



Royal Hakea.
PHOTO: South Coast NRM.

SOUTHERN PROSPECTS 2011-2016

Biodiversity

BIODIVERSITY

This section describes the importance of our biodiversity assets in the management of natural resources. The main components of the Biodiversity theme are described and factors affecting these assets are discussed. Aspirations (25+ years), Goals (10+ years) and Outcomes (one to five years) are outlined in a Program Logic Summary (See section 6.6).

ASPIRATION: *Natural ecosystems, habitats and landscapes are valued, resilient, effectively linked and managed to provide increased viability for native species and communities.*

This section deals with the fundamental requirements for managing biodiversity sustainably, with specific actions to manage terrestrial biodiversity. There are cross-references to managing water resources in the Water theme section, which incorporates actions relating to the biodiversity of freshwater and estuarine systems. The theme area for coastal and marine systems also includes consideration of the coastal zone and marine biodiversity.

Sources of information for this section include:

- Background Paper on Biodiversity Values and Threats in the South Coast Region (Department of Environment and Conservation, 2011)
- Australian Terrestrial Biodiversity Assessment (National Land and Water Resources Audit, 2002)
- Salinity Investment Framework Interim Report (Department of Environment, 2003)
- Preliminary Agency Statement of Natural Resource Management Priorities in WA (November 2003)
- Threatened Species and Ecological Communities Regional Strategic Management Plan (Department of Environment and Conservation, 2009c)
- various State, national and regional databases and contributions from key stakeholders.

6.1 Principles

Principles for management of biodiversity include:

- identification and protection of key biodiversity assets
- minimise incremental loss of native vegetation with goals of 'no net loss'

- maintain and/or restore healthy, resilient ecosystems by reducing threatening processes
- plan and manage natural ecosystems, species, communities, habitats and landforms at a landscape scale
- facilitate delivery of strategic information to support actions.

6.2 What we know – values and threats

6.2.1 Significance of the region's biodiversity

Scientists have identified 34 'biodiversity hotspots' in the world. These areas are considered to be of international significance and support a combination of high species diversity, high numbers of endemic species and high levels of threat to biodiversity (Myers, 2003; Mittermeier et al., 1999; SWAEI, 2006). The South West Botanical Province of WA, defined by a line from Shark Bay to Israelite Bay, is one of these 34 'hotspots' and is the only one in Australia. The South Coast NRM Region occupies the south eastern part of the South West Botanical Province and contributes significantly to its biodiversity values. Within the region there are 5472 known flora taxa (species and subspecies). This is more than 60% of the flora of the Province. Of these, around 694 are endemic to the region. Two of four Centres of Plant Endemism in the South West of WA occur here. The Ravensthorpe Range-Fitzgerald River National Park area (75 plants endemic to the National Park and 17 to the Ravensthorpe Range), and the Stirling Range (82 endemic plant species within the National Park area) are key areas for plant endemism. Gioia and Hopper (2004) further describe high plant species diversity in the Walpole, Frankland, Stirlings West, Manypeaks and Stirlings

East areas, with another area of richness in the Bremer Bay to Ravensthorpe area.

The high levels of diversity are partly due to the bio-geographical complexity in the region, and to the geological and climatic history (McQuoid, 2003). The region includes the South West's only 'mountain' peaks in the Stirling Range, the Porongurup Range and the peaks of the Barren Ranges within the Fitzgerald River National Park (Barrett & Gillen, 1997). It has a complex drainage system, including a range of riverine and estuarine types, complex freshwater and saline wetlands systems, and large areas that are internally draining. "Combinations of these systems and processes have provided acute patterning in the flora including extensive endemism, aggregations of closely related species,

and significant hybridisation and intergradation" (McQuoid, 2003). Surveys, particularly for non-vascular flora and lower order fauna, are incomplete. However, the level of knowledge and awareness of ecological processes and function has expanded greatly over the last five years.

Biodiversity contributes to our economy and provides ecological processes such as water and air purification and pollination of our food crops. It is intrinsically valuable for our health and well being and contributes to tourism and the beauty of the region. In many cases, the components of the biodiversity building blocks are better known than the complex interactions and inter-relatedness between and within ecosystems.

Kunzea recurva.



PHOTO: Eileen Rodgers.

6.2.2 Bioregions

The national ecosystem based classification system referred to as IBRA (Interim Biogeographic Regionalisation of Australia) has recognised 85 biogeographic areas in Australia based on regional patterns of landform and vegetation (Thackaway & Cresswell, 1995). These have more recently been divided into sub-regions (53 sub-regions in Western Australia). A similar system has been developed for the marine environment (Integrated Marine and Coastal Regionalisation of Australia or IMCRA). The South Coast region contains two complete IBRA sub-regions and parts of a further five. The two complete sub-regions are:

- **Fitzgerald (ESP 1):** is the western section of the Esperance Sandplain and includes the Ravensthorpe Range, Fitzgerald River National Park to Cape Riche and the Stirling Range. The subregion consists of metamorphosed sandstones, Eocene marine sediments with small areas of Proterozoic gneiss and Archaean greenstones and sandsheets with varying levels of lateritisation. Vegetation includes: scrub heath, mallee heath, coastal dune scrub, mallee, woodlands on greenstone, Yate and York Gum woodlands on alluvials, and Jarrah/Marri woodlands in the west.
- **Recherche (ESP 2):** is the eastern part of the Esperance Sandplain from Hopetoun to Israelite Bay. This is an area of Proterozoic gneiss and granite as well as Eocene sediments and more recent coastal limestone. It also includes Quaternary coastal sandplains and dunes plus numerous granitic islands. Vegetation comprises heath, coastal dune scrub, mallee, mallee-heath and granite heath.

In addition, the South Coast contains the southern portions of both the eastern and western Mallee bioregion:

- **Eastern Mallee (MAL 1):** calcareous clays and loams as duplex soils that often contain sheet and modular kankar, outcrops of metamorphosed sandstone, white and yellow sandplains and loamy plains with numerous salt pans. Vegetation includes mallee on sandplains, samphire around small salt lakes, mallee and patches of woodland on clay and scrub-heath on sandstone.
- **Western Mallee (MAL 2):** clays and silts underlain by Kankar, exposed granite, sandplains and laterite pavements. Salt lake systems on a granite basement with occluded drainage system. Mallee communities occur on a variety of

surfaces; *Eucalyptus* woodlands occur mainly on fine-textured soils, with scrub-heath on sands and laterite.

