

# South Coast Biodiversity

## An Overview of Biodiversity Values, Threats and Conservation in the South Coast Region

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## 1. Scope of the Paper

This paper attempts to summarise current knowledge of biodiversity and approaches to biodiversity conservation in the SCRIPT NRM South Coast Region (Figure 1), which for the purposes of this paper will be referred to as the South Coast Region. Ongoing biodiversity inventory and research is continually improving understanding and identification of species richness and ecological function in the region. The Department of Conservation and Land Management (CALM) is primarily responsible for terrestrial biodiversity conservation in the region, and approx 1.4 million hectares of public land in the South Coast Region is managed by CALM primarily for this purpose.

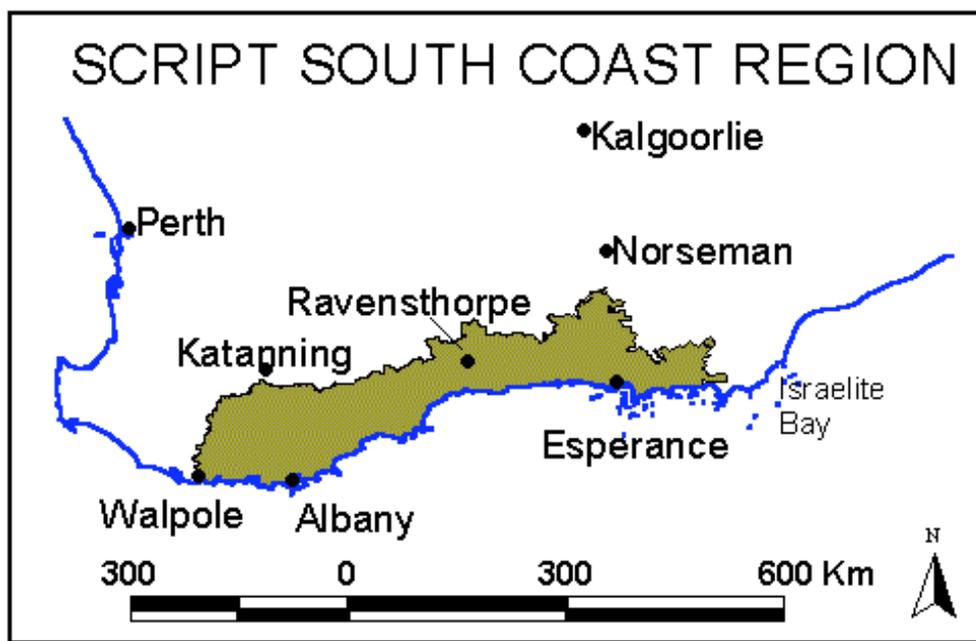


Figure 1: The SCRIPT South Coast Region

The analysis conducted for this paper draws from information for the South West Botanical Province and South Coast Region collated by research staff of CALM, Albany, staff of other organisations such as Edith Cowan University and Greening Australia, the community and from the 2003 CALM Biodiversity Audit.

## 2. What is Biodiversity?

Biological diversity, or biodiversity, is the variety of life – all of the living things in our world, and the processes and interactions that sustain them. Biodiversity can be quantified at a number of levels - genes, species, populations, communities and ecosystems. Species are the most basic and recognisable units for analysing and understanding biodiversity. Higher order (phyletic) and ecosystem diversity are also important but these too are ultimately based on species.

The world is in the middle of a major plant and animal extinction event arguably the most severe since the dinosaurs disappeared 65 million years ago. The major difference is that the extinctions that have occurred in the past 2 to 3 centuries have been largely human induced, and have taken place over a very short period of time in evolutionary terms. In Western Australia, 25 plant species have become extinct since European settlement (Brown et al 1998), and regionally 12 mammals and two bird subspecies are now presumed extinct.

Recent rapid global extinctions have been caused by clearing of native vegetation for timber, minerals, farming and housing; the introduction of competitive pests and diseases; overexploitation of plant and animal stocks for food and the effects of climate change.

The impending extinction crisis and the loss of our planet's biodiversity is the most far-reaching environmental crisis we face. Biodiversity is impossible to replace. Understanding the underlying bio-geographical processes that sustain local and global biodiversity values is receiving increasing national and international attention. Norman Myers (1988, 1990) introduced the concept of global priority setting defining global 'hotspots' on the basis of species diversity and endemism in impacted landscapes.

Scientists have identified 25 places in the world which are of very high biodiversity importance because of a combination of their high species diversity, their high numbers of endemic plants, and the high levels of threat to their biodiversity (Myers 2000, Mittermeier et al 1999). Known as biodiversity ‘hotspots’, they are recognised as places of international significance. These areas cover only 1.4% of the Earth’s land surface but contain an estimated 60% of its biodiversity. Such areas are considered to be priorities for biodiversity conservation.

## 2.1 Biodiversity in the South Coast Region in a Global Context

The South West Botanical Province of Western Australia has been identified as one of these 25 ‘hotspots’. This area is defined by a line from Shark Bay to Israelite Bay following the 350mm rainfall isohyet. Protection and management of the biodiversity of this area is of global importance. The South Coast Region occupies the south eastern part of the South West Botanical Province and contributes significantly to the biodiversity values of the province.

