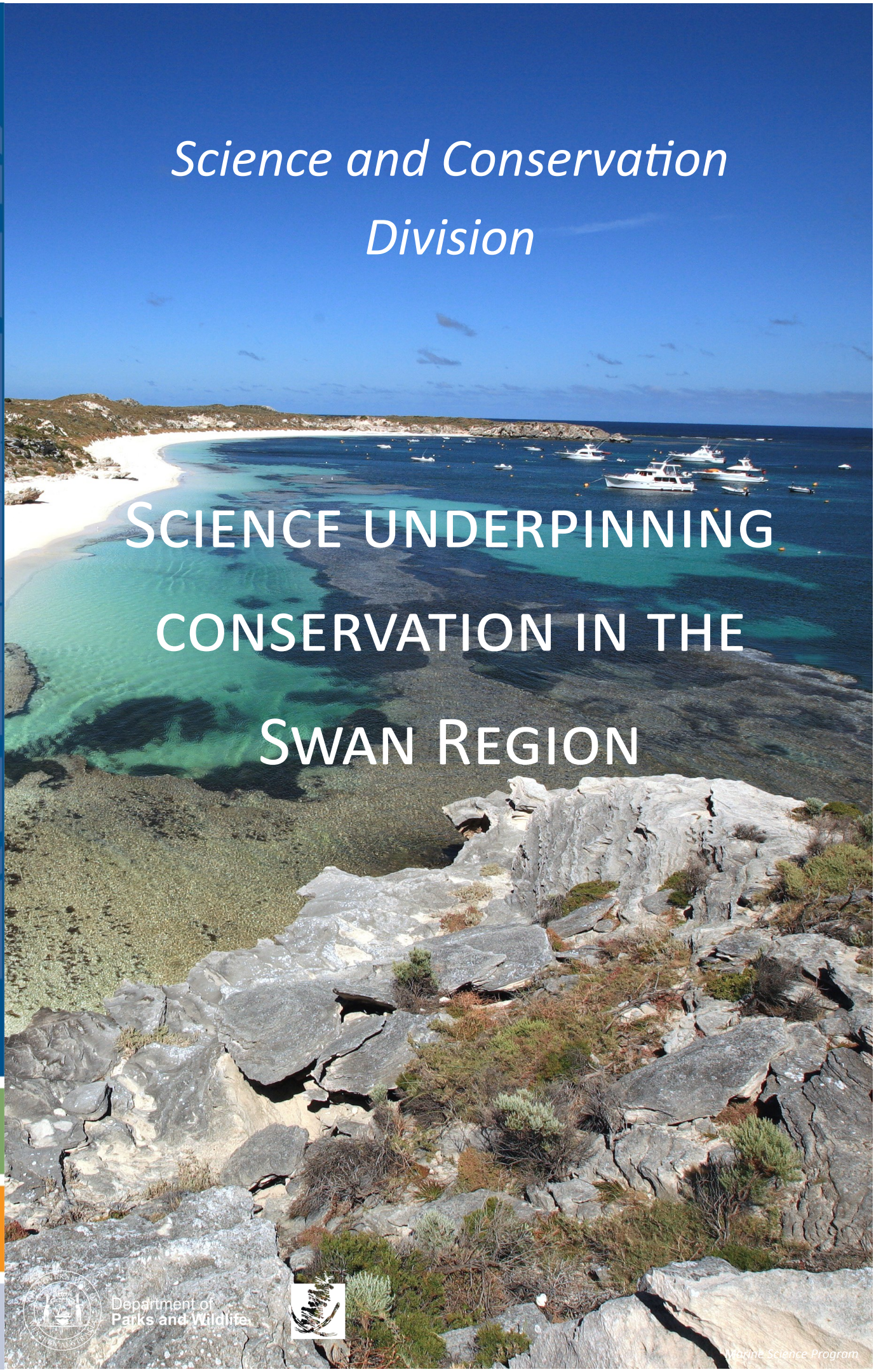
Science and Conservation Division



SCIENCE UNDERPINNING CONSERVATION IN THE SWAN REGION

Department of Parks and Wildlife

Marine Science Program

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

Richard Robinson

Richard Robinson

Matthew Williams

Matthew Williams

New light on sun-moths

Targeted surveys for the graceful sun-moth (*Synemon gratiosa*) have not only improved our understanding of the conservation status of the species, but have also led to the rediscovery of the 'Kukerin sun-moth' (currently undescribed). Sun-moths are strictly day-flying moths that are often observed during the hottest part of the day, leading them to commonly being confused with butterflies.

