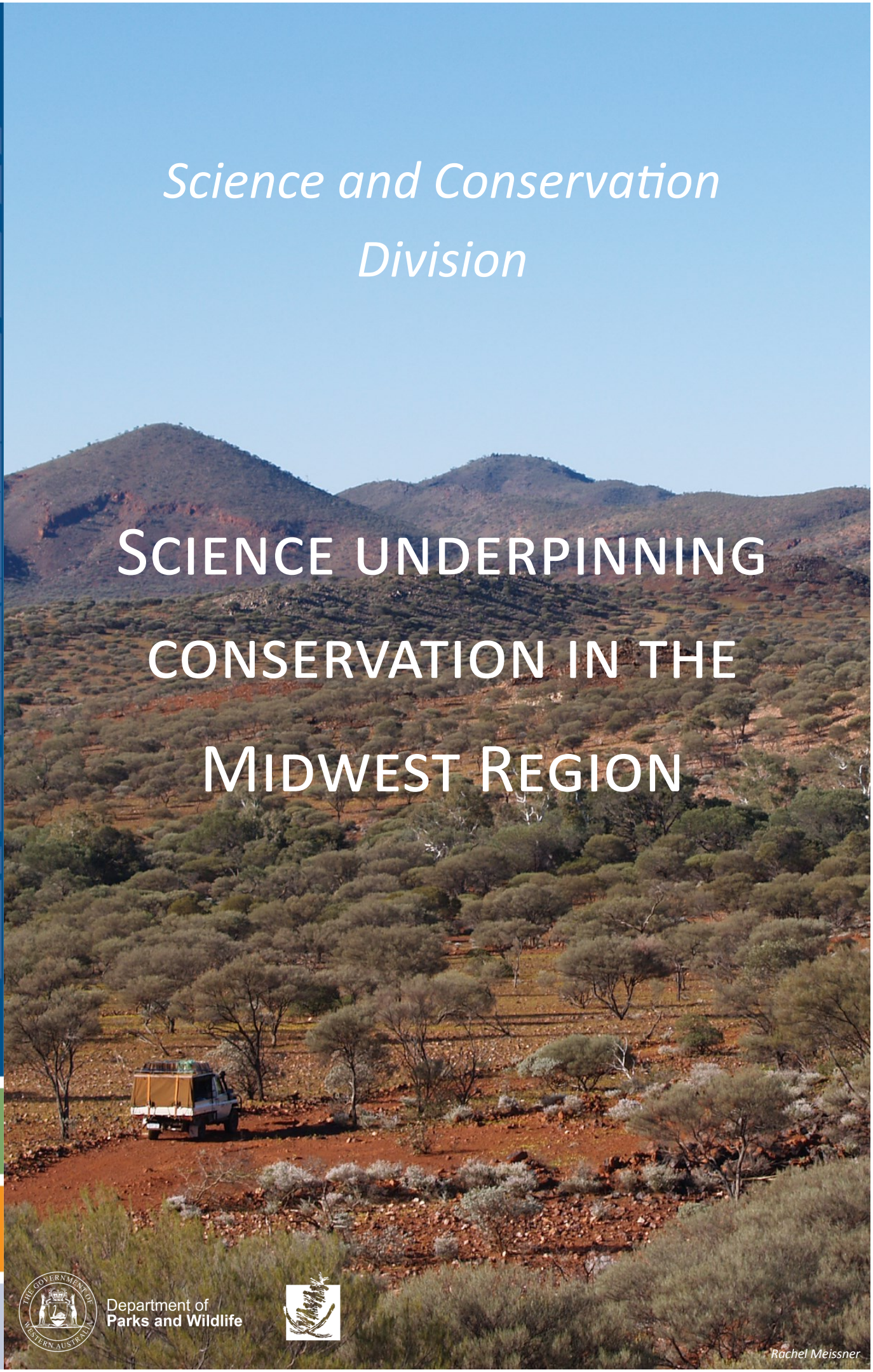
Science and Conservation Division

Science underpinning conservation in the Midwest Region



Department of Parks and Wildlife

Rachel Meissner

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

Andrew Crawford

Robert Davis

Rachel Meissner

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 Midwest and Goldfields regions, to explore how patterns of species diversity and community composition change 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 Koolanooka Hills in the Midwest Region and the Helena and Aurora ranges in the Goldfields region.

Research contact: Dr Neil Gibson (neil.gibson@dpaw.wa.gov.au).

Maintaining kwongan diversity in a changing climate

While bioclimatic models can provide some predictive power as to how vegetation may change as the climate becomes hotter and drier, mechanistic understanding of how plant communities will change requires experimental field studies. Scientists from the division and Murdoch University have artificially manipulated rainfall and temperature to better predict how climate, plant water availability and population dynamics will interact to affect WA's distinctive, species-rich kwongan communities.