## 2.2 Biodiversity Values

The larger organisms on Earth (including humans) owe their existence to biodiversity. Biodiversity is essential for human survival. As an example, just three plant species – wheat, rice and maize – provide the world’s people with half its nutrient intake. On the south coast we farm biodiversity in a number of ways to provide food, clothing, shelter and wealth. We also use the region’s remarkable biodiversity for its aesthetic, recreational and spiritual value. Biodiversity not only gives us enjoyment, it also brings us money in the form of tourists who come from other parts to enjoy the south coast too.

We know much less about the ecological processes of interaction and survival that underpin our natural environment than we do about many of the individual species that are part of it. There are many natural processes that we take for granted, such as the way plants absorb carbon dioxide and produce oxygen, the hydrological cycles that give us water, pollination processes that provide us with fruit and grains for food.

Native plant communities rely heavily on pollinator species like Honey Possums, various honey-eaters and invertebrates such as beetles, ants and wasps. Fungi also provide key ecological processes - both as a source of food for native animals such as Woylie, Gilbert’s Potoroo, Bush Rat and Quokka – as well as through their mycorrhizal associations which make soil nutrients accessible to plants and which are vital to plant health.

There are many fauna species that play an important role in maintaining the health of our ecosystems. Both vertebrates and invertebrates maintain soil condition and nutrient cycling through their digging, nest building, foraging and defecating. Research has shown that burrowing animals like Woylies and Quenda (Bandicoot) help soil conditioning through aeration, nutrient distribution and soil moisture penetration associated with their digging and soil turnover. Native animal pollinators are essential for the persistence of native flora diversity.

Native vegetation provides important ecological functions such as maintaining surface and underground hydrologic cycles, shelter and habitat for fauna and flora, nutrient cycling and as a ‘bank’ of seeds, plants and animals for recolonisation of rehabilitation areas.

The great variety of organisms that make up our biodiversity and its ability to continue evolving provides us with huge safety net for our continued survival and well being on the south coast. The more diverse our ecosystems, the more robust they are to sudden change, the more able they are to continue to provide us with services such as pest control and new plant species for food and medicine. Looking after the South Coast biodiversity is in our own best interest, environmentally, socially and economically, and some commercial enterprises are beginning to consider biodiversity outcomes and the use of native species for cropping, whole farm planning and even carbon credits.

# 3 Biogeographic Systems of the South Coast Region

## 3.1 IBRA Regions

The national ecosystem-based classification system referred to as IBRA (Interim Biogeographic Regionalisation of Australia) has divided Australia into 85 biogeographic areas on the basis of regional patterns of landform and vegetation (Thackaway and Cresswell 1995). These have more recently been sub-divided into sub-regions and Western Australia has 53 such sub-regions. The IBRA system is a useful way of describing the different environments that make up the Australian land mass and provides a common language for describing ecosystems across the continent. A similar system has been developed for the marine environment (IMCRA).

The South Coast Region contains two complete IBRA sub-regions, and parts of a further 5. The 2 complete IBRA regions are:

- **Fitzgerald (ESP1)** is the western section of the Esperance Sandplain and includes the Ravensthorpe Range, Fitzgerald River NP 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. 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 (ESP2)** 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 limestones. Quaternary coastal sandplains and dunes. Numerous granitic islands. 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, and 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. 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 (JF2) sub-region and the Warren (WAR) 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 causes poor drainage and large (eg 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 Paperbarks 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 very small part of the eastern part of the Avon Wheatbelt (AW 2) around Tambellup is included in the South Coast Region.

- **Eastern Wheatbelt (AW 2)** An ancient peneplain with low relief. There is no connected drainage; 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.

In all seven bioregions - half of the 14 that make up the Southwest Botanical Province - are represented within the South Coast Region reflecting the corresponding diversity of vegetation and landform. Areas at or near the junction of several biogeographic sub-regions would be expected to hold a greater diversity of plants. This is the case in South Coast areas such as Stirling Range and Ravensthorpe Range.

### 3.2 Eco-zones

A system of "eco-zones" has been developed for the Region in an attempt to subdivide the IBRA sub-regions. Nathan McQuoid has distinguished 13 eco-zones based on similarities in physical and biological patterns of geology, climatic history, drainage patterns, major soil systems and existing native vegetation types has been proposed for the South Coast Region (see Background Paper 9). Further research and improved understanding of vegetation systems and eco-zone biogeography of the region will assist future landscape-based conservation and biodiversity planning and management.

### 3.3 Vegetation Systems

Around 120 vegetation associations as described and mapped by John Beard (Hopkins et al 2001) are represented in the South Coast Region. These distinct vegetation types include forests in the higher rainfall western part of the Region, woodlands, mallee, mallee-heath and shrublands. They range in size from small areas such as the Karri

*Eucalyptus diversicolor* and Red Tingle *E. jacksonii* Tall Forest which occupies 54.2 ha in total to the very extensive Tallerack *E. tetragona* Mallee Heath covering over 1 million hectares of the Region. These vegetation associations are not necessarily equivalent to communities but in the absence of more detailed knowledge may be taken as surrogates for ecological communities. They are a fundamental component of the South Coast's biodiversity and more accurate mapping and description of South Coast vegetation is necessary in order to conserve them (See also Section 4.4). For part of the South Coast Region vegetation communities have been mapped at a more satisfactory scale by Ken Newby. These maps have recently been digitised (Mercer, 2003).