The western part of the South Coast region is dominated by the Southern Jarrah Forest sub-region and the Warren region:

- **Southern Jarrah Forest (JF 2):** Part of a broad plateau that slopes gently to the South Coast. Drainage is dissected in the west but broadening and levelling of the surface in the east which causes poor drainage and large lakes (e.g. Lake Muir) and numerous small wetlands. Vegetation comprises Jarrah - Marri forest in the west grading to Marri and Wandoo woodlands in the east. There are extensive areas of swamp vegetation in the south east dominated by paperbark and Swamp Yate.
- **Warren (WAR):** Dissected undulating country of the Leeuwin Complex and Albany Orogen with loamy soils supporting Karri forest, laterites supporting Jarrah-Marri forest, leached sandy soils in depressions and plains supporting paperbark/sedge swamps, and Holocene marine dunes with *Agonis flexuosa* woodlands.

A small part of the eastern part of the Avon Wheatbelt around Tambellup is included in the South Coast region:

- **Eastern Wheatbelt (AW 2):** An ancient peneplain with low relief. There is no connected drainage and salt lake chains occur as remnants of ancient drainage systems that now only function in very wet years. Lateritic uplands are dominated by yellow sandplain. Mosaic of scrub and woodland.

A system of ecozones have been described in the region in an attempt to subdivide the IBRA sub-regions. Thirteen ecozones based on similarities in physical and biological patterns of geology, climatic history, drainage patterns, major soils systems and existing native vegetation has been proposed for the South Coast region (McQuoid & Greening Australia, 2004).

6.2.3 Vegetation

Beard described and mapped 120 vegetation associations in the South Coast NRM Region, many of which are endemic (Hopkins et al., 2001). Parts of the region were opened up for agriculture during the 1950s and 1960s, with broadscale clearing occurring as recently as the 1980s. Parts of the region have been protected within the conservation reserve system, or retained on private land, so extensive blocks of native vegetation remain. However, several vegetation associations have less than 15% of their total remaining extent protected in IUCN (World Conservation Union) management reserve categories I-IV, and some are not represented at all. This information is summarised in the Background Paper for Biodiversity (Department of Environment and Conservation, 2011).

The conservation status of Beard vegetation systems has been reviewed, updated and reassessed using the Comprehensive, Adequate and Representative (CAR) Analysis Report (Department of Environment and Conservation, 2011). More detailed information is presented in Department of Environment and Conservation, 2011 (Appendix I). Eleven vegetation systems in the region have been identified as having 15% or less of their original (pre-European) extent remaining, and 13 others have less than 30% remaining. The remaining areas of these vegetation communities are conservation priorities to meet the nationally agreed criteria for the establishment of a CAR Reserve System.

More detailed vegetation mapping is crucial to confirm the relevance of Beard's vegetation assessment and provide more strategic directions for conservation priorities in the South Coast region. Some vegetation communities in specific areas of the South Coast region have been mapped at a more relevant scale by Ken Newby (Department of Environment and Conservation, 2011). More recently two significant vegetation mapping projects have been completed with the support of South Coast NRM. In 2008 the vegetation of approximately 10,000 ha of the northern section of the Ravensthorpe Range was mapped and data digitised (Craig et al., 2008). In 2010 the Albany Regional Vegetation Survey (ARVS) was completed (Sandiford and Barrett, 2010). This work provides mapping and supporting digital data for the vegetation communities of the Albany area (approximately 124,400 ha). The ARVS assists with identification of vegetation communities that are locally restricted and of conservation concern.

6.2.4 Legislation

In Australia, fauna and flora species and ecological communities can be listed at a Commonwealth level under the EPBC Act and/or at a State level under the WC Act. Listing a species provides it legal protection under the relevant legislation.

The International Union for Conservation of Nature and Natural Resources (IUCN) also produces a list of threatened species (IUCN 2008). Although this Red List does not provide any legislative protection for a species in Australia, the categories and criteria used for the Red List are used as a framework for the listing of species at both a Commonwealth and State level.

Various national and international agreements and legislation can assist in the conservation of biodiversity including the:

- IUCN International Convention on Biological Diversity 1992
- convention on the conservation of Migratory Species of Wild Animals 1979 (the Bonn Convention)
- agreement between the Government of Australia and the Government of the Peoples Republic of China for the Protection of Migratory Birds and their Environment (CAMBA)
- agreement between the Government of Japan and the Government of Australia for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment (JAMBA)
- Ramsar Convention (an agreement to protect important wetlands)
- *Environment Protection and Biodiversity Conservation Act 1999*
- National Strategy for the Conservation of Australia's Biological Diversity
- *Conservation and Land Management Act, 1984*
- *Wildlife Conservation Act, 1950*
- *Environmental Protection Act 1986.*



PHOTO: Project Dieback

Around 694 known plant species are endemic and found only in the South Coast region.

6.2.5 Flora

The South Coast region encompasses the southern and eastern part of the Southwest Botanical Province where the diversity of landform and soil types and long history of isolation have produced a very diverse flora. The range of rainfall from 1400 mm per year in the west to 300 mm per year in the east has also contributed to this diversity. A 2010 analysis of Naturemap data (Department of Environment and Conservation, 2011) records the South Coast region as containing 5472 native flora taxa (i.e. species and subspecies). This is over 60% of the flora of the Southwest Botanical Province. Around 694 known plant species are endemic and found only in the South Coast region. While they represent only 12.6% of the region's flora, as endemic species these plants make an important contribution to the biodiversity of the Southwest Botanical Province.

Only one plant is known to have become extinct in the South Coast region over the last 200 years (*Acacia prismifolia*). However, there are 121 taxa that are currently at risk of extinction or range reduction and are listed as Threatened Flora, representing 30% of the State's Threatened Flora. Thirty eight South Coast Threatened Flora are regarded as Critically

Endangered, 34 are in the Endangered category and 49 are listed as Vulnerable. A further 793 taxa are listed as Priority species. These species require monitoring or more investigation to determine their conservation status.

The proportion of threatened flora populations found entirely within protected national parks and nature reserves has remained fairly stable since 2004, while those occurring outside conservation reserves have risen by 5.7%. These populations account for 30% of the total South Coast threatened flora and may be at significantly greater risk of threatening processes than those within the conservation estate.