The graceful sun-moth breeds on only two species of *Lomandra* (*L. maritime* and *L. hermaphrodita*), and their caterpillars live entirely within or next to the underground rhizomes. Adult moths emerge over a four to six-week period between mid-February and late March, with adults only living two to ten days. The graceful sun-moth is restricted to the Swan Coastal Plain, and is threatened by urban and other development. Surveys conducted during 2010 led to a significant range extension for the graceful sun-moth and also the location of several large populations.

The surveys also discovered new populations of the Kukerin sun-moth, which had not been recorded between 1948 and 1996. Originally thought to be the graceful sun-moth, genetic analysis has confirmed that the Kukerin sun-moth is a separate species, with its own flight period, preferred habitat and larval host plant (*Chamaexeros fimbricata*).

The information gained from the surveys led to the conservation status of the sun-moth being changed from Vulnerable to Priority 4 (not threatened). Monitoring of sun-moth populations until 2017 will confirm this conservation status and ensure the population is stable.

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Fire behaviour in the 21st century

Climate and weather, topography, vegetation and fuel will influence the ignition, behaviour and extent of fire in the landscape: together they encompass the 'fire environment'. As the climate of the south-west becomes warmer and drier, with less autumn and winter rainfall, the duration of the traditional fire season has extended. At the same time, changes in land use, socioeconomic and organisational factors has led to large areas of land being unburnt for two or more decades. This increases the risk of large-scale, high severity fires. Yet much of the information linking climate, fire weather and fire behaviour, and the resultant guidelines for fire management, have not been revised since data was first gathered in the 1960s and 1970s.

Scientists are developing new predictive models of fire occurrence and behaviour based on contemporary patterns of weather, fuel characteristics and human behaviour. To date they have developed models to predict the daily occurrence of human-caused bushfire in the South West, Swan and Warren regions, and have developed a database of fire caused by lightning strike. Lightning is a significant cause of fire in the south-west, with these fires burning a disproportionately large area relative to the number of ignitions. Understanding the interactions between weather patterns and lightning ignitions will help predict periods of above-normal activity, ultimately leading to improved deployment of resources during periods of high fire risk.

A specific focus for fire behaviour research will be on the coastal shrubland ecosystems that are a predominant vegetation type in coastal areas between Geraldton and Esperance. The lack of a fire behaviour prediction guide for coastal shrublands was highlighted as a significant gap to effective decision-making on the prescribed use of fire in these ecosystems. When dry, the fine fuels found in coastal shrublands are highly flammable, leading to the potential for intense and fast-moving fires when wind speeds are greater than 15 km/hr. In this vegetation type, fires may also jump from the litter layer to the shrub layer in response to small changes in wind speed and fuel dryness, increasing the difficulty in predicting how prescribed fires may behave. Systematically describing fuel characteristics is a key component of the project, and scientists have undertaken pilot studies at seven sites to test the effectiveness and practicality of a number of fuel sampling techniques. Data will continue to be gathered from planned burns, and scientists will undertake experimental burns to better understand under which conditions and in which shrubland types fire is likely to be sustained and spread.

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Lachie McCaw


Rick Dawson


Cristina Ramalho

Understanding the extinction risk to vulnerable species from future urbanisation on the Swan Coastal Plain

Quantifying the impacts of potential land development and management scenarios for threatened species requires robust risk assessments of the alternative scenarios. Population viability analysis (PVA) is a modelling tool used for this purpose. PVA works by using ecological and demographic monitoring data to build a population model. This is then used to project population dynamics and estimate the future population size and extinction risk of the species under different development or management scenarios.