#### 4: Flora and Fauna in the South Coast Region

Plants and animals are generally the most easily recognised components of natural biodiversity and at least the vertebrate groups and higher plants are usually well known. The numbers of these organisms present in a region provide a means of “measuring” biodiversity and comparing one region with another (see section 2.1 and 2.2). In this regard, species (or subspecies) endemic to a region are particularly significant. Since they are found nowhere else they are the best examples of the special biodiversity values of the region and its contribution to global biodiversity. It follows that the conservation of these endemic species is particularly important aspect of biodiversity conservation.

##### 4.1 Flora

The Southwest of Western Australia is home to one of the richest floras in the world. South and west of a line between Shark Bay and Israelite Bay there are over 7000 species of flowering plants (Hopper 1996). This is comparable with the Cape Floristic Province in South Africa and is considerably higher than other Mediterranean climate areas of similar size such as central Chile and California. It is primarily this rich flora which makes the southwest of Western Australia an area of international biodiversity significance. In addition, more than 80% of these species grow nowhere else; in other words they are endemic to the southwest. There are also many endemic plant genera and many other genera that have centres of diversity in the Southwest Botanical Province. However, there is only one endemic plant family in this province.

The South Coast Region encompasses the southern and eastern part of the Southwest Botanical Province where the diversity of landform and soil types (particularly the low nutrient nature of most of the soils) and long history of isolation have produced a very diverse flora. The range of rainfall from 1400mm per year in the west to 300mm per year in the east has also contributed to this diversity. The South Coast Region contains 4687 known flora taxa (ie species and subspecies). This is over 60% of the flora of the Southwest Botanical Province. Around 400 known plant species are endemic or found only in the South Coast Region. While they represent only 8.5% of the Region's flora, as endemic species these plants make an important contribution to the biodiversity of the Southwest Botanical Province.

##### 4.2 Centres of Plant Species Diversity and Endemism

The South Coast Region contains two of the Southwest Province's four recognised Centres of Plant Endemism (Goia and Hopper in prep 2003). The **Ravensthorpe Range-Fitzgerald River National Park** area and the **Stirling Range** both show up as areas with much higher numbers of endemic plants compared to surrounding areas. The FRNP contains 75 endemics (FRNP Management Plan, CALM 1992) and the Stirling Range NP has 82 endemic plants (SRNP and PNP Management Plan, CALM 1999). These areas therefore make very significant contributions to the South Coast Region's biodiversity values highlighting the importance of ensuring they are protected and managed for their biodiversity values.

Mapping of plant species diversity by Goia and Hopper (in prep 2003) also shows several areas within the South Coast Region with relatively high numbers of plant species. These lie in the **Walpole, Frankland, Stirlings West, Manypeaks and Stirlings East** areas. Another area of richness occurs in the **Bremer Bay to Ravensthorpe** area. The mapping of plant endemism and species richness has been based on specimens lodged in the Western Australian Herbarium. Additional field collecting and taxonomic studies may alter the current picture.

The South Coast Region contains many plant taxa with very small distributions, often restricted to particular rock or soil types in the many geological systems across the region. The flora also has several aggregations of closely related species and many examples of hybridisation and intergradation pulling the concept of diversity beyond the species level.

##### 4.3 Important Plant Families and Genera in the South Coast

The plants of the South Coast Region belong to 756 genera in 146 families. The major families present include Myrtaceae (*Eucalyptus*, *Melaleuca*), Proteaceae (*Hakea*, *Grevillea*, *Banksia*), Papilionaceae, Epacridaceae (*Leucopogon*), Mimosaceae, Orchidaceae.

- Myrtaceae:

The diversity of Eucalypts in the Southwest is greater than anywhere else – well over 200 species occur here, the majority being endemic (Brooker and Kleinig, 2001). A number of Eucalypts provide structural dominants in the forests of the higher rainfall areas of the Region: *Eucalyptus marginata* (jarrah), *E. calophylla* (marri), *E. diversicolor* (karri). Eucalypts such as *E. wandoo* (wandoo), *E. loxophleba* (York Gum), (*E. occidentalis*) yate, (*E. cornuta*) yandil and (*E. salmonophloia*) salmon gum provide the major structural components of woodlands across the region. The mallett and mallee formations in the region are also dominated by Eucalypts such as *E. astringens* subsp. *redacta*, *E. clivicola*, *E. densa* subsp. *densa*, *E. dielsii*, *E. pleurocarpa*, *E. falcata*, *E. lehmannii*, *E. uncinata*, *E. buprestium*, etc. Significant hybridisation and intergradation occurs within this genus. In the Ravensthorpe area there are 81 known Eucalypts and in the Fitzgerald Biosphere 132 species, subspecies and hybrids, (N McQuoid in prep). These areas are considered to be a centre of diversity for the genus.

Other Myrtaceae genera include *Agonis*, *Chamelaucium*, *Calothamnus* and *Melaleuca*. A number of spectacular *Darwinia* species are confined to upland areas within the Stirling Range – these are the nine species of Mountain Bells. Many species of *Verticordia* occur in the Region and provide brilliant colour displays attracting beetles (including jewel beetles), flies, bees and wasps. Successive flowering of many Eucalypts provides an important food source (nectar, pollen) for a large number of animals including pygmy possum, honey possum, honeyeaters, beetles (weevils, longicorn beetles, jewel beetles), flies (hover flies, Tabanids), bees, wasps (flower wasps) and ants.

