Science and Conservation Division

Science underpinning conservation in the Goldfields Region

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FOREWARD

Effective communication of the outcomes of science is particularly important for ensuring the results inform conservation policy and wildlife, forest and parks management practice. Science undertaken in the Science and Conservation Division is carried out in collaboration with staff in the regions and our research partners, which include CSIRO, universities and industry. We highly value these partnerships, which deliver immense benefits in providing a scientific, evidence-based approach to conservation.

To facilitate communication with all regional staff we have produced a series of non-technical publications that describe the science we are undertaking in each of the regions of the Department. These 'Science in the Regions' publications capture a snapshot of current science activities that support wildlife, forest and parks management in each region, and are available on the website. Please contact any of our scientists if you would like more information on any of the topics described here.

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Unique plant communities on each of the Yilgarn ranges

The banded iron formation (BIF) and greenstone ranges of the Yilgarn, with their distinct floras composed of significant numbers of localised endemic species, have been under increasing pressure from mineral exploration and extraction in the past two decades. The high variability in species composition from one range to the next means there is potential conflict between resource development and the conservation of restricted vegetation communities.

Since 2005, scientists have been undertaking flora surveys on the BIF and greenstone ranges throughout the Goldfields and Midwest regions, to explore how patterns of species diversity and community composition reflect local topographic and soil chemistry patterns, and how this changes over broader climatic gradients. Understanding these patterns at the landscape scale provides a regional context for the assessment of the environmental impact of mining proposals.

Scientists found that even though there were lower numbers of species and fewer endemic species on the ranges in more arid areas, each of the ranges surveyed had a unique combination of species. A comprehensive reserve network for the BIF and greenstone ranges would therefore require the inclusion of part of all the ranges. The areas of highest priority for conservation action are the two 'hotspots' of specialist ironstone species: the Helena and Aurora ranges in the Goldfields Region and the Koolanooka Hills in the Midwest Region.

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Rachel Meissner

Rangeland restoration at Lorna Glen (Matuwa)

An integrated and adaptive approach to the restoration of rangeland vegetation and mammal communities is continuing at Lorna Glen. One of the first priorities for the program was the eradication of feral cats and foxes through an integrated predator control program.

Analysis of the feral cat baiting program conducted between 2003 and 2009 found that cat numbers could be significantly reduced (to less than 10 cats per 100 km of track-transect) by baiting in the winter months when prey availability was low. The researchers found that rainfall would affect the efficacy of the baiting program, and this occurred in 2012 when a number of good seasons led to increased prey numbers, particularly the availability of mulgara, and a consequent increase in the numbers of feral cats. Foxes are absent from the reserve, and dingos are present in low numbers. Research is continuing on whether the dingos within the reserve regulate the numbers and activity of feral cats, and therefore reduce cat predation on native mammals. The 18 dingoes and 14 feral cats fitted with satellite collars in 2014 are being monitored for movement and survivorship before and after cat baiting.

Bilbies have continued to establish outside the enclosure, despite the recent increases in cat numbers. The expansion of bilbies across the reserve is likely to have increasingly positive effects on soil health and plant regeneration. Scientists studying bilbies at Lorna Glen have found that their ability to modify soil through digging was more significant than for any other terrestrial species found in the same habitat. The soil in and around bilby diggings had higher pH and increased nutrient availability, and diggings provided milder and more stable microclimatic conditions. This may be beneficial for the activity of soil fungi and bacteria, and provide less hostile conditions for seed germination and seedling establishment. Soil that had been dug over by bilbies was also less compacted than surrounding soil, which is likely to improve water infiltration and therefore plant growth.

Improving fire management is another strategy to improve landscape health, and scientists and managers have introduced a new fire management plan and continue to develop and test a spinifex fuel model to improve predictions of the rate of the spread of fire through spinifex.

The work undertaken at Lorna Glen shows that mammal assemblages can be restored and soil and vegetation health improved by using integrated and landscape-scale approaches to ecosystem management in the arid zone rangelands.

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Understanding mulga

Mulga—most commonly thought of as *Acacia aneura* and its close relatives—plays an important role in the structure, ecology and function of arid ecosystems across Australia. Mulga communities provide patches where scarce water and nutrient resources are captured and recycled, and thus are significant in maintaining the productivity of rangeland systems.

Traditionally, mulga was considered to comprise five species, including *A. aneura*, which contains 10 varieties. Yet these varieties and species are notoriously variable both within and between populations, leading to complex compositional mosaics of mulga communities across the landscape. The future conservation and management of this keystone group requires better understanding of this variation and the factors that cause it.

The first step of the process was to develop a new taxonomic classification of mulga, using both traditional taxonomic techniques and genetic data. Based on examination of almost 2000 herbarium specimens and study of 293 field populations, scientists have defined 12 species contained within three informal groups (the blue, grey-green and green alliances).

A new, user-friendly electronic identification key for mulga has been incorporated into *Wattle2* version 2.2. Comprehensive descriptions and illustrations of the new mulga entities were published in *Nutysia* (2012) (https://florabase.dpaw.wa.gov.au/nuytsia/article/604). Improved understanding of the identity of and variation in mulga communities will make for more meaningful conservation and land management decisions in the future.

