

In the Nick of Time – Post-drought recovery of two threatened *Zieria* species in central-western New South Wales

DARREN SHELLY*, MARC IRVIN AND JAMES FARIS

NSW Department of Planning, Industry and Environment, Dubbo and Narrabri.

*Corresponding author: Darren.Shelly@environment.nsw.gov.au

Introduction

Granite *Zieria* (*Zieria obcordata*) is Endangered under the *NSW Biodiversity Conservation Act 2016* (NSW BC Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The perennial shrub grows to 100 cm and only occurs on granite outcrops in the Wellington and Bathurst districts in NSW. Monitoring has occurred since 2008, however most conservation management has happened since the start of the NSW Government's Saving Our Species (SOS) program in 2016. The greatest threat to the species is continuous grazing. In native forest, wallabies target plants at certain times, removing branches and reducing reproductive potential.

The Mount Kaputar Scented *Zieria* (*Zieria odorifera* subsp. *copelandii*) is Critically Endangered under the NSW BC Act but is not listed under the EPBC Act. This erect perennial shrub grows to 60 cm amongst boulders and rock crevices in shallow soils. All plants found to date form a single population within Mount Kaputar National Park. The subspecies was formally described in 2002 when *Z. odorifera* was split into four subspecies. Threats to the survival of the species are browsing by feral goats, death during drought conditions and wildfire. The recent drought and bushfires prioritised establishment of a SOS project in 2019-2020.

Population monitoring

Zieria obcordata Population censuses were scheduled for every five years, unless major changes in annual sub-population counts warranted further investigation. The first census was done in 2011 and this was followed by census in 2016. Census were conducted in 2019 and 2020 to get an accurate reflection on drought losses and will continue to ascertain the success rate of any post-drought regeneration through to maturity.

Previous monitoring has shown a more reliable indicator of plant population persistence is via adult plant counts rather than the total number of plants. Regeneration typically occurs after large rainfall events, however, all young plants are generally not sustained until they reach maturity (*i.e.*, capable of reproduction).



Figure 1. Mature *Z. obcordata* in granite rock habitat. Photo: Garry Germon

Zieria odorifera* subsp. *copelandii Due to the number of plants being very low (<15), a census of the known population was undertaken including a survey for new individuals. Surveys recorded mature plants or seedlings (a term which covers all young plants).

Population counts have varied from 10 adults in 2002, seven adults in 2012, up to 15 adults in 2015 and 12 in 2019. No recruitment of new plants was recorded was recorded.

The SOS project is to monitor the population in drought recovery at six-monthly intervals.

Drought impacts

Zieria obcordata Average annual rainfall data indicate the drought lasted through 2017, 2018 and 2019, as all three years experienced significant rainfall deficits at both Wellington and Bathurst *zieria* locations.

Plant abundance only decreased slightly over the three years of drought, with only one location at Wellington showing a large decline. This showed there was some resilience in mature plants to prolonged dry conditions. The turning point was actually a ten-day period from Christmas 2019 when a severe heatwave led to several consecutive days of 40-45°C temperatures. This proved too much for the already stressed plants and mass plant deaths had occurred by mid-January 2020.

Comparing the numbers of adult plants remaining in 2020 to the highest plant abundances recorded in 2016 (before the drought) gave an average loss of 82% across selected Bathurst locations with a range of loss from 70-91%. The Wellington sub-populations showed similar heavy losses with an average adult plant decline of 84% from 2016 levels and the range of loss being 56-100%.

Zieria odorifera* subsp. *copelandii Average annual rainfall data indicates the drought did not begin in the Narrabri region until 2018 which is a full year less than what was experienced at the *Z. obcordata* locations.



Figure 2. Mature *Z. o. copelandii* growing in rocks.
Photo: James Faris



Figure 3. Drought death of protected *Z. obcordata* at Bathurst.
Photo: Chris Dawe



Figure 4. Drought affected *Z. o. copelandii*. Photo: Marc Irvin

The number of mature plants in this population reduced only slightly from 15 plants in 2015 to 12 in September 2019 (which was most of the way through the drought period). Deaths of several plants were noted during the extreme and prolonged heatwave over Christmas 2019-20 and emergency watering of the two remaining plants took place.

The population reduced to only two mature plants by 11th April 2020, a drop of 84%. This decline of plants between 2015-2020 was likely due to a combination of severe drought conditions over several years and excessive browsing by feral goats.

Post-drought recovery

Zieria obcordata The October 2020 census revealed large-scale regeneration had occurred with nearly 12,000 young plants counted across all sub-population locations. The scale of regeneration suggests three or four separate phases since March 2020, when the first rainfall event occurred, as no recruitment was observed before that time. The smallest regeneration cohort observed was seedlings less than 1 cm high, a second cohort seemed to be 3-6 cm high and another from 8-10 cm high with the tallest cohort 10-15 cm.

Almost all of the mature plants that survived the drought showed significant foliage growth and were flowering along with having numerous seed pods.

Zieria odorifera subsp. copelandii Surveys within the month of April 2020 show a large germination event occurred between the 11th and 23rd April as no seedlings were recorded on the 11th but by the 23rd, 477 seedlings were recorded. Bureau of Meteorology rainfall records for Narrabri Airport (site 504038) show 19.2 mm of rain fell on 3rd and 4th April 2020, which may have wet the soil. An additional 32.8 mm rain occurred on the 10th and 11th April which may have been the trigger for germination subsequently observed on the 23rd.