- Proteaceae:

This southern-hemisphere family originated before the break up of the Gondwanan supercontinent and has representatives in South Africa, New Zealand and South America. Interestingly, the two richest areas for Proteaceae (Africa and Australia) have no genera in common reflecting a long period of separation. In southern Western Australia there are about 550 species in Proteaceae – 90% (500) of these being endemic to the area.

Proteaceous genera well represented in the South Coast Region include *Dryandra*, *Synaphea*, *Adenanthos*, *Banksia*, *Hakea*, *Isopogon* and *Grevillea*. Species within these genera are major components of the extensive mallee-heath and Banksia heath associations of the Esperance Sandplains bioregion. The region is particularly rich in Banksia species with 40 of the total 76 in this genus being found within 200km of Albany. Three Banksias (*B. aculeata*, *B. gardneri* subsp. *brevidentata*, and *B. solandrii*) are endemic to the Stirling Range NP.

- Orchidaceae:

The southwest region is very rich in terrestrial orchids but has no epiphytic orchids. Many orchid genera have the majority of their species in the southwest eg among *Caladenia* - the Spider Orchids there are 140 species in the Southwest out of a total of 180 (Hoffman and Brown 1998). The Stirling Range contains a total of 123 species of orchid (Thompson et al 1993) - this is 38% of WA's orchid taxa.

- Epacridaceae:

180 species in the southwest. 84% of the family is endemic to the Southwest. This is a relatively poorly known family.

- Cephalotaceae:

This is a monotypic family and the only member is the Albany Pitcher Plant *Cephalotus follicularis* that occurs in swampy areas from Augusta to east of Albany.

#### 4.4 Conservation Status of Vegetation Systems

The conservation status of Beard vegetation systems has been quantified for the CALM South Coast region (see CALM Biodiversity Audit 2003). Nine vegetation systems in the region have been identified as having less than 10% of their original (pre-European) extent remaining, and 20 others have less than 30% remaining. The remaining areas of these vegetation communities are conservation priorities.

Because of its broad scale approach, the Beard classification system, however, may be of limited value for determining conservation priorities. Further vegetation mapping is crucial to confirm the relevance of Beard's vegetation assessment and provide a strategic direction for conservation priorities in the South Coast Region.

## 4.5 Vertebrate Fauna

Vertebrate animals – mammals, birds, reptiles, frogs and fish – are what most people think of as “animals”. However, they are only the more conspicuous members of the very large animal kingdom. As a consequence of their large size and familiarity they have been popular subjects for study and our knowledge of their biology, ecological relationships and distribution is more advanced than for the invertebrate groups.

About 414 species of native vertebrate animals may be found within the South Coast Region distributed across the various habitats according to rainfall, vegetation and landform. The Region’s fauna includes representatives adapted to wetter forests, woodlands, moist coastal communities and semi-arid areas.

In Mediterranean ecosystems such as those of the South Coast Region, faunal endemism is generally low. A total of 11 vertebrate fauna taxa are endemic to the South Coast Region.

- Mammals:

The South Coast Region hosts about 42 species of native mammals including one Monotreme, 24 Marsupials, nine bats and six native rodents. All the mammals endemic to the Southwest Botanical Province (Dibbler *Parantechinus apicalis*, Grey-bellied Dunnart *Sminthopsis griseoventer*, Quokka *Setonix brachyurus*, Honey Possum *Tarsipes rostratus*, Western Ringtail Possum *Pseudochierus occidentalis*, Western Brush Wallaby *Macropus irma* and Gilbert’s Potoroo *Potorous gilbertii*) and 89.4% of all the Province’s native mammals occur in the region. The region is also home to a number of Southwest endemic sub-species – Mardo Antechinus *flavipes leucogaster*, Quenda *Isoodon obesulus fusciventer*, Recherche Rock Wallaby *Petrogale lateralis hacketii* and Bush Rat *Rattus fuscipes*.

Gilbert’s Potoroo – at one time thought to be extinct – occurs only as a small, Critically Endangered population in Two Peoples Bay Nature Reserve and is the only native mammal species endemic to the South Coast Region. The Recherche Rock Wallaby – subspecies of the more widespread Black-flanked Rock Wallaby is endemic to the region.

- Birds:

According to Pizzey’s Field Guide to the Birds of Australia (1997) about 270 bird species can be found in the South Coast Region and the adjacent sea.

South Coast islands provide important breeding areas for Recherche Cape Barren Geese *Cereopsis novaehollandiae grisea*, Little Penguin *Eudyptula minor*, Great-wing Petrel *Pterodroma megaptera*, Little Shearwater *Puffinus assimilis* and Flesh-footed Shearwater *P. carneipes*. About twenty six species of migratory wader utilise wetlands and coastal areas along the South Coast during summer before returning to the northern Hemisphere to breed.

The Recherche Cape Barren Goose, Western Ground Parrot *Pezoporus wallicus flaviventris*, Noisy Scrub-bird *Atrichornis clamosus*, Western Bristlebird *Dasyornis longirostris* and Western Whipbird (heath subspecies) *Psophodes nigrogularis nigrogularis* are endemic to the South Coast Region.

- Frogs:

The frog fauna of the South Coast Region totals 22 species. This is 63% of the frogs of the Southwest Botanical Province. Only three of these are tree frogs (Hylidae) and the rest belong to the ground dwelling and burrowing frog family Myobatrachidae. Burrowing species are more common in the semi-arid areas in the eastern part of the Region (eg *Neobatrachus albipes*).