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Fire management in woodland, mallee and mallee-heath reserves

Managing fire for ecological outcomes, such as maximising plant diversity and maintaining community structure, is a major operational challenge, particularly in areas where fire history is poorly known and our knowledge of how species respond to fire is limited. Too frequent fire can lead to a loss of species that rely on seed to re-establish after fire but, when the time between fires is too long, those species reliant on fire senesce and community diversity and structure is decreased. In recent decades, large areas of the Great Western Woodlands (GWW) have been burnt more frequently than what appears to have occurred in the past, while in contrast, the time since fire in many small wheatbelt reserves has been greater than 100 years.

To understand how fire intervals affect vegetation composition and structure in plant communities in the eastern wheatbelt and adjoining GWW, scientists from the division and CSIRO used a combination of satellite imagery and aerial photography to determine the time since fire in remnants of mallee and mallee-heath around Lake Magenta, and analysed growth rings in long-unburnt stands of gimlet (*Eucalyptus salubris*) in the GWW. They aimed to predict and generalise changes in plant communities with time since fire by grouping species into plant functional types (PFT) based on the combinations of traits that plants show in response to fire. In fire-prone environments, for example, critical traits to long-term survival include plant longevity (long- or short-lived), whether plants are able to resprout after being scorched by fire, how long their seeds persist and where they are stored (in the soil or in the canopy), and plant height (with taller plants considered at a competitive advantage between fires).

The researchers found that the time between fires was strongly affected by the broader landscape context, with the shortest time between fires found in the GWW and the longest in small wheatbelt remnants, with large wheatbelt remnants intermediate between the two. They found that mallee-heath communities would benefit most from direct fire management: these communities are most likely to lose diversity and vegetation structure with large variations in intervals between fires because they are dominated by species that store seed in the canopy and are unable to resprout after fire. Mallee communities were found to be more resilient to longer periods without fire, but both communities contained species that had traits that would make them vulnerable if fires occurred less than 25–30 years apart. In gimlet woodlands in the GWW, diversity was highest in mature stands, indicating that recurrent fire is not necessary to maintain plant diversity in this vegetation type. In these communities, intense, stand-replacing fires less than 200 years apart are likely to have significant impacts on plant diversity and the conservation values of the woodlands.

This knowledge of the fire-response traits of vegetation communities is used to determine the appropriate time between planned burns, ensuring that species diversity and vegetation structure, particularly in mallee-heath, is maintained in the long term.

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Seed collection zones in a changing climate

Until recently, best-practice for seed collection for restoration has been to gather seed from local populations of plants so that local genetic integrity is maintained. Yet as the climate changes, it may be more prudent to source the seed of widespread species from areas that better represent the future climate conditions at a site.

In widespread species, two broad genetic 'patterns' may occur: geographically separated populations that have evolved under different climates may have retained a high potential to adapt to climate change; or each population may have become adapted to its local climate. If the potential to adapt to a changing climate exists, then seeds can continue to be sourced from local populations, but if a species shows little genetic ability to adapt, then seed should be sourced from areas that reflect likely future climate conditions at the restoration site.

Scientists used both traditional ecophysiological techniques and genomic markers to study populations of York gum (*Eucalyptus loxophleba*) and gimlet (*E. salubris*) across a climate gradient. There was little variation in ecophysiological and morphological traits across the gradient, indicating that these species are highly adaptable in how efficiently they use water and may be able to adapt to climate change to some extent. Both species showed genetic variation across the gradient, and in York gum this genetic variation was correlated with climatic variables, indicating some genetic adaptation to local climate. In gimlet, however, the genetic variation indicated two distinct lineages suggesting some cryptic speciation, and the need for caution in mixing seed sources between lineages. These results support a proposed 'climate-adjusted' provenance strategy of sourcing seed for restoration from both local populations and those from areas consistent with the direction of future climate conditions.

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Biogeography Program


Judith Harvey

Monitoring vegetation on the deep sand plains

The data gathered from long-term monitoring programs are essential in understanding how the structure and function of ecosystems change over time, including how ecosystems respond to direct disturbances, such as fire, or diffuse environmental changes, such as climate change.

The South Western Australian Transitional Transect (SWATT) is one of four national ecological transects that traverse key Australian terrestrial ecosystems. The transect extends over 1000 km from Walpole north-east into the Little Sandy Desert, crossing six bioregions. The current focus is on the vegetation found on the deep sand plains along the transect. Ten sites have been established along the transect—six of which are located within the Great Western Woodlands—and at each site 16 quadrats were surveyed for vegetation. Soil samples were also collected for textural and chemical analysis.

Detailed analysis of the floristic patterns of the sand plain vegetation is currently underway, with an emphasis on understanding how soil and other environmental factors influence these changes. This analysis will complement the knowledge gained from similar, extensive surveys carried out on the banded iron formation and greenstone ranges in the region. The data collected from along the SWATT will provide baseline data against which to monitor future environmental changes, as well as allow the identification of significant species and communities within the sand plain ecosystems. The scale of the transect across several bioregions allows understanding of how the structure, composition and diversity of vegetation communities changes across the landscape, and how particular groups of species are replaced by others as soil chemistry and climate changes.

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