Twenty-three regional flora species have increased their threatened status since 2004, while nine have had status reduced. Nineteen of the 23 species were not previously listed as threatened flora. Their current ranks were determined after extensive survey and following nominations based on IUCN criteria. Six declared rare flora species were similarly analysed and delisted to Priority 4. The conservation status of nine species was reduced during the period due to concentrated survey efforts, implementation of recovery actions and/or enhanced habitat protection.

6.2.6 Fauna

About 414 species of native vertebrate animals (mammals - 12, birds - 300, reptiles - 70, frogs - 22 and fish - 10) are found within the South Coast region across the various habitats according to rainfall, vegetation and landform. This does not include the multitudes of invertebrate species (such as insects, spiders and crustaceans). More details are included in Department of Environment and Conservation, 2011.

Twelve species of mammals and two bird sub-species are presumed extinct on the South Coast since European settlement (Department of Environment and Conservation, 2011). The South Coast's 59 threatened fauna species (terrestrial and marine) represents 28% of the Western Australian total of 209 (Department of Environment and Conservation, 2011). Nearly three quarters of the threatened terrestrial birds in the State occur here and 29% of the threatened terrestrial mammals. A suite of endemic ground-dwelling birds (Noisy Scrub-bird, Western Bristlebird, Western Whipbird [western heath] and Western Ground Parrot) are present in the Two Peoples Bay - Waychinicup area and this area has been recognised as one of the most important areas for threatened birds on the Australian mainland (Garnett & Crowley, 2000). The region has an important role to play in the protection and recovery of threatened fauna. Recovery programs for South Coast threatened species are ongoing (details in Department of Environment and Conservation, 2011).

6.2.7 Non-vascular flora and fungi

Our knowledge of non-vascular flora has improved through studies such as a fungi survey (Syme, 2008) within the region, revealing 622 distinguishable taxa. Syme (2008) recommended that to consolidate previous records and to build to data on poorly-collected species and images, surveys should continue across the region with a focus on dry woodlands and mallee, as well as in drought susceptible ecosystems due to climatic restraints and the sporadic nature of the emergence of fungi. The need for continued work on taxonomy, multivariate analysis of fungi distribution, cataloguing and communication to the scientific and non-scientific community was also recognised (Syme, 2008).

6.2.8 Threatened Ecological Communities

Five Threatened Ecological Communities (TEC) are State listed for the region, including the Critically Endangered Montane thicket of the Eastern Stirling

Range, and a further 25 ecological communities are priority listed by the Department of Environment and Conservation. Recovery Plans and Recovery Teams are current for many of the threatened species and communities (Department of Environment and Conservation, 2011). TECs are also recognised at the national level under the *Environment Protection and Biodiversity Conservation Act, 1999*.

6.2.9 Reserves system

The reserves in the South Coast region contain a high proportion of the remaining vegetation. While biodiversity values are better known than in 2004 when *Southern Prospects* was first prepared, management is still limited by a shortage of resources. Some natural areas are well connected across the landscape, while others act as stepping stones with limited or no connectivity. Many reserves have detailed management plans directed towards maintaining biological diversity and community values such as low key recreation. Reserves with high visitor numbers are a focus for biodiversity information and education.

The Department of Environment and Conservation is primarily responsible for terrestrial biodiversity conservation with approximately 4.25 million hectares of public land managed primarily for this purpose (Department of Environment and Conservation, 2011). Of this, approximately 1.82 million hectares are unallocated crown land (UCL) where the Department seeks to manage invasive species, weeds and fire pre-suppression activities. These areas represent an increase of approximately 3 million hectares since *Southern Prospects* was prepared in 2004. National parks and nature reserves are vested in the Conservation Commission of WA and managed by the Department of Environment and Conservation primarily for conservation under the *Conservation and Land Management Act 1984*. In national parks (and some nature reserves) public recreation is facilitated as long as it is compatible with conservation goals.

While National Parks such as Stokes, Cape Le Grande and Cape Arid are highly significant in terms of biodiversity, the two largest conservation reserves on the South Coast are the Fitzgerald River National Park and Stirling Range National Park, totalling 413,000 ha. The Stirling Range National Park contains the five highest peaks in southern WA, is a recognised centre for plant diversity and contains many endemic plants. It is also a significant area for endemic terrestrial invertebrate fauna.

The Fitzgerald River National Park contains a large number of endemic plants and more native mammal species within its borders than any other conservation reserve in southern WA. These include many threatened mammals which are locally extinct in other areas. The Fitzgerald River National Park Biosphere Reserve was declared in 1978 under UNESCO Man and the Biosphere Programme and is one of only two such reserves in WA. Biosphere Reserves are 'areas of terrestrial and coastal ecosystems, promoting solutions to reconcile the conservation of biodiversity with its sustainable use' (Unesco, n.d.). The Man and the Biosphere Program has also developed the Seville Strategy (The Seville Strategy for Biosphere Reserves, 2002) which provides guidance for the management of effective Biosphere Reserves. The Federal *Environment Protection and Biodiversity Conservation Act 1999* contains provisions for the management of Biosphere Reserves, including reference to their particular functions in:

- conserving genetic resources, species, ecosystems and landscapes
- fostering sustainable economic and human development
- supporting demonstration projects, environmental education and training, and research and monitoring related to local, national and global issues of conservation and development.

Biospheres should ideally include a core "reserve" area (in this case, the Fitzgerald River National Park), a "buffer" of other publicly owned land, and the "zone of cooperation" in which sustainable economic and human development are encouraged. The Fitzgerald Biosphere Group, Ravensthorpe Agriculture Initiative Network, Fitzgerald Biosphere Marketing Association and Shires of Jerramungup and Ravensthorpe have captured the imagination of the world community and successfully promoted the Biosphere concept. These innovative groups continue to explore ways to improve knowledge and expand partnerships.

The Walpole Wilderness Area (363,333 ha) has been established and comprises national parks, nature reserves and other reserves in the western part of the South Coast NRM Region. The area includes Mount Lindesay National Park, the Walpole Nornalup National Park, Mount Frankland National Park, Mount Frankland North National Park, Mount Frankland South National Park, Mount Roe National Park, William Bay National Park and Shannon

River National Park. Areas of State forest are also included and the Wilderness Area extends across the South West and South Coast NRM Regions. This consolidated area contains a varied treasure trove of endemic species and assemblages that are found nowhere else, many of which have relictual linkages to Gondwanan times.