The Sunset Frog *Spicospina flammocaerulea* (discovered as recently as 1996) and the Nornalup Frog *Geocrinia lutea*, have very small ranges in the higher rainfall parts of the Region and are both endemic to the South Coast Region. The Spotted-thigh Frog *Littorea cycloryncha* and the South Coast Froglet *Crinea subinsignifera* are almost endemic to the region.

- Reptiles:

The South Coast Region contains a terrestrial reptile fauna of the about 70 species consisting of one turtle, seven geckoes, seven legless lizards, eight dragons, two varanids, 27 skinks, three blind snakes, one python and 13 elapid snakes. The Oblong Turtle *Chelodonia oblonga* is a familiar animal in most of the region’s waterways east to FRNP. The Carpet Python *Morelia spilota imbricata* is reasonably common in some coastal habitats.

Only two reptiles are endemic to the South Coast Region. The fossorial skink *Lerista viduata* occurs in the Ravensthorpe Range and the Recherche Dugite *Pseudonaja affinis tanneri* is found on Boxer and Figure of Eight Islands in the Recherche Archipelago.

- Freshwater Fish:

Only ten freshwater fish species are native to the Southwest of Western Australia (Morgan et al 1998) but all occur within the South Coast Region. The streams of the higher rainfall areas have the greatest fish diversity.

This region is the only part of Western Australia where the Trout Minnow *Galaxias truttaceus* and Spotted Minnow *Galaxias maculata* occur. The former has a very restricted range being found only in a few streams in the Two Peoples Bay area. The Spotted Minnow is a Gondwanan species as well as Western Australia and occurs in Eastern Australia, Tasmania, New Zealand, Chile and Argentina.

Other significant South Coast freshwater fish include the Salamander fish *Lepidogalaxias salamandroides* and the Pouched Lamprey *Geotria australis*.

- Fish with marine affinities (estuarine species):

The estuarine fish species are an important component of the estuarine biota, both for ecosystem function (trophic networks), and as a commercial or recreational resource. South Coast Region estuarine fish include: Swan River Hardyhead (*Leptatherina wallacei*), Swan River Goby (*Pseudogobius olorum*), Big headed Goby (*Afurcagobius suppositus*), Yellow-eye Mullet (*Aldrichetta forsteri*), Sea Mullet (*Mugil cephalus*) and Black Bream (*Acanthopagrus butcheri*). Some of these species are also found in freshwater upstream from the estuaries.

## 4.6 Invertebrate Fauna

Invertebrates are distinguished from vertebrate animals by the absence of a backbone. They may be soft-bodied like the worms (Polychaetes), have exoskeletons like spiders, scorpions (Chelicerata) and crayfish (Crustacea) or carry a shell like the snails (Mollusca).

Invertebrates are often referred to as “the other 99%” on account of their abundance in most ecosystems, especially when compared to vertebrates. For instance the insects - a class of arthropods - number far more species worldwide than any other group of animals and outnumber humans by 300 million to one. They have been in existence for over 250 million years and are the most successful group of organisms on Earth (Nauman 1992).

Invertebrate animals can be expected in all habitats from soil ecosystems to freshwater and all vegetation communities. Their abundance and diversity means they play very significant ecological roles in every ecosystem. They occupy most trophic levels from detritus feeders to herbivores and carnivores and play important roles as parasites and pollinators of plants. They also provide a food supply for insectivorous birds, mammals and fish.

Despite their undoubted ecological significance however, knowledge of the invertebrate fauna of the South Coast is far less comprehensive than for vertebrates. This situation is slowly being addressed as more biological surveys include invertebrates in their range of target groups. However, difficulties are encountered due to the large number of undescribed invertebrate species and the fact that experts on particular groups often reside outside the state or overseas.

Many of the invertebrates common to southern temperate Australia occur in South Coast communities and representatives of most Australian orders are present. There are endemic species among most groups.

Additionally, the Region provides refuge for a number of significant Gondwanan relicts (Hopper et al 1996). These are species that evolved many millions of years ago generally in temperate rainforest communities. They have been able to survive in moister micro-climates of the South Coast – particularly in shaded gullies and higher altitudes. Some have adapted to drier conditions.

### Gastropoda

The land snail genus *Bothriembryon* has diversified extensively in the Southwest. Of the 30 species endemic to the SW Botanical Province, 16 (more than 50%) are found within the South Coast Region and 14 are endemic to this Region. Several species are restricted to particular areas and habitats such as tingle forests (*B. fuscus*), mallee woodlands (*B. dux*), mountains in the Stirling Range (*B. glauerti*) or off shore islands (*B. rhodostomus*).

### Onychophora

Velvet worms (Peripatus) are enigmatic predatory inhabitants of rotting logs and Australia has more species than any other country. Work on Western Australian species is still in its infancy but research has revealed a number of short-range endemic species from the wetter forests and another in the Porongurup Range (Mark Harvey, pers comm.).

### Diplopoda

Numerous short-range species of millipedes have also been recently found in the Southwest with a number of species endemic to small areas such as particular groups of mountains in the Stirling Range, Porongurup Range and coastal granit hills (Karen Edward, pers comm.).

