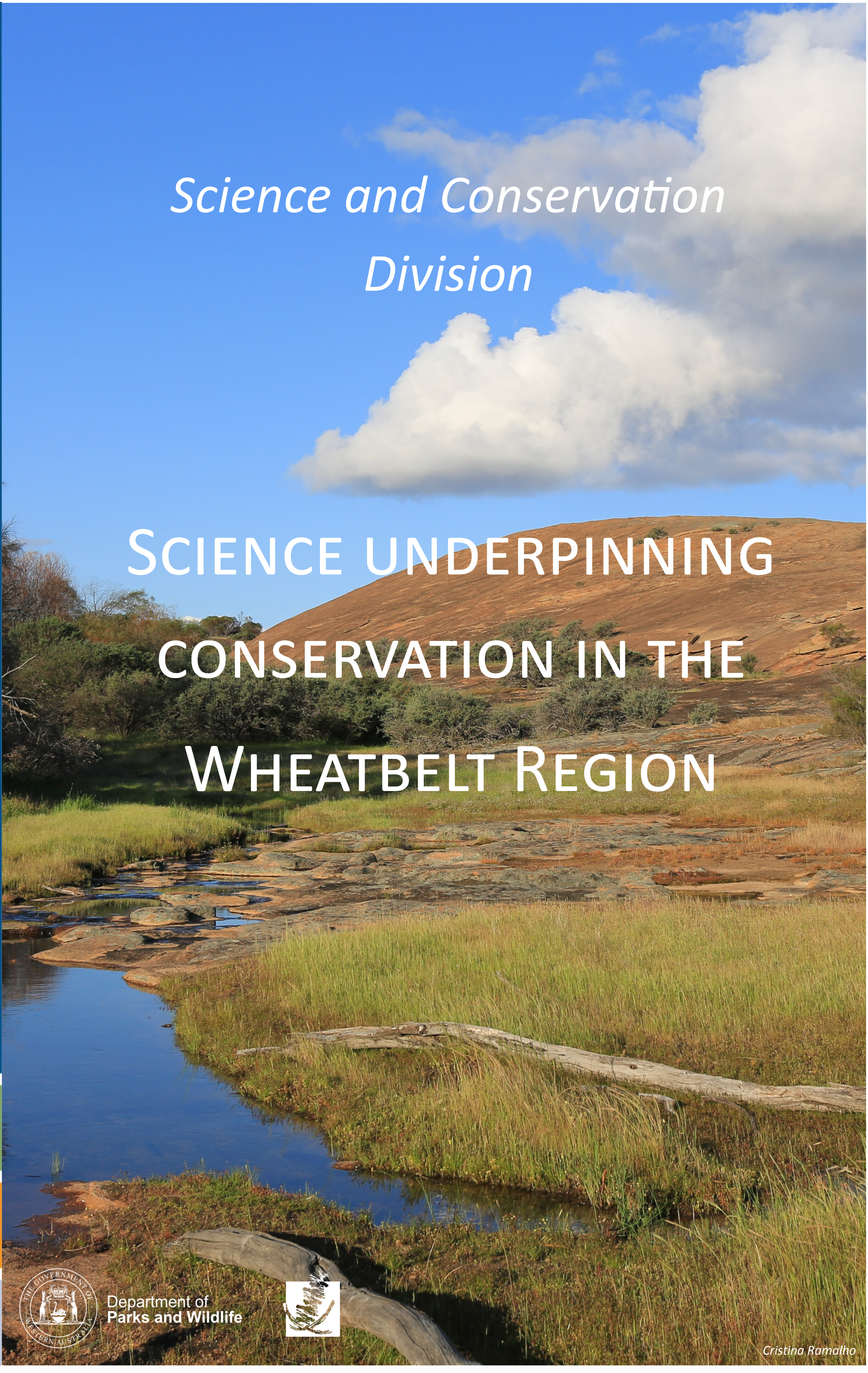
Science and Conservation Division

Science underpinning conservation in the Wheatbelt Region



Cristina Ramalho

Department of Parks and Wildlife

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.

Dr Margaret Byrne, Director, Science and Conservation Division

Climate refuges in granite outcrops

During past periods of hotter and drier climate, many plant and animal species survived by contracting to refugia where milder climate conditions were maintained. In the gently undulating landscapes of the south-west, granite outcrops, with their seasonally water-rich margins and gnammas (rock pools), may have sustained populations of plant species as their microhabitat disappeared from the surrounding landscape.