Outside of the Department of Environment and Conservation estate, reserves which are often managed by Local Government Authorities and other organisations have an important role to play in the framework of the conservation estate, even if these areas are managed for other purposes such as recreation.

There are a small but increasing number of areas that are privately owned and managed for conservation purposes. The Gondwana Link partnership has facilitated the purchase of properties in the Corackerup area, while the Friends of the Porongurups purchased the Twin Creeks reserve area, providing a 'stepping stone' between the Porongurup and Stirling Range national parks. While some of the purchases have been assisted by public funding, they also represent a considerable investment of private funds and voluntary management activity on the part of the groups involved. The contribution of private land management for conservation has been improved by policies that relate to subdivision of rural land.

The Land for Wildlife program is a voluntary scheme that aims to encourage and assist private landholders to provide habitats for wildlife on their property even although the property may be primarily managed for other purposes. Other useful tools to protect or enhance biodiversity outcomes that could be pursued in the future include rebates, tax relief and additional assistance with processes that promote conservation and management of natural systems.

6.2.10 Enterprises supported by biodiversity

The conservation estate and other natural areas contribute to the region's growing nature based tourism industry. The Tree Top Walk near Walpole is well patronised by visitors and residents of the region, and is supported by Walpole Wilderness Discovery Centre. Further east, the Stirling Range and Fitzgerald River National Parks are popular destinations, and the coastal parks near Esperance and the islands of the Recherche Archipelago are receiving increasing numbers of visitors.

Biodiversity also supports other enterprises either directly or indirectly. It should be noted that there are likely to be significant future applications for biodiversity in the medical and industrial fields

6.2.11 Threatening processes

Under the Environment Protection and Biodiversity Conservation Act 1999, there is a list of threatening processes which are seen as the major concerns for protection of biodiversity. Of these, the following contribute the largest risks to biodiversity in our region.

6.2.11.1 Habitat reduction

Land clearing, mainly between 1950 and the 1980s for the purpose of 'opening up' land for broad-acre agriculture, livestock and dairy farming is the primary reason many plant and animal species have become rare or threatened. The process of clearing land in many cases simply left too little vegetation for viable populations of native plants and animals. More recently, the expansion of urban areas and associated habitat clearing, fragmentation, hardening of surfaces, feral animal invasion, weed introduction and pollution combine to threaten biodiversity values.

6.2.11.2 Fragmentation

Even where some habitat remains in cleared areas, the fragmentation of vegetation communities has major ongoing effects. The viability of small populations is reduced by isolation. Gene flow between populations may be disrupted or, for sedentary species and poor dispersers, prevented. Some pollinators may be prevented from reaching the next patch of flowers and movements of seed dispersing agents may be curtailed. Edge effects may dominate small fragments, gradually eroding their biodiversity values by exposing the community to weed invasion and predation.

6.2.11.3 Plant diseases

Phytophthora cinnamomi is one of the most serious threats to the biodiversity of the region. It is a soil borne water mould that kills susceptible plants by destroying their root system. It is spread by the movement of soil – particularly by vehicles and machinery and is now widespread throughout the western districts of the South Coast region and in isolated patches in central and eastern districts. Many plant communities in the region



PHOTO: Birds Australia.

Habitat reduction threatens biodiversity values.

are dominated by families such as Proteaceae, Epacridaceae and Myrtaceae which are highly susceptible to *Phytophthora*. It results in species-rich communities being turned into ones dominated by a small number of resistant species. Managing access, ensuring appropriate hygiene and selective treatment of susceptible plants with phosphite are important strategies for preventing or reducing the spread of dieback.

Other plant diseases include rusts, *Armillaria*, and stem cankers, including the *Cryptodiaportha* canker that infects the Scarlet Banksia (*Banksia coccinea*) throughout its geographic range (Shearer, 1994). Tree decline is apparent in many parts of the region and appears to often be associated with insect attack following other stresses. These can include rising groundwater and/or salinity, but may also be associated with other soil and land conditions. It has been observed for example that in areas where wandoo and yate are in serious decline (associated with waterlogging and salinity), healthy wandoo occur where native rushes and sedges still occur within the understorey (Wendy Bradshaw, pers. comm.). The loss of native fauna, including birds and small ground dwelling mammals, is also associated with increased insect damage.

6.2.11.4 Invasive species

Vertebrate pests cause habitat loss (e.g. rabbits and pigs) and predation (e.g. cats and foxes) that threaten the survival of native fauna on public and private land (Natural Resource Management Ministerial Council, 2007a). Coordinated baiting programs (such as the Western Shield program which baits one million hectares in the region four times per year), are very important and are having significant benefits to agricultural production as well as biodiversity. Control of cats is an increasing focus, with experimental work being undertaken to increase the ability to undertake integrated fox and cat control in key conservation reserves (Comer et al., 2010). Diseases including fungal infections in animals such as frogs reduce populations, often with secondary impacts in wetland communities.

The State Weed Plan (Department of Agriculture, 2001) lists a number of actions to address weeds of national significance and those declared under the Agriculture and Related Resources Act (1976). Those occurring in the region include gorse, blackberry, bridal creeper, skeleton weed and three-cornered bed straw. Other environmental weeds that are a threat to biodiversity include Victorian tea-tree, Sydney golden wattle, other introduced *Acacia* species, African boxthorn, golden dodder and lantana which

are often well established along roadsides and in bushland. Other weed species are problematic at a district scale. Some sub-regions and local groups have developed weed plans as part of their catchment or other local planning strategies. Department of Environment and Conservation reserve management plans also include weed management activities.

Environmental weeds threaten natural diversity through their ability to invade natural areas (e.g. bush land, coastal dunes and waterways) often following disturbance, where they can alter the natural structure and composition of the area. Environmental weeds compete vigorously with native plants, often becoming the dominant vegetation system in an area. As a result the natural structure of the vegetation community can alter significantly (Natural Resource Management Ministerial Council, 2007b). The diversity of plant species is also reduced, with environmental weeds dominating and altering the ecology to make it unsuitable for native plant systems to exist, often to the extent that areas become a monoculture of weed species. These structural and compositional changes can lead to increased flammability. An integrated approach to environmental weed management was developed in the Environmental Weed Strategy for WA (Department of Conservation and Land Management,

Fauna are susceptible to threats including habitat reduction and invasive species.