The next survey in September 2020 found 59% of the seedlings had died since April. However, 14 new seedlings were found nearby that appeared to have germinated between the April and September 2020 surveys. In January 2021, searches for new plants re-examined the new seedling locations with 230 seedlings recorded. Many of the plants were 15-20 cm high and multi-branched with stems starting to harden and become woody.

Conclusions

Zieria obcordata The recruitment event in 2020 is by far the largest recorded for this species. This event was the only one where preceding drought had near-denuded groundcover beforehand, as well as causing significant *Zieria* plant loss. One possible explanation for the massive germination could be that the rainfall events throughout 2020 (after March) were significant rainfall events spaced throughout the year, thus providing continual top-ups of soil moisture, before it could dry out to the point of impeding seedling growth.

Another potential explanation for the scale of this recruitment event is fire. Although the sites were not burnt in the 2019-2020 bushfires, smoke (and other remnants of the fire) were washed out onto the near-bare ground when the drought broke in March. This may have had the impact of applying smoke water across the region, increasing subsequent regeneration from the soil seed bank. ("Editor's note: Smoke water is water containing some of the chemicals which are found in smoke. It is used to stimulate seed germination in some species.") Heat and/or smoke water are well known treatments for seed germination in a number of plant species. While there were no *Zieria* sub-populations burned over that summer, both Bathurst and Wellington had a number of days reported as being blanketed by smoke haze.

The vast majority of recruitment first noted in March 2020 was still alive in October 2020 and remained alive in March 2021. If survival continues until the next census in October 2021, then the drought-breaking recruitment will more than make up for all the drought losses across all the sub-population locations and will lead to the highest known total population size for this species.



Figure 5. Typical cluster regeneration of *Z. obcordata*.
Photo: Darren Shelly



Figure 6. Juvenile *Z. o. copelandii* growing in rock crack.
Photo: James Faris

Zieria odorifera subsp. copelandii Surveys and observation also show recruitment occurred in several phases throughout 2020. With such a small base of adult plants it is most unlikely they could produce enough seed in one season to produce so many seedlings. Given the drought lasted at least two full years in the region with no seed set, it is assumed that the soil seed bank had been established over a number of prior years and that such seeds have remained dormant but viable in the soil for long periods of time.

The reduction in seedling numbers from around 477 to 279 between April and September 2020 is consistent with what one would expect with a natural mortality rate of seedlings. Seedlings were often found in small clusters and in such cases, logic would argue that as they grew competition for resources would increase to the point where they would self-thin. It is also possible that seedlings have been eaten by feral goats in the time between surveys.

It would seem that for these two threatened *Zieria* species, if enough mature plants can be protected from continual browsing so that they can set seed in good times, then the species can withstand prolonged drought.

Acknowledgements

These projects are funded by the NSW Government through the Saving Our Species program. Census and surveys were conducted by the authors with in-kind support of staff from National Parks and Wildlife Service and the Biodiversity, Conservation and Science Division of Department of Planning, Industry and Environment. Additional survey support came from botanist volunteers (Paul Carmen and Cathy Hook) for *Z. obcordata* and ecologist contractors (Lachlan Copeland of Ecological Australia) for *Z. o. copelandii*.

Welcome to the Banksia Garden

SABRINA SONNTAG

Australian National Botanic Gardens

Corresponding author: Sabrina.Sonntag@awe.gov.au

In October 2020, the Australian National Botanic Gardens opened a new garden dedicated to the genus *Banksia* in celebration of its 50th birthday. The garden has been carefully designed to showcase a diverse range of banksias, one of Australia's most fascinating plant groups.

The Banksia Garden features over 80 kinds of *Banksias* including subspecies, cultivars and varieties from across Australia and tells stories of their place in the Australian landscape. The primary focus is on members of the genus prior to the addition of *Dryandra* species.

Interpretive themes underpin the layout and include how Gardens' horticulturalists have cultivated some of the difficult-to-grow *Banksias*, life cycles of *Banksias*, pollination, and *Banksias* and fire. A burnt *Banksia* installation featuring twisted banksia trunk skeletons burned by fires in Booderee National Park on the New South Wales south coast creates effect and a link to the burnt wood used to construct the nearby Paperbark Treehouse.

A circular artwork positioned in the gardens' main courtyard highlights the variation in leaf shapes within and between species in the genus. Imprints of nearly five hundred leaves from thirteen *Banksia* species are

arranged in a radiating pattern, reflecting the structure of a *Banksia* inflorescence.

Quotes in language from Indigenous Australians on the importance of *Banksia* to their culture together with English translations are embedded into the paths of the garden. These reflect the intimate link and rich plant knowledge that has been critical to the survival of Indigenous Australians and the fabric of the Australian landscape.

An entire section of the Banksia Garden is dedicated to Western Australian *Banksia* species including *B. baxteri*, *B. coccinea*, *B. prionotes*, *B. media*, *B. occidentalis*, *B. grandis*, *B. menziesii* and more. Another area of interest is a sand dune section showcasing *B. integrifolia*. A meandering creek along the eastern boundary of the garden links the *B. integrifolia* dune with drifts of *B. robur* in both the purple foliage form, "Purple Paramour" soon to be commercially released by the Gardens, as well as the green form. The creek provides the perfect environment for *B. robur* to thrive, as well as being a backdrop for the *B. integrifolia* dune. Another section is dedicated to showcasing the subtle differences within the *B. spinulosa* complex.