As the climate once again becomes hotter and drier, granite outcrops may again become important refugia. Scientists are recording the flora and environmental conditions on 15 granite outcrops across a climate gradient to determine if the environments at the base of granite outcrops are more productive than surrounding areas, and if plant communities around granite outcrops are more resilient to climate change.

They are also studying the genetic patterns in a range of species to determine whether granite outcrops acted as refugia in the past. For *Kunzea pulchella*, which is endemic to granite outcrops, they found no genetic evidence that this species had contracted to particular outcrops during past periods of aridity and then expanded when conditions eased. Instead, it had persisted over prolonged periods on isolated outcrops throughout the landscape. This suggests that smaller areas within the granite outcrops themselves may be important microsites of plant persistence during periods of aridity, and that all granite outcrops may act as important local refugia in the future.

Identifying which granite outcrops, or which areas within granite outcrops, will act as refugia as the climate changes allows conservation management to be targeted towards those areas where the most species are likely to persist.

Research contacts: Dr Colin Yates (colin.yates@dpaw.wa.gov.au), Dr Margaret Byrne (margaret.byrne@dpaw.wa.gov.au).

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.

Research contacts: Dr Carl Gosper (carl.gosper@dpaw.wa.gov.au), Dr Colin Yates (colin.yates@dpaw.wa.gov.au).

Carl Gosper/Georg Wiehl

Carl Gosper/Georg Wiehl

Carl Gosper/Georg Wiehl

Marika Maxwell

Integrated management of foxes and cats

Reducing the numbers of the most dominant feral predator in an area may not lead to the recovery of native fauna when other, smaller predators are able to take its place—a situation known as mesopredator release. A major program of research has focussed on whether fox control has led to increased numbers of other predators, such as feral cats, and if this has impacted on the survival and recovery of threatened native fauna.

After several years of fox baiting around the Lake Magenta and Dunn Rock nature reserves, fox activity decreased, but was accompanied by an increase in feral cat activity. This response was also observed after fox baiting of the Dryandra Woodland and Tutanning Nature Reserve. Initially the number of woylies trapped in the reserves increased dramatically after fox baiting but, despite continued and more intense baiting, trap success declined after 2002.

The absence of foxes as both predators of, and competitors with, cats resulted in increased numbers of cats, with significant consequences for woylie populations. Controlling foxes without also controlling feral cats within an area is unlikely to lead to improved survival of rare or threatened fauna. The recovery of native fauna in wheatbelt reserves will only occur when fox and feral cat control is undertaken together as part of an integrated baiting program.

Research contact: Mr Keith Morris (keith.morris@dpaw.wa.gov.au).

Weed risk assessment

In areas affected by dryland salinity, farmers are often advised that perennial -based production systems, rather than traditional annual-cropping systems, may provide better environmental and economic benefits. The introduction of new perennial species is not without environmental risk—new species may become environmental weeds, they may hybridize with native species, or there may be gene flow from cultivated into natural populations.

In collaboration with the former Future Farm Industries CRC, scientists from the department have been conducting weed risk assessments and genetic risk assessments for all species developed for potential agricultural use, whether that species is native to Australia (but proposed to be used outside its natural range) or is introduced. Scientists determine the weed risk a species poses by assessing the area over which it could potentially grow, its ability to invade natural ecosystems, and its ability to alter ecosystem processes once it has established.

Assessment of genetic risk begins with a consideration of taxonomy: is a potential agricultural species taxonomically related to native species in the area? If there is a relationship, and therefore the potential for hybridization, the likely biological management of the agricultural species is then assessed. For example, mallee species grown as biofuels can be harvested before reaching maturity and flowering. Finally, a geographic assessment is made, in terms of the size of the planting site, its location in relation to natural stands of related species, and the vulnerability of those populations to potential genetic contamination. Once these assessments have been made, information is distributed to as wide an audience as possible to help reduce the identified environmental and genetic risks. Preventing the establishment of new ecological and agricultural weeds through the weed risk assessment process is more efficient and cost-effective than undertaking the difficult 'cure' of eradicating weed populations in the future.

Research contacts: Dr Margaret Byrne (margaret.byrne@dpaw.wa.gov.au), Ms Christine Munday (christine.munday@dpaw.wa.gov.au).