Working across a gradient of soil depths, they examined how decreased rainfall and increased temperature affected the daily and seasonal patterns of water use in two groups of plants that access water from different parts of the soil profile: sub-shrubs that use water from the surface soil layers or shrubs and small trees that primarily use groundwater. They also studied how reduced water availability and increased temperature affected seed germination and seedling survival and growth, and the survival, growth, canopy health, flower and fruit production in mature plants.

Decreased rainfall or increased temperatures reduced almost all of these aspects of plant demography. The magnitude of the responses varied between species, but was greatest in areas where soil water was most limited. The results of these experiments showed that a warmer and drier climate will lead to reduced species richness in kwongan communities, accompanied by a shift towards a greater abundance of shorter and more drought-tolerant species. Minimising the loss of species from kwongan communities in the Midwest will require ongoing management of other threatening processes (e.g. inappropriate fire regimes) that will interact with changes in climate, as well as maximising genetic diversity by maintaining local populations of species and improving the ecological connectivity between populations.

Research contact: Dr Colin Yates (colin.yates@dpaw.wa.gov.au).

Steve Dillon

Using genetics to guide the management of isolated populations of local endemics

Acacia woodmaniorum is a sprawling, prickly shrub endemic to a small number of banded ironstone ridges around Blue Hill. Its entire population—about 29,000 plants contained within roughly 40 km^2—is currently covered by exploration mining leases. The flora of the south-west contains many species that, like *A. woodmaniorum*, are historically rare, restricted to specific habitats and consist of isolated populations. Understanding the conservation genetics of such rare and restricted species, particularly the importance of connectivity between isolated populations in maintaining genetic diversity, will help inform conservation management.

Scientists found that there was little genetic difference between populations of *A. woodmaniorum*, suggesting high levels of gene flow even to the smallest and most isolated populations. This high gene flow, lack of self-pollination and the wide variety of insects able to pollinate *A. woodmaniorum* means that inbreeding is not an issue, even in small populations. On the basis of this genetic evidence, seed from different populations can be mixed and used for future restoration plantings without comprising local genetic adaptations.

Research contact: Dr Melissa Millar (melissa.millar@dpaw.wa.gov.au).

Parks and Wildlife

Sustained control of feral cats in the rangelands

The control of feral cats is one of the most important issues for fauna conservation in Australia. Any widespread control requires effective aerial baiting techniques and the development of a toxin and a bait medium that are suitable for feral cats. A state-wide project focussing on a range of climate zones is assessing how the timing of baiting, baiting intensity and baiting frequency all influence the effectiveness of a baiting program. Research is also focused on developing integrated programs that control both feral cats and foxes.

In the Midwest Region, research has been focussed on the Parks and Wildlife-acquired leases of Karara and Lochada, as well as the adjoining Mt Gibson Sanctuary (Australian Wildlife Conservancy), and is currently expanding onto Dirk Hartog Island, where the long-term aim is to reconstruct the island's original mammal assemblage. A cat barrier fence has been constructed and cats are being monitored in the southern half of the island. The island has been baited for cats and initial monitoring shows a reduction of over 90% of radio-collared cats.

The work at Karara–Lochada and Mt Gibson showed that long-term and sustained control of cats and foxes in rangeland areas is possible and that many native species can survive when predator numbers are reduced. The recovery of species more sensitive to cat predation, such as mala and stick-nest rats, relies on successful and sustained eradication of feral cats from conservation areas.

Research contact: Dr Dave Algar (dave.algar@dpaw.wa.gov.au)

Is local-provenance seed the best choice?

In the past, strong arguments—such as the need to protect for local genetic adaptations to the environment—have been made for using only seed of 'local provenance' for restoration projects. While defining restricted seed collection zones is essential for species where there is significant genetic differences between populations, for species with high levels of genetic diversity and low levels of genetic differences between populations this may not be necessary.

An analysis of the genetic diversity and structure of the populations of four plant species commonly used in mine site revegetation in the Midwest—*Grevillea paradoxa*, *G. globosa*, *Melaleuca nematophylla* and *Mirbelia* sp. Bursarioides—has been completed. The analysis showed that genetic variation was low within the populations of both *Mirbelia* sp. Bursarioides and *Grevillea globosa*, suggesting that seed for restoration projects can be collected from across the entire distribution of each species. Greater genetic structure was found within *Grevillea paradoxa*—likely related to the territorial activity of bird pollinators and a degree of self-pollination—and scientists have identified three regional collection zones for seeds of this species. *Melaleuca nematophylla* growing within the Murchison River Gorge was identified as having a distinct genetic lineage, and seed from this area should not be used in restoration programs outside of the gorge. Low levels of genetic difference in *M. nematophylla* outside of the gorge means that seed can be collected from across wide areas for use in restoration.

This analysis of genetic and population structure has shown that local-provenance restriction on seed collection is not necessary in all species. For those species that show distinct genetic lineages and do require defined seed collection zones, understanding which seed collection zone is the most appropriate for a particular restoration project will ensure the continued genetic integrity of the species and improve long-term success of restored populations.