Scientists working with staff from Swan Region are using PVA to evaluate the potential impact of different land development scenarios on foraging habitat of the endangered Carnaby's cockatoo (*Calyptorhynchus latirostris*) on the Swan Coastal Plain for the Strategic Assessment of the Perth and Peel Regions. PVA is also being used to evaluate the impacts of fire management, increased urbanisation and the benefits of road underpasses for quenda (*Isoodon obesulus fusciventer*) in the Perth metropolitan region. The quenda PVA model is being used to guide conservation actions to maximise the viability of quenda populations in the rapidly developing Perth metropolitan area.

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Erin Clithero

Managing little penguins and people

The potentially dangerous walk across the sandbar that links Penguin Island to the mainland is not only a risk to those who attempt it, but may also disrupt the breeding activities of little penguins (*Eudyptula minor*). Penguin Island is an important northerly breeding location for little penguins, and an important breeding site for many other seabirds. Scientists are using a remote camera system that will be able to record arrivals of little penguins to the island, but also track the number, timing and characteristics of visitors that make a high-risk crossing of the sandbar.

Data from the first summer season showed how many visitors cross the sandbar and the peak periods when the sandbar was used. The camera data has also assisted scientists in assessing the condition of little penguins as they arrive and breed on the island, as well as the potential impacts of human activities on them. This information will help marine park managers to respond to adaptively manage the interactions between little penguins and visitors, and also put in place procedures to minimize the number of attempted high-risk crossings of the sand bar.

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Increasing streamflow for human use and ecosystems

Since the 1970s, declining rainfall in the south-west has been accompanied by even greater declines in streamflow, with consequent impacts on the availability of water for human use and on the integrity and health of freshwater ecosystems. Yet the reasons why the decrease in streamflow has been so much greater than the decline in rainfall were not clearly understood.

To investigate the interactions between rainfall, streamflow, stream salinity and groundwater, scientists have been studying hydrological data from an experimental catchment to the east of Dwellingup. They found that since 1976, the groundwater system in the catchment has progressively declined and, around 2001, became disconnected from the surface water system. Once groundwater and surface water systems are no longer connected, the proportion of rainfall that becomes run-off declines by about 50%. Rather than directly contributing to streamflow itself, a connected groundwater system is an important amplifier of other streamflow generating processes because it allows additional surface water runoff and subsurface flows.

The research has suggested that vegetation thinning may be an appropriate management action to increase the amount of streamflow, and therefore water production, within a catchment. Thinning will be most effective where groundwater is connected to surface water, and so thinning levels should ensure a sufficient rise in groundwater. While the magnitude of land clearing in the south-west is the cause of groundwater rise and associated secondary salinity, the risk of stream salinity from the thinning of forested catchments is considered to be lower because current silvicultural practices, in combination with the drying climate, will result in a more subdued rise in groundwater.

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Lachie McCaw

Documenting intertidal reef communities

Sub-tidal and emergent limestone reefs are a distinctive feature of the Perth coastline, yet little is known of the structure and diversity of communities on the intertidal reef platforms. The rising and falling tides, as well as wave action, exert a major influence on the spatial and temporal structure of intertidal reef communities.

Scientists surveyed numerous reef platforms in the Marmion and Shoalwater Islands marine parks and recorded over 100 species each of algae and invertebrates. As predicted, exposure to wave action was an important determinant of community distribution and structure. More sheltered reefs supported a dense canopy of algae, often dominated by *Sargassum*, and the invertebrate species that shelter within algae, such as sea stars, sea urchins and small gastropods. High energy reefs, in contrast, had relatively sparse amounts of algae, and were dominated by short turf or encrusting coralline species. Species that could adhere strongly to rock surfaces, such as abalone, chitons, anemones and limpets, were more likely to be found on these reefs.

Information gained on the distribution and habitat of species will be used to develop long-term monitoring protocols and to identify species that may be used as indicators of environmental changes on the reefs.

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John Huisman

John Huisman

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.

The rapid increase in Perth's population in recent years has been accompanied by a substantial increase in the number of boats registered within the metropolitan region, and it is likely that anchoring and fishing pressure is increasing in seagrass communities along the Perth coastline. Understanding how this will affect both seagrass and macroalgal communities within the Marmion and Shoalwater Islands marine parks is an important component of the monitoring program for the region.