Viki Cramer

Keith Morris

Remnant shape affects plant population health

Many populations of plant species of conservation significance within the agricultural lands of the south-west are located within the long, narrow remnants of vegetation within road and rail reserves. The viability of these populations is important not only to the persistence of a species within any individual remnant, but may also be critical in maintaining the genetic diversity of the species across the landscape. In degraded remnants, recruitment failure is the primary cause of species loss. The size, shape and isolation of remnants is likely to influence whether pollinators visit the remnant, how much pollen is available, and the levels of inbreeding of a species, which in turn will influence seed production, germination and seedling fitness. To understand how the physical characteristics of remnants and the density of plants within them affects reproductive fitness, and therefore the likelihood of species persistence within a remnant, researchers studied large and small populations of *Banksia sphaerocarpa* var. *sphaerocarpa* and *B. cuneata* (both pollinated by birds) in remnants and reserves of various configurations and with varying degrees of disturbance.

For *B. sphaerocarpa* var. *sphaerocarpa*, population shape was the only factor that explained differences in reproduction and population fitness; population size, isolation and density had no effect after shape was taken into account. Plants in linear populations were larger and produced more cones and inflorescences, yet their seeds were smaller, had poorer germination, and produced smaller seedlings with lower survival rates. This was most likely due to seeds in linear remnants having lower paternal diversity (i.e. fewer 'fathers'), due to the lack of neighbours to mate with and reduced visitation by birds in these narrow remnants.

In *B. cuneata*, researchers found that levels of inbreeding varied between years, and that this variation was greater in highly disturbed than less disturbed populations—likely a reflection of changes in the behaviour of bird pollinators from year to year. Increasing the population size through planting reduced the levels of inbreeding.

Understanding how mating patterns vary between species, and how this is affected by remnant size, shape and level of degradation allows managers to set evidence-based goals for increases in remnant size and the density of plants within remnants.

Research contacts: Dr Dave Coates (dave.coates@dpaw.wa.gov.au), Dr Tanya Llorens (tanya.llorens@dpaw.wa.gov.au).


Dave Coates


Carl Gosper/Georg Wiehl

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.

Research contact: Dr Margaret Byrne (margaret.byrne@dpaw.wa.gov.au).

Dave Coates

Predicting and managing the threats to rare flora

The majority of the State's threatened flora is located within the highly cleared agricultural areas in the south-west. Understanding the threats to these species, as well as means to ensure the continued survival of current populations is critical to their continued viability.

Researchers tested the susceptibility of rare and endangered flora to *Phytophthora cinnamomi* so that the management of those taxa at risk could be prioritised. Of the 501 taxa tested, those species that are sprouters are more likely to be resistant than those that are seeders. Susceptibility to infection varied within families: most taxa in the Fabaceae, Malvaceae and Poaceae were resistant; taxa in the Casuarinaceae were mainly resistant, but some taxa were susceptible to infection; and a few taxa in the Myrtaceae were susceptible. Taxa in the Proteaceae showed a range of responses from resistant to susceptible, and most of the taxa in the Ericaceae were susceptible. Mortality was lower in those taxa with higher concentrations of leaf phenolics, which suggested that pre-existing traits in some species may improve their resistance to the disease.

Where disease or other disturbance leads to a species becoming critically endangered, translocations of seedlings to increase the size of current populations or to establish new populations is likely required. A range of different planting techniques have been applied to the translocations of over 60 plant species in order to improve translocation success. Watering translocated plants has had mixed results, due in part to the difficulties in reliably delivering water in remote sites. Excluding vertebrate herbivores had a positive effect on translocation survival and growth.

The germination of seed is also fundamental to the long-term persistence of those species that do not resprout after disturbance, and will be directly affected by the hotter and drier climate of the future. Researchers are investigating the temperature thresholds for germination in a range of flora to identify those species most at risk from germination failure under future climate scenarios. The seeds of four species of *Banksia* were collected from populations across a latitudinal climate gradient. Seed germination experiments showed that once the optimum temperature for germination was exceeded, percentage germination sharply declined, and that this optimum temperature varied among populations of the same species. Those populations that require lower optimum temperatures for germination, or that have narrow ranges of optimal temperature, are most vulnerable to a warming climate.

Knowledge of the germination requirements of rare and endangered flora, how susceptible these species are to disease, and how to successfully establish translocated populations is being used to inform integrated management programs that address the range of current and future threats to these species.

Research contacts: Dr Bryan Shearer (bryan.shearer@dpaw.wa.gov.au), Ms Leonie Monks (leonie.monks@dpaw.wa.gov.au), Ms Anne Cochrane (anne.cocharne@dpaw.wa.gov.au).

Viki Cramer