Research contact: Dr Melissa Millar (melissa.millar@dpaw.wa.gov.au).

Cristina Ramalho

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 enable informed conservation and land management decisions in the future.

Research contact: Mr Bruce Maslin (bruce.maslin@dpaw.wa.gov.au).


Bruce Maslin


Cristina Ramalho

Marine monitoring for better management

Long-term datasets help us understand the direction and rate of change in ecosystems, so that managers can identify change related to human activities from underlying natural change. The Western Australian Marine Monitoring Program (WAMMP) aims to provide such information to marine conservation managers, so that they can respond to changes in marine biodiversity and ecosystem condition as they become apparent. The program is a state-wide, long-term monitoring, evaluation and reporting program of both protected areas and threatened marine fauna.

During 2013, scientists from the department began monitoring macroalgae at 12 permanent sites in Jurien Bay Marine Park. While the potential threat to coral reefs from increases in ocean temperatures are widely recognised, the impacts of ocean warming on the health of macroalgae and seagrass communities are perhaps less understood. The canopy cover of *Ecklonia* (a type of kelp) decreased from more than 80% to less than 60% in areas surveyed before and after the ocean warming event of 2010/11, and the monitoring program will assess if the decline in cover has continued.

Recent assessment of subtidal microbial communities in the Shark Bay Marine Park and Hamelin Pool Marine Nature Reserve showed that these communities are more widespread than previously thought. These communities are now known to cover more than 30,000 ha—more than double the area previously recorded. These slow-growing communities are vulnerable to direct disturbance by humans and to changes in water quality caused by increased sedimentation or deposition of air-borne particulates caused by erosion in the Gascoyne and Wooramel river catchments. Very little is currently known about these microbial communities, and the monitoring program will assist in determining how best to manage visitor activity to limit disturbance to these rare and distinctive communities.

Research contact: Dr Kim Friedman (kim.friedman@dpaw.wa.gov.au)

Effective and reliable surveys of fish communities

Fish communities in shallow coastal waters have traditionally been monitored by underwater visual census—a technique which requires little equipment but a high degree of observer expertise to identify fish species *in situ*. Underwater video camera techniques are increasingly used to assess fish communities in shallow waters, whereby stereo-video is used to capture images of a fish community that are later analysed in the laboratory. Diver operated video theoretically requires less scientific expertise than visual census, takes less time in the field, video footage can be repeatedly screened with access to reference material, and it provides a permanent record of the survey.

Scientists determined the comparability of the data collected using both techniques, as well as their overall utility and cost-effectiveness, for fish communities in the Rowley Shoals Marine Park (Kimberley), Ningaloo Marine Park (Pilbara), Jurien Bay Marine Park (Midwest) and Rottnest Island Marine Reserve (Swan). These locations covered the tropical and subtropical coral reefs and temperate rocky reef systems that characterize shallow coastal waters in Western Australia. Visibility and fish diversity vary across the locations, so the techniques were able to be assessed in waters with low or high visibility and with different fish communities.

Datasets from each technique were most comparable in temperate locations where fish diversity was lower, or when the data was assessed at broad functional or taxonomic levels. Visual census consistently recorded higher levels of species richness, particularly at tropical locations where fish diversity is high, and also was more efficient at detecting cryptic species. Data collected by video required extensive post-processing, with up to three times the time investment post-field than census data. While the choice of the most appropriate method to use should be based on both management objectives and resource availability, when significant expertise is available, visual census is considered to be the most cost-effective choice.

Research contact: Dr Shaun Wilson (shaun.wilson@dpaw.wa.gov.au).


Marine Science Program


Marine Science Program

Mangrove morphology

The mangroves within the Shark Bay Marine Park are the southern-most area of extensive mangrove cover along the WA coast. Unlike the more diverse mangrove communities found in the tropics, mangrove communities in temperate regions are comparatively species-poor. At Shark Bay, only one species occurs, the white mangrove *Avicennia marina*. Yet this species displays a wide range of structural forms in the widely dispersed and often isolated stands in which it grows in the park. Some stands contain tall, large trees that form a dense canopy, while in other stands growth is stunted and the sparsely distributed mangroves appear shrub-like.

Researchers are investigating how the unique oceanic characteristic of the marine park, where the salinity gradient in the semi-enclosed lagoons ranges from that of normal seawater to highly saline, influences the structure and density of mangrove stands. Larger trees mostly occur in areas where seawater salinities resemble that of the open ocean, while stunted stands typically occur where seawater is more saline. The differences in mangrove structure are likely to influence the ecological role that mangroves play throughout the marine park in terms of habitat provision for fish and turtles, the breakdown of organic material and nutrient cycling.

Improved understanding of the variation in the structure of mangrove communities in the marine park will guide revised management zoning so that each mangrove type is adequately represented in sanctuary or special purpose zones.

Research contact: Dr Michael Rule (michael.rule@dpaw.wa.gov.au).