### Arachnida

The trapdoor spider genus *Moggridgea* has several species confined to particular habitats in the Region. *Moggridgea tingle* occurs in the Tingle and Karri forests. An undescribed species (possibly several species) forms colonies of burrows in shaded clay banks in the Stirling Range. Another trapdoor spider genus *Neohomogona* is endemic to the southwest and has representatives on isolated mountains of the Albany District. *Neomohogona bolganupensis* occurs in the Porongurup Range (Main 1987), *N. stirlingii* in the Stirling Range (Barrett 1996) and an undescribed species has been found on Mt Manypeaks (Sarah Comer pers com). Two species of the southwest genus *Eucyrtops* occur in the Stirling Range. Several species of *Stanwellia* (Nemesiidae) and *Chenistonia* occur in the Stirling Range, Porongurup and Mt Ragged (Barrett 1996).

### Malacostraca

Freshwater crayfish are a very diverse group in Australia as a whole and the Southwest has a number of endemic taxa. In the South Coast Region *Cherax cainii* (Marron), *C. quinquecarinatus* (Gilgie) and *C. preissii* (Koonac) are important components of aquatic fauna.

The burrowing crayfish *Engaewa walpolea*, *Engaewa subcoerulea* and *Cherax crassimanus* are almost endemic to the South Coast Region having ranges that extend just outside the region. The Yabbie *Cherax destructor* was probably introduced to the Southwest from Eastern states although see Horwitz and Knott 1995 for alternative hypotheses. (P Horwitz pers comm.)

## 4.7 Fungi and Lichen

Fungi, often treated as members of the plant kingdom, in fact have their own kingdom separate from that of plants and animals. The number of fungal species – especially among the microfungi – is probably far greater than that of plants (Bougher and Syme 1998). Although detailed knowledge is lacking, fungi can be expected to play crucial ecological roles in most South Coast ecosystems. For instance many fungi form mycorrhizal associations with native plants that enhance the host's ability to derive nutrients from the soil. For plant communities growing in the generally nutrient-poor soils of the South Coast such symbiotic associations may be extremely important.

Lichens are intimate associations of fungi and algae such that neither component is able to live alone and lichens are recognised as species in their own right. Lichens may be found throughout the region from wetter areas to the drier areas inhabiting bark, dead wood, soil and bare rock surfaces. The many granite rock outcrops of the region often host a variety of lichens that are part of the granite rock community. Lichens often play a role in stabilising soil surfaces by forming crusts on bushland soils.

## 5. Ecological Processes

Plants, fungi, animals, and other micro-organisms interact with each other and with their environment in complex ecological processes. The dynamic biogeochemical relationships between the abiotic components of the environment (soils, geology, climate, topography and hydrology) and the biota are both spatially and temporally variable.

Comprehensive knowledge of fine-scale and species-specific ecological processes is lacking in the Region. However, increasing interest and awareness of the unique biodiversity of the area is responsible for a growing effort to improve knowledge at this level. Work on plant pollination, life histories and response to disturbance by specific taxa are examples of research conducted in the Region. Broad, or landscape scale, ecological processes influencing biodiversity in the region are somewhat better understood. Examples include knowledge of the impacts of disease, fire and fragmentation on biota. Nevertheless there are still large gaps in knowledge of the long-term effects of these processes on biodiversity.

From a biodiversity manager's perspective the ability to predict responses of species and ecosystems to disturbance or modification of ecological processes is a key to establishing context for management decisions.

Anthropogenic disturbances to natural ecological processes are often key threats to biodiversity. Historically land clearing, inappropriate fire regimes, disease, altered hydrological regimes and the introduction of feral animals have been the key disturbances to ecosystem processes on the south coast, and these threats are discussed in more detail below.

## 6. Threats To Biodiversity

### 6.1 Threats

Any factor that tends to reduce the number of species or ecosystems is considered to be a threat to biodiversity or a “threatening process”. Worldwide there are many threats to biodiversity; those of most concern in the South Coast Region are summarized below. Biodiversity in the remainder of the Southwest Botanical faces similar suite of threats.

- **Habitat reduction**  
Land clearing, mainly between 1950 and the 1980’s for the purpose of “opening up” land for broad-acre wheat 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, is a major threat to biodiversity values in areas adjacent to human settlements.
- **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.
- **Salinity and altered hydrological regimes**  
Rising water tables and associated surface or subsurface soil salinisation makes life impossible for species intolerant of salt and water logging. Salinisation is a form of habitat destruction. As a result of the broad scale removal of native vegetation many of the agricultural areas of the South Coast Region face major impacts from salinisation. Many of the remaining patches of native vegetation, particularly those lower in the catchment, will be impacted by salinity and water logging that may result in the total destruction of the plant community. Biological surveys recently carried out in the wheatbelt are helping to assess the impact of salinity on biodiversity.
- **Plant Disease**  
The introduced soil fungus *Phytophthora cinnamomi* 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 in the South Coast Region. Many plant communities in the region are dominated by families such as Proteaceae, Epacridaceae, Myrtaceae, etc (see section 4.3) and are highly susceptible to *Phytophthora*. The disease results in a species-rich community being turned into one dominated by a small number of resistant species.
- **Introduced species**  
As a result of European settlement a large number of alien plants and animals have been introduced into South Coast Region ecosystems. Introduced species may disrupt populations of native plants animals through predation, competition or habitat alteration.

The introduced Red Fox became established in Western Australia in the 1920s and through direct predation has had an enormous impact on populations of small to medium-sized native mammals. It is considered to have caused the extinction of several native animals formerly found in the South Coast Region and is currently putting populations of most small mammals under threat. Feral Cats are a similar problem for native fauna although their impact in the south coast is not as apparent as in arid areas.