PHOTO: South Coast NRM.

1999). As part of the strategy, environmental weeds are rated in terms of their impact on biodiversity. Many community groups are tackling weeds on reserves and roadsides. Targeted and integrated programs have seen significant reduction of some weed species in some areas.

6.2.11.5 Inappropriate fire regimes

Fire has been a part of South Coast ecosystems for a very long time and the flora and fauna have adapted to particular fire regimes for intensity, frequency and seasonality. Species adapted to longer cycles between fire events can be eliminated by frequent, high intensity fires. On the other hand, long periods without fire can lead to senescence, reduced regeneration and vulnerability to extreme fires. Large scale, intense fires present the greatest danger to native species in fragmented habitats. Weed species often proliferate after fire resulting in their establishment at the expense of native species.

An assessment of the fire sensitive species and communities of the South Coast region was recently completed (Barrett et al., 2009). This report provides a synthesis of the fire response of various taxa and communities, and recommendations for future research and monitoring to inform fire management. Generally a combination of prescribed burns and fire suppression are used to minimise the impacts of large, frequent or intense fires. Consideration of fire in management plans and cooperation between the community, fire brigades, Fire and Emergency Services and the Department of Environment and Conservation are essential.

6.2.11.6 Salinity and altered hydrological regimes

As a result of the broad scale removal of native vegetation many of the agricultural areas of the South Coast NRM Region face major impacts from salinisation. Rising water tables and associated surface or subsurface soil salinisation changes the distribution of species intolerant of salt and water logging and is a significant risk to ecosystems. Many of the remaining patches of native vegetation, particularly those lower in the catchment, are at risk from the impacts of salinity and water logging that may result in the loss of the plant community. Biological surveys carried out in the Wheatbelt are helping to assess the impact of salinity on biodiversity. Salinity is difficult to combat and requires a catchment or landscape approach including alternative farming practices (e.g. perennial pastures), revegetation and drainage control.

6.2.11.7 Climate change

The South Coast NRM Region has a marked rainfall gradient from west to east and south to north (Coffey Environments et al., 2009). Predicted climatic changes may see this gradient shift to the west and south with less rain inland. Annual average rainfall has declined some 20-30% in the southwest over the last couple of decades. Plants not well suited to a drier climate and relictual Gondwanan fauna on higher peaks in Stirling Range are likely to be particularly affected by changing climatic conditions. The impact of sea level change on estuarine and coastal biodiversity is likely to have a marked effect on vegetation and fauna associated with these ecosystems (Coffey Environments et al., 2009).

The Department of Environment and Conservation has identified that the following needs to occur to assist natural systems to adapt to the impacts of climate change (Department of Environment and Conservation, 2009b):

- protecting and establishing habitat corridors to allow plants and animals to migrate through the landscape as climate change alters environmental conditions and habitats
- protecting existing and identifying new refuges. Refuges are areas that provide natural sanctuaries for plants and animals. Refuges can protect small, geographically restricted or remnant populations. Populations that occur in past climatic refuges will also harbour increased genetic diversity that may allow adaptation to future climatic conditions. Identifying the characteristics of future refuges will be important as it will influence the design of the State's national parks and conservation reserves.
- building resilience to climate change by reducing the impact of threatening processes, particularly those that may be exacerbated by climate change. To improve ecosystem resilience, the Department of Environment and Conservation actively works to manage and reduce these pressures.
- safeguarding the most vulnerable species. Vulnerable species are species with long generation times, low mobility, high specific host relationships, small or isolated areas in which they can live and/or low genetic variation. Where climate change is likely to result in such species becoming locally extinct, seed collection and storage or protection in a garden or zoo will be required. Protection of species in this way is considered an essential component of a

comprehensive biodiversity conservation program, and will be an increasingly important option as climate change proceeds.

6.2.11.8 Altered ecological processes

The cumulative effects of post-European settlement impacts and broad acre farming practices have resulted in changes to biophysical environments, species composition, nutrient relationships, disturbance regimes, and ecosystem dynamics. Both terrestrial and aquatic ecological processes, gene flows and nutrient interactions have changed markedly and while systems have the ability to adapt to new levels and introduced states, there are ramifications and harmful effects at all levels (genetic, species and ecosystems) for native biodiversity values of the South Coast NRM Region.

6.2.11.9 Other threats

While one of the important values of the protected areas, and other areas of natural diversity, is the provision of suitable public recreation and education, public recreation can also present a threat to natural diversity and needs to be carefully managed (e.g. unauthorised tracks, spread of *Phytophthora cinnamomi*, spread of weeds, etc.).

Lack of knowledge and awareness of complex ecological systems and processes has led to damage of natural systems. Fortunately, there are increasing examples of actions being taken to improve awareness and knowledge across the region.

6.3 Achievements

The following provides a short summary of achievements for the Biodiversity theme (a more complete description of achievements has been compiled in a status report [South Coast NRM, 2011]):

- a biodiversity inventory program has been undertaken on the following studies: Regional Salinity Hazard Assessment on Priority Biodiversity Assets, Terrestrial Invertebrates on the South Coast Region, Vegetation of the Ravensthorpe Range and Albany Regional Vegetation Survey. These studies have created information databases and mapping for use by NRM practitioners.
- completion of the *Phytophthora Dieback Management Plan for the South Coast 2010 - 2017* (Steady State Consulting, unpublished) has resulted in the development of regional

priority areas (84 nominated to date) based on biodiversity values including the Walpole Wilderness, Fitzgerald River National Park and Cape Arid National Park. In addition, strategic dieback mapping has been undertaken across the entire region, a regional risk assessment has been undertaken and implementation is underway in 10 of the 84 priority areas. Maps 3 and 4 show dieback affected areas and regional priority areas for protection. Communication programs and a short documentary have raised public awareness.

