wanted to establish a second population in the wild. All previous attempts at re-introduction had, however, failed.

The first step was symbiotic germination using a mycorrhizal fungus, which I isolated from the wild population. It is also possible to germinate the seeds successfully without the aid of a fungus using Kevin Western's patent medium. As it turns out, all such seedlings passed on to us by Kevin rapidly became infected by a fungus in the nursery which, using DNA sequencing, turned out to be almost identical to that found in the wild. At the moment, we are not quite sure how the fungus spreads between pots. It could have been in the potting compost for example, or perhaps transferred by splashover when the plants were being watering.

Did you have to do much fieldwork?

Fieldwork was a major component of my project. You have to be careful, and we are all taught outdoor safety at school, but the dangers of Australian wildlife do tend to be overstated. Apart from being burned by the sun, and rained on, the major problem is the flies, which congregate around ►

your eyes and make life impossible. We all had to wear a veil, a bit like a beekeeper's hat – not the classic hat with dangling corks!

On one occasion I trod on a brown snake (*Pseudonaja textilis*), which is reputed to be one of Australia's most dangerous reptiles. Its bite is said to be very painful, and it tends not to let go. Unless antivenom is administered promptly, death usually occurs within a few hours of being bitten. Happily, I stood on its tail rather than its head, and it slithered away quite rapidly.

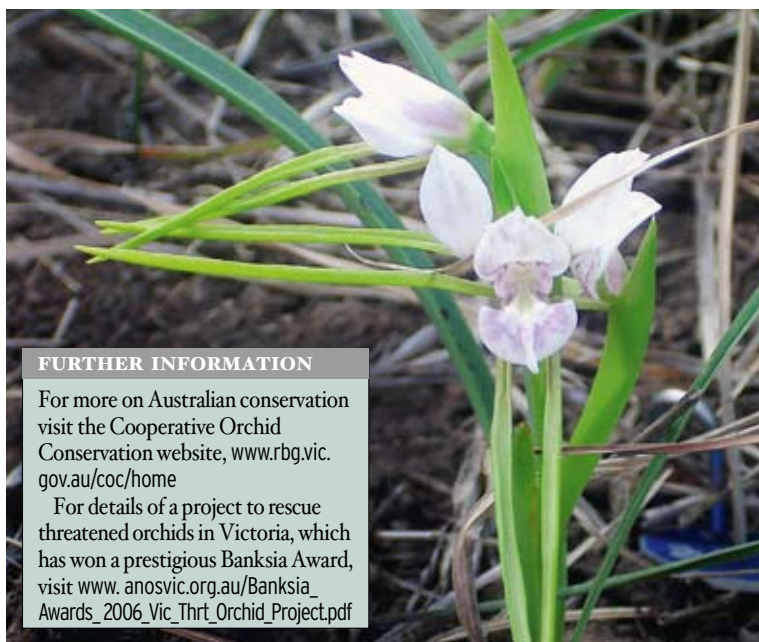
I was confronted by a rogue kangaroo on one evening. It sounds funny now, but solitary kangaroos can be very dangerous. You don't do fieldwork alone in Australia.

How many *Diuris fragrantissima* plants have you reintroduced?

I reintroduced 700 plants in 2004. We compared planting time, tuber size, addition of support fungus and soil tilling. The tilling was thought to be a possible factor as sheep compact the clay soils, which dry and crack.

And what have you discovered?

Unsurprisingly perhaps, bigger tubers are better. They increase both survival and flowering. Adding the fungus and soil tilling are also beneficial if the tubers are planted in spring, but not in summer or autumn. The best time for planting is in spring or autumn, as growing seedlings rather than dormant tubers. Half of the tubers flowered in the first and second years after planting, which was very encouraging. However, since 2006 survival and flowering have declined progressively in this population. Unless they stabilise, further reintroductions may be required, with more research into the species' biological requirements. In 2008, approximately 30 percent of the plants were surviving. Ongoing monitoring has been essential for determining reintroduction success.



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FURTHER INFORMATION

For more on Australian conservation visit the Cooperative Orchid Conservation website, www.rbq.vic.gov.au/coc/home

For details of a project to rescue threatened orchids in Victoria, which has won a prestigious Banksia Award, visit www.anosvic.org.au/Banksia_Awards_2006_Vic_Thrt_Orchid_Project.pdf

Where do you go from here Zoe?

I would like to continue my work in orchid conservation, particularly looking at their complex ecological requirements, and how to best allocate resources to conservation, and also learning from management projects. I came to the Royal Botanic Gardens, Kew, to do some work with David Roberts on extinction modelling.

I am currently a Postdoctoral Fellow at the Australian Research Centre for Urban Ecology, a division of the Royal Botanic Gardens, Melbourne. I am investigating the impacts of landscape fragmentation on the genetic structuring of a threatened daisy, *Senecio macrocarpus*.

I will be working with orchids again when I start a new postdoctorate in August, at the Smithsonian Environmental Research Centre in Maryland, USA. This new project will investigate the ecology of orchid mycorrhizal fungi.

I am also very excited about the establishment of a new Student Group of the Orchid Specialist Group. The students will bring a lot of energy and enthusiasm to the OSG. ■

PHIL SEATON is currently based at the Royal Botanic Gardens, Kew, where he is Project Manager for OSSSU, a project to establish a global network of orchid seed banks

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