Other introduced animals such as rabbits, feral horses, pigs and goats degrade habitat by reducing plant cover, eating some plant species out, disturbing soil and generally making natural vegetation more susceptible to weed invasion.

- **Invasive species/Weeds**  
Exotic plants that become naturalised can invade areas of native vegetation and eliminate understorey and ground cover species. In the South Coast Region Bridal Creeper, Blackberry, Victorian Tea-tree, Watsonia and Pampas Grass are among our most invasive weed species. They are particularly prevalent in roadside vegetation and drainage lines. Some (bridal Creeper, Blackberry) have become established in conservation areas.

- **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 – intensity, frequency and season. Species adapted to longer cycles between fire events can be eliminated by frequent, high intensity fire. On the other hand, long periods without fire can lead to senescence, reduced regeneration and vulnerability to wildfire. Large scale, intense fires however, 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.

- **Altered Ecological Processes**

The cumulative effects of the above 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. Natural ecological processes, gene flows and nutrient interactions have begun to change and adapt to new levels and introduced states, which have ramifications and potentially harmful effects at all levels (genetic, species and ecosystems) for native biodiversity values of the South Coast Region.

- **Climate Change and sea level rise**

The South Coast Region has a marked rainfall gradient from west to east. Predicted climatic changes may see this gradient shift to the west. Annual average rainfall has declined some 20-30% in the southwest over the last couple of decades. Mesophyllic flora and relictual Gondwanan fauna of higher peaks in Stirling Range are likely to be particularly affected by drying climatic conditions. The impact of sea level change on estuarine and coastal biodiversity, although predicted with some degree of certainty, is an unknown quantity at present.

## 6.2 Managing Threats

While most threats to biodiversity are considered and usually managed alone, it is important to bear in mind that threats posed by different agents can operate in tandem with each other, for example, dense cover protects some species from predation by foxes, and the reduction or removal of that cover by *Phytophthora* plant disease, fire or the effects of salinity will make prey species more vulnerable. A drier climate may mean wildfires become more prevalent. Climate change in combination with already fragmented habitats will further reduce scattered populations. The increase in human population in the region results in urban and infrastructure expansion, causing further fragmentation and isolation of habitat remnants by urban barriers such as roads and fences, and increasing recreational pressures on the natural landscape.

### Fire management

The deleterious effects of large scale, intense fires can be reduced through effective suppression of wildfires and prescribed burning of vegetation to reduce the fuel which supports intense fire activity. In the Protected Areas (national parks, nature reserves, state forest) these fire management strategies are the responsibility of the Department of Conservation and Land Management. Fire management plans are part of area management plans for national parks and nature reserves (see Section 8.1) and individual burn prescriptions are developed for all prescribed burns on CALM-managed land. Environmental issues and values are assessed during the development and assessment of these prescriptions. These principles also apply to Unallocated Crown Land (UCL) and unvested Crown Reserves for which CALM now has pre-suppression responsibilities. Outside such areas the Fire and Emergency Services Authority (FESA) works with local brigades to achieve similar objectives.

### Fox control

The fox, like most mammals is susceptible to the poison sodium monofluoroacetate (1080). This chemical is produced naturally by *Gastrolobium* - a genus of plants mostly confined to the southwest of Western Australia where, fortunately most native animals have evolved immunity to the poison. The fox control program Western Shield uses aerially dispersed meat baits impregnated with 1080 and in the South Coast Region over 1 million hectares of parks and reserves are baited four times each year. The ensuing reduction in fox numbers has allowed the recovery of many native mammal, bird and reptile populations.

### Dieback management

Measures such as banning or restricting vehicle movements to times of dry soil conditions and using, boot cleaning stations on walk trails can limit or reduce the transport of infected soil into uninfected areas. Movement through root-to-root contact, in surface and sub-surface water flow and by animal vectors however, is not practical. The chemical Phosphite can confer temporary immunity to many susceptible plants and is used to provide protection for selected small populations of threatened plants, particularly in the Stirling Range National Park.

### Weed Control

Many community groups are tackling weed control on reserves and roadsides managed by Local Government Authorities. Control methods include physical removal, selective use of herbicides and the release of biological control agents such as leaf-hoppers and rusts to control blackberry and bridal creeper. Weed control is part of routine management in most national parks and nature reserves in the regio. In Porongurup National Park where there are major weed infestations, targeted annual control programs are carried out.

### Salinity

The control of salinisation and waterlogging in soils is a particularly difficult problem that needs to be tackled on a catchment basis. Current approaches include changing farming practices, revegetation and drainage control.

## 7. Threatened Species and Communities

Flora, fauna and ecological communities that are at risk of extinction unless effective remedial action is taken are classified as "threatened". In Western Australia the Department of Conservation and Land Management has statutory responsibility to ensure the conservation of flora and fauna and is responsible for maintaining lists of the State's threatened species and ecological communities. Nominations for these lists are considered by the Threatened Species Scientific Committees. Recommendations for gazettal as Threatened Species are then made to the Minister for the Environment.

Threatened species and communities are grouped into categories of risk according to internationally accepted IUCN criteria. The most seriously endangered are placed in the Critically Endangered category followed by the Endangered and Vulnerable categories. Extinct (or presumed Extinct) species are also listed as such. Species and communities for which there is some concern about their conservation status, or which are too poorly known for assessment as well as those only recently removed from the list due to conservation action, are listed separately as Priority Species.