- the South Coast Macro Corridor project (Wilkins et al., 2006) mapped existing vegetation to assess regional scale linkages between major areas of native vegetation and examined the potential to improve this network of corridors for dispersal, recolonisation and gene flow between populations
- the Malleefowl Preservation Group has played a vital role in the recovery of this threatened species through fox control, corridor establishment and surveying. Their work has spread to other parts of southern WA, where surveys for Malleefowl have also been carried out.
- establishment of the Gilberts Potoroo Action Group has provided an avenue for direct community support for the Gilberts Potoroo recovery program through fund raising, project assistance, providing information and raising public awareness
- implementation of the Western ground parrot recovery program is supported by an active Friends group
- the Gondwana Link partnership (including Bush Heritage Australia, The Fitzgerald Biosphere Group, Friends of the Fitzgerald River National Park, Greening Australia, Malleefowl Preservation Group, Green Skills, The Nature Conservancy and The Wilderness Society WA) is working towards the protection and restoration of ecological function through recreating linkage in the landscape, purchasing and/or covenanting areas of bush, rehabilitating degraded bush, restoring habitat in critical areas and increasing poorly represented vegetation associations. The project is also developing compatible economic enterprises and lifestyle opportunities and is currently facilitating these activities between the South West NRM region and the Western Woodlands of the Goldfields.
- the Gondwana Link partners have instigated innovative approaches to conservation through involvement of groups such as The Nature

Conservancy. Philanthropic funding, marketing and other business skills have broadened the approach to landscape conservation. The Gondwana Link project has contributed to the conservation of 11,772 ha of native vegetation on privately owned properties between the Fitzgerald River National Park and the Stirling Ranges National Park, the two centres of endemism in the South Coast region.

- Greening Australia (WA) formed a partnership with Shell to undertake a project called 'Reconnections' (2004 – 2009) which involved large-scale revegetation of native plants between the Stirling Range and Fitzgerald River National Parks. Revegetation of 975 hectares has been completed, with over 60% on private land.
- the Co-operative Research Centre for Greenhouse Accounting have investigated the carbon sequestration potential of revegetation in low rainfall areas using a diversity of native plants and indicated that rates of sequestration are likely to be higher than originally predicted (Jonson, 2010)
- with limited resources, the Department of Environment and Conservation is responsible for the management of 1,377,127 ha of land in the region for biodiversity and landscape conservation, including the management of threatened species and communities, fire management, fox control, scientific research and monitoring, visitor access, sustainable tourism and public education. The Department also contributes to weed and feral animal control and fire management on unallocated Crown land and unvested reserves.
- nine threatened species and communities recovery teams are implementing recovery plans for the South Coast. An additional four species that occur within the South Coast but have major populations outside of the region are also the subject of recovery plans.
- there are various schemes for covenanting or otherwise dedicating land for conservation purchases and management support available. In WA, Land for Wildlife, a program operated by the Department of Environment and Conservation, has over 2000 members to date, covering more than 700,000 ha. In the region, there are more than 150 registrations (5500 ha), most of which are on private property. There are also three registrations from school properties and thirteen registrations from properties owned by timber plantation companies. This has resulted in the



PHOTO: South Coast NRM.

Conservation is the primary focus at Land for Wildlife sites.

documentation of about 45,000 ha of land, of which approximately 5,500 ha of bush land were selected as Land for Wildlife sites where nature conservation is the primary focus. Advice has been provided to land managers on management issues like fire, weeds, habitat rehabilitation, wildlife corridors, salinity and dieback.

- the *Albany Hinterland Native Vegetation* projects have undertaken large scale revegetation or protection projects to enhance the Fitzgerald to Magenta Bush Corridor and 600 ha of revegetation undertaken on the Yarrabee property east of the Stirling Range (owned by Greening Australia). Southern Incentives has encouraged the protection or revegetation of native vegetation through incentives for fencing, replanting and other protective actions. This combined with works in the Warden, Young River, West River, Bremer River, Middle Pallinup, Oyster Harbour and Upper Hay has resulted 750 km of fencing to protect remnant vegetation and 1500 ha of revegetation. Innovation in revegetation tools and techniques now mean that large areas of revegetation are feasible, due to the efforts of local champions.
- revegetation of native species on 2,832 ha of private land, erection of 1,430 km of fencing to protect native vegetation. Production of guidelines by Greening Australia for maximising biodiversity benefits of revegetation. Production of a pocket guide for revegetation in the Bremer River catchment to show suitable native species by soil type.
- research and development in the cultivation of native plant based commercial enterprises that have a biodiversity outcome, such as sandalwood, broom-bush, mallet poles and native tubers, is increasing. Greening Australia (WA) and CENRM have been involved in research with involvement of Aboriginal organisations. Commercial success

of these industries will encourage replanting with benefits for conservation and rehabilitation of degraded land.

- control programs for 20 weed species (e.g. Sydney golden wattle, Victorian tea tree and weeds of national significance such as blackberry, gorse and boneseed) and four vertebrate pests (pigs, foxes, wild dogs and starlings) are being implemented across the region in partnership with community groups
- the Carnaby's Black Cockatoo Recovery Plan is being implemented by Birds Australia and other partners to carry out identification and monitoring of breeding sites, protection and management of breeding and foraging habitat through fencing, weed control and revegetation. The project has also promoted conservation through presentations at community events, school visits and community surveys. Other on-ground works include working with land managers to repair hollows and install breeding boxes.
- use of Vegmachine (a software package that uses LandSat Satellite imagery to determine changes in vegetation cover) to create baseline data for the evaluation of changes in biodiversity
- employment of three biodiversity implementation officers and eight NRM and project officers across the region
- increased awareness and education through a project called 'Cultural Corridors' which was undertaken by Greening Australia, Gondwana Link and South Coast NRM to increase and promote awareness of biodiversity values and threats targeting schools, rural land managers and urban residents. Also, distribution of the biannual newsletter 'Biodiversity NRM News' with a focus on farmland. Production of a 'Best Practice Management Toolkit' to outline techniques to reverse environmental degradation such as groundwater rise and loss of native vegetation. Hosting of various workshops focusing on bushland management and healthy landscapes across the region.

6.4 Current community capacity

Understanding and awareness of biodiversity values and management has been increased over the last five years, but is still inconsistent across the region. Management for conservation is often not well linked with other land management practices. Projects that engage, inform and result in positive behaviour

changes are important to increase the appreciation and protection of biodiversity values outside the conservation estate.

While the management of biodiversity in the conservation estate throughout the region is largely provided by the Department of Environment and Conservation, its limited resources reduce its ability to extend support to other land managers. Staff are located at a regional office in Albany, district offices in Esperance, Katanning and Walpole, and a network of outstations including several national park rangers across the region. However, increasingly, the community relies on other groups such as NRM officers for technical knowledge and support.