Scientists analysed data collected by the Cockburn Sound Management Council since 2003 and data collected from six new sites within the Shoalwater Islands Marine Park (three in general use zones, two in sanctuary zones and one in the Port Kennedy Boating Exclusion Zone) to assess changes in seagrass density over the past decade. They found that there have been significant declines in seagrass density at the Warnbro Sound reference site, but as yet it is unclear if this trend is occurring across the marine park. Information from the monitoring program will determine the levels of recreation pressure that can be sustained in various management zones while also maintaining healthy seagrass and macroalgal communities in the marine parks.

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FORESTCHECK is a long-term, landscape-scale monitoring program that seeks to inform the adaptive management of jarrah forests. Scientists are investigating how forest structure and biodiversity are affected by timber harvesting and silvicultural treatments (regeneration release through gap creation or regeneration establishment using shelterwood and selective harvesting), compared with forests that have never been harvested or were harvested more than 40 years ago. Monitoring is carried out on a series of 2 ha grids (65 grids in total) in seven locations within five jarrah forest ecosystems, with the grids located across ecological gradients associated with rainfall, evapotranspiration and soil fertility.

While the silvicultural treatments did not affect species richness or the abundance of understorey plants, the soil disturbance associated with timber harvesting was found to be an important contributing factor in altering plant species composition. The areas trafficked by harvesters, skidders and loaders are often subject to excessive disturbance and compaction, with consequent effects on soil and forest health. Scientists measured soil bulk density as a measure of soil compaction across the sampling grids. Although highly variable, the mean bulk densities for soils in areas that had been harvested were significantly greater than in areas that had never been harvested. The effects of machinery activity on soil bulk density were still apparent in the reference grids that were harvested more than 40 years ago. This information allowed scientists to revise the limits for soil disturbance and the criteria for moist soil harvesting operation in jarrah forest.

The silvicultural treatments favoured species with an abundant soil seed store (e.g. *Kennedia coccinea*) over those with woody stems that are vulnerable to mechanical disturbance. More species of small and medium shrubs were recorded in forests that had not been harvested or were harvested before 1960. While grids in the gap release treatment were well stocked with saplings and ground coppice, regeneration of seedlings in the shelterwood treatment was not adequate to satisfy regeneration stocking standards within 10 years of treatment. The silvicultural treatments had a significant impact on the composition of cryptogam communities (lichens and bryophytes). Half of all cryptogams recorded were found on coarse woody debris, and 40% of them depended on it entirely, emphasizing the importance in retaining coarse woody debris over a range of sizes and in various stages of decomposition. Each forest ecosystem supported a unique fungal community, and the species composition of macrofungi differed in each treatment. The landscape mosaic of mature forest and stands of forest at various stages of succession after timber harvesting, combined with a range of times since fire, is important in maintaining fungal biodiversity in jarrah forests.

Scientists found that the type of jarrah ecosystem and the year of sampling had a greater influence on macro-invertebrate communities than did the silvicultural treatments. The maintenance of a mosaic of mature forest adjacent to harvested forest, as well as retaining macro-invertebrate habitat within harvested areas, will help to maintain species diversity locally and across the jarrah forest ecosystems. The silvicultural treatments also had little effect on bird community structure or on individual species, despite the typically strong association of bird species with vegetation type and structure. Most of the birds found in the jarrah forest are widespread throughout the south-west and have evolved to be resilient to disturbance. For terrestrial vertebrates (mammals, reptiles and frogs) the effect of silvicultural treatments were examined in combination with the impacts of fox control. Fox control had a greater impact on terrestrial vertebrates than silvicultural treatment: three times as many individuals of native animals were recorded in areas that had been baited. While the disturbance from harvesting will temporarily favour some species, the silvicultural treatments did not negatively impact terrestrial vertebrate fauna.

The information gained from FORESTCHECK's systematic monitoring of the jarrah forests is used to guide future silvicultural practice, to ensure that timber harvesting in these forests is ecologically sustainable in the long-term.

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