Local Government Authorities generally have limited capacity to manage their community's reserves and roadsides for biodiversity. The City of Albany and shires of Esperance and Denmark employ officers to assist in NRM planning and activities. Several local governments contribute to the employment and resourcing of NRM officers who manage biodiversity projects. There are large areas of Unallocated Crown Land, particularly in the northeast of the region. Some specific management responsibilities for nature conservation aspects of unallocated crown land (fire and invasive species) have been devolved to the Department of Environment and Conservation but there is very limited capacity to do this effectively due to poor resourcing.

There is on-ground support for management for biodiversity through two part-time Land for Wildlife Officers employed by the Department of Environment and Conservation (based in Albany and Esperance). Rangers and other Department based officers have an extension role but demand for service exceeds capacity as their primary focus is management of the conservation estate.

Volunteers play an essential role in the delivery of biodiversity protection, particularly for the support of Recovery projects for threatened species. This assistance is highly valued and appreciated. Volunteers benefit too, by getting the experience of working with experts in the field and are given the opportunity to visit areas where people rarely go.

A number of 'Friends' groups operate within the region, either on land within the reserves system (e.g. Friends of the Fitzgerald River National Park) or supporting recovery programs and teams for threatened species. The Friends of the Fitzgerald River National Park have previously supported facilities such as the Twertup Field Studies Centre

– a resource which was damaged by fire in 2008 and is yet to be reopened to the public. A Bushcare Group is active in the City of Albany and promotes restoration of natural ecosystems through control and management of weeds on public and private land.

There is a growing interest in private investment in land for conservation through purchase and management by private, national and international organisations. Some interest is expressed by people who have a special interest in conservation outcomes, while others need to offset for development in other parts of the State. This is sometimes achieved through subdividing properties so that the purchaser can acquire those parts of the original property that can be managed for conservation of biodiversity. The vendor benefits by receiving payment for the land and the biodiversity values are better managed (Western Australian Planning Commission, 2001, 2004).

Aboriginal people have a strong interest in increasing their involvement in management for biodiversity, through land traineeships, on-ground enterprises, sharing of traditional ecological knowledge and project work. Joint management of the Department of Environment and Conservation managed estate will provide Aboriginal people with a real opportunity to assist in managing and protecting biodiversity (Department of Conservation and Land Management, 2003).

6.5 Gaps

The following gaps have been identified:

- while base line information and understanding of ecological functions and processes has increased significantly in the last five years, some systems are still poorly understood, particularly in the east of the region. The development of systematic vegetation mapping at scales suitable for strategic planning and management is seen as a priority (especially for areas facing development pressures such as Bremer Bay, Hopetoun, Ravensthorpe Range, Recherché Islands and Great Western Woodlands). Priorities include increasing knowledge of fire sensitive communities and species, predator – prey relationships, impacts of plant diseases on habitat functionality, climate change impacts on threatened taxa and baseline information on short range endemic species.
- there is a lack of consideration of regional scale – cross tenure planning for management of biodiversity. This is especially the case for unallocated or unmanaged crown land.
- property purchases for conservation, such as those through the Gondwana Link partnership, and others such as the Twin Creeks Reserve (Friends of the Porongurups) have highlighted the disincentives to private purchase. These include difficulties in getting subdivision approvals, the costs associated with subdivision, and the taxation system not differentiating a ‘public good’ purpose from a commercial business. Schemes such as the Bush Bank Revolving Fund (National Trust) can assist potential purchasers, but are relatively limited. The harnessing of private funds for conservation purchases have not yet been realised due to factors such as the global financial crisis.
- while purchase or securing of private property is recognised as a means to achieve conservation goals outside of the conservation reserve system, gaps relating to off-reserve conservation of habitat needs to be addressed by including development of revegetation programs for key catchments (similar to what has been developed for the Bremer River catchment)
- to effectively conserve the biodiversity of the region, a conservation reserve system needs to be a comprehensive, adequate and representative, similar to previously outlined by the Department of Environment and Heritage (now the Department of Sustainability, Environment, Water, Population and Communities). This requires the establishment and maintenance of a network of reserves that includes representatives of all the ecosystems of the region in areas of sufficient size and diversity to ensure their viability. A review of the South Coast region Conservation Reserve System needs to be undertaken to ensure that there is an adequate and representative system that will ensure the persistence of species and ecosystems, especially in view of the threats faced by threatening processes such as climate change. The possible impacts of Native Title determinations on the ability to secure land for conservation needs to be considered.
- research on the effectiveness of previous strategies (e.g. fencing for restoration) needs to be undertaken
- landholders and land managers need to be engaged to raise awareness about the importance of the management of biodiversity values.



PHOTO: Yengernow.

The malleefowl is a threatened species on the South Coast.

6.6 Program logic summary – Biodiversity

ASPIRATIONS (25+ YEARS)

Natural ecosystems, habitats and landscapes are valued, resilient, effectively linked and managed to provide increased viability for native species and communities.

- Effective protection and management regimes for ecosystems
- Protected and recovered significant taxa, species and ecological communities, including those currently threatened
- Minimised impacts of threats on native ecosystems
- Maintained or improved extent, quality and connectivity of native vegetation and ecological communities
- Protected significant landscapes
- Maintained or improved recreational, cultural, commercial and social amenity values of public lands
- Expanded, linked and created buffer zones, and re-established native vegetation
- Increased awareness and understanding of values (including social, cultural and economic) of biodiversity, eco-systems and their functions, impacts of threats degrading processes and possible management responses
- Improved ability and willingness of local governments to participate in NRM, including through use of statutory planning mechanisms
- Regional monitoring systems assessing trends in condition, impacts of threats and effectiveness of management actions, with monitored outcomes readily available to wider community and influencing management actions
- Comprehensive information base on natural ecosystems, habitats and landscapes
- Improved understanding of potential impacts of climate change on biodiversity and appropriate management responses.

GOALS (10+ Years)

Goal B1. Biodiversity values Maintain and/or improve biodiversity values across the landscape for identified priority areas by 2030 using quantifiable targets.

Goal B2. South coast significant species and communities Maintain and/or improve extent and condition of threatened and other significant species, communities and habitats by 2030 using quantifiable targets.

OUTCOMES (1-5 Years)

MEASURES AND MONITORING

Outcome B1. Strong information base Collect and map baseline data for identified gaps in knowledge and collate and improve accessibility and communication of existing data/information by 2012.

Outcome B2. Evaluate priorities Set priority activities based on an evaluation of the existing prioritization processes by 2011 (to be informed by review of existing data, community passion and knowledge and prior investments)

Outcome B3. Set benchmarks and measures Identify reference condition sites for biodiversity values to guide the implementation and monitoring of revegetation and restoration of priorities sites (B1) by 2012

Outcome B4. Monitor asset condition Maintain, support and/or expand a biodiversity monitoring program at priority areas to inform management, using appropriate protocols and indicators by 2015.

ON GROUND ACTIONS

Outcome B5. Support recovery plan implementation Protect threatened and significant species, communities and habitats by the implementation of 80% of recovery plans by 2015.

Outcome B6. Effective on-ground works Implement the restoration of 5000 ha of cleared land in priority areas identified in Outcome B3, by 2015. (restoration as defined by the Society for Ecological Restoration).

Outcome B7. Protect private biodiversity resources Increase area of privately owned native vegetation valued and managed for conservation by 5000 ha by 2015 (by initiatives such as establishment of conservation covenants, voluntary management agreements, Land for Wildlife and Indigenous Protected Areas).

Outcome B8. Improve management practices Improve management practices for priority areas identified in Outcome B2 (including Unvested Crown Land) through the preparation of grouped, area or theme management plans/agreements commenced or implemented by 2013.

Outcome B9. Management of invasive species Manage the impacts of priority invasive species and diseases through information sharing, training and on-ground works by 2015.

Outcome B10. Prevention and eradication of emerging invasive species Prevent the occurrence and spread of emerging invasive species through training, early identification, control and eradication by 2015.

Outcome B11. Improve dieback management Protect priority areas by implementing identified subprogram projects in the delivery framework of the Phytophthora Dieback Management Plan for the South Coast 2010-2017.

OUTCOMES (1-5 Years) (continued)

CAPACITY BUILDING

Outcome B12. Support appropriate fire management Facilitate appropriate fire management for biodiversity conservation by progressing the recommendations from the Identification and Conservation of Fire Sensitive Ecosystems and Species of the South Coast Natural Resource Management Region document by 2015.

Outcome B13. Education Increase ownership, knowledge and awareness of biodiversity values, threats, and engagement opportunities by 2015.

Outcome B14. Improve awareness and recognition Raise the profile of the value of and threats to biodiversity assets across the region in relation to local, State, national and international policy and frameworks by 2012.

PLANNING AND POLICY FRAMEWORKS

Outcome B15. Climate change adaptation and mitigation Identify biodiversity assets most at risk from the effects of climate change and associated threats and develop adaptation strategies and actions for these assets by 2015.

Outcomes B16. Community input Ensure that community input including traditional ecological knowledge is incorporated into planning for biodiversity outcomes in all plans and programs across the region by 2012.

Verticordia



PHOTO: South Coast NRM



PHOTO: Eileen Rodgers.

Tall kangaroo paw (*Anigozanthos flavidus*).

6.7 Measures and indicators

Use of the following indicators and measures (Table 9) as a guide will assist in setting targets for projects and programs and allow for standard

approaches to measurement. Indicators should be selected according to the principles of cost, simplicity, consistency, practicality and capacity to deliver information across the region.

Table 9: Measures and indicators – Biodiversity

ASSET	INDICATOR HEADING	RECOMMENDED INDICATORS
Specific native species and ecological communities	<ul style="list-style-type: none"> Selected significant native species and ecological communities extent and distribution 	<ul style="list-style-type: none"> Invertebrates in aquatic systems Abundance and distribution of key flora and fauna species Abundance and distribution of threatened or significant species Ecological community indicators (such as health of Banksia and heath communities) at a site-specific level.
	<ul style="list-style-type: none"> Selected ecologically significant invasive species extent and impact 	<ul style="list-style-type: none"> Distribution and abundance of significant invasive species Impacts of significant invasive species.
Native vegetation	<ul style="list-style-type: none"> Native vegetation extent and distribution 	<ul style="list-style-type: none"> The extent of each priority native vegetation type by IBRA subregion measured in hectares The extent of each present native vegetation type by IBRA subregion measured in hectares The proportion remaining of each native vegetation type by IBRA subregion measured as a percentage of the pre-European extent.
	<ul style="list-style-type: none"> Native vegetation condition 	<ul style="list-style-type: none"> The proportion of each native vegetation type in each IBRA subregion that is estimated to be in specified condition classes based on a selected set of attributes.

(Based on Department of Environment, Water, Heritage and the Arts, 2007)

Acacia leioderma.



PHOTO: Eileen Rodgers



PHOTO: Department of Environment and Conservation.

South Coast NRM has worked with the Department of Environment and Conservation to protect the Woylie.

6.8 Trade-offs

Achieving a balance between conservation and the sustainable use of natural resources is the greatest challenge for all communities and has been the subject of many reports, studies and debate. The economic benefits of commercial enterprises are more readily demonstrated than the less obvious benefits arising from conservation of ecosystems. The 'sense of place' that the native plants, animals, communities and landscapes of the region provide is part of an important legacy that can be handed on to future generations. So too is the clean water, productive soils and fresh air that are supported by healthy ecosystems.

Some of the trade-offs that need to be considered within the suite of potential target outcomes include the investment in consolidating and building on base-line information versus investment in on-ground actions (e.g. fencing, planting, eradicating pest species). Both types of actions are needed in the right balance so that future effectiveness is improved but valuable assets are maintained. In addition, there are decisions to be made relating to the balance of protection of specific threatened species and communities versus the protection of biodiversity at the broader landscape scale.

Similarly, whilst investment in highly strategic, high value assets is important, focusing too much on a few areas could result in loss of momentum, skills and experience in other parts of the region and could also exacerbate threatening processes.

Public and private land actions are also potential trade-off areas. The dedicated conservation estate is generally considered to be the most secure conservation option, but reservation is clearly not the only means to ensure species and communities are maintained. The management of isolated remnant vegetation on private property is offering real opportunities (e.g. to protect vegetation communities that are susceptible to disease). The public costs of maintaining the reserve system also need to be considered and supplementary measures on other reserved and private land supported where possible. Investing in compatible land uses that may deliver both biodiversity and commercial outcomes such as native plant based industries offers a win-win situation.

Possible trade-offs between areas, types of actions and outcomes will need to be explored further during development of the Investment Plan.