The first three Priority categories (Priorities 1, 2 or 3) are ranked in order of priority for survey and evaluation of their conservation status so that consideration can be given to their declaration as threatened flora or fauna. Species that have been adequately surveyed, are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Conservation Dependent species are also placed in Priority 4.

Where a species occurs as a number of discrete populations or sub-populations across its range, the loss of one of these populations constitutes a local extinction. A series of such local extinctions can ultimately result in extinction of the species itself and the number of extinct species is a direct measure of the loss of biodiversity. Species, subspecies and communities that are considered likely to become extinct ie those listed as Threatened Species, indicate the imminent loss of biodiversity.

On the other hand a decrease in the total number of Threatened Species or decreases in the number of species in higher risk categories, may reflect some success in conserving biodiversity although movement up or down the list may also result from improved knowledge of the status of species and communities.

The 2003 lists of threatened species for Western Australia includes 351 threatened flora, 205 threatened fauna and 80 threatened ecological communities.

### 7.1 Threatened Flora

Only one plant is known to have become extinct in the South Coast Region over the last 200 years. However, there are 94 taxa that are currently in some danger of extinction and are listed as Threatened Flora. This represents 27% of the state's Threatened Flora. Twenty six South Coast Threatened Flora are regarded as Critically Endangered (CR), 33 are in the Endangered category (EN), 35 Vulnerable (VU). Threatened flora species and their conservation status with reference to their occurrence on land vested as conservation estate are listed in Table 1 below. A further 547 taxa are listed as Priority species. These species require monitoring or more investigation to determine their conservation status. Threatened flora in the South Coast is summarised in Table 1:

Table 1: Threatened flora in the South Coast Region

No.of Taxa	Endemic	Extinct	Threatened			Priority 1 - 4	
			Total	CR	EN		VU
4687	400	1	94	26	33	35	547

Data from Paul Gioia, WA Herbarium, Jan 2004, Sarah Barrett, CALM Albany.

Table 2(a): Threatened Flora in Protected Areas: Occurrence on land in National Park (NP) or Nature Reserve (NR)

Status	Found only on NP, NR	Part of population occurs in NP or NR	Occurs only outside NP or NR
Critically Endangered	13 (50%)	3 (11.5%)	10 (38%)
Endangered	16 (48.5%)	10 (30%)	7 (21%)
Vulnerable	15 (42.8%)	14 (40%)	6 (17%)
<b>All DRF taxa</b>	<b>44 (46.8%)</b>	<b>27 (28.7%)</b>	<b>23 (24.5%)</b>

Table 2(b): Threatened flora in the South Coast Region and their occurrence on land vested as conservation estate (National Park or Nature Reserve). O = only on conservation estate, P = partly, N = not present.

Species	Status	Present on Conservation Estate	Species	Status	Present on Conservation Estate
Grevillea maxwellii	CR	N	Eucalyptus insularis	EN	O
Lambertia orbifolia	CR	N	Adenanthos cunninghamii	EN	P
Scaevola macrophylla	CR	N	Banksia brownii	EN	P
Dryandra mucronulata ssp retrorsa	CR	N	Drakaea micrantha	EN	P
Adenanthos pungens subsp. effusus	CR	N	Drandra pseudoplumosa	EN	P
Eremophila verticillata	CR	N	Eucalyptus bennettiae x	EN	P
Nemcia lehmanii	CR	N	Myoporum cordifolium	EN	P
Eremophila lactea	CR	N	Orthrosanthus muelleri	EN	P
Myoporum turbinatum	CR	N	Verticordia fimbriolepis ssp australis	EN	P
Rhizanthella gardneri	CR	N	Acacia depressa	EN	P
Daviesia glosseosema	CR	O	Caladenia dorrienii	EN	P
Daviesia pseudaphylla	CR	O	Darwinia oxylepis	EN	O
Dryandra anatona	CR	O	Acacia trulliformis	VU	N
Persoonia micranthera	CR	O	Constylis lepidospermoides	VU	N
Andersonia axilliflora	CR	O	Lepidium ascheronii	VU	N
Dryandra montana	CR	O	Marianthus villosus	VU	N
Leucopogon gnaphaloides	CR	O	Thelymitra psammophila	VU	N
Nemcia luteifolia	CR	O	Eucalyptus merrickae	VU	N
Verticordia apecta	CR	O	Acacia awestoniana	VU	O
Lambertia echinata ssp echinata	CR	O	Darwinia meeboldii	VU	O
Eremophila subteretifolia	CR	O	Darwinia squarrosa	VU	O
Rhacocarpus webbians	CR	O	Deyeuxia drummondii	VU	O
Caladenia bryceana sub.sp. bryceana	CR	P	Kennedia glabrata	VU	O
Drakaea confluens	CR	P	Adenanthos dobagii	VU	O
Isopogon uncinatus	CR	P	Adenanthos ellipticus	VU	O
Calectasia cyanea	CR	O	Asplenium obtusatum	VU	O
Acacia rhamnophylla	EN	N	Microtis globula	VU	O
Anigozanthus bicolor ssp minor	EN	N	Chordifex abortivus	VU	O
Boronia clavata	EN	N	Stylidium galioides	VU	O
Centrolepis caespitosa	EN	N	Tribonathes purpurea	VU	O
Daviesia megacalyx	EN	N	Verticordia carinata	VU	O
Dryandra ionthocarpa	EN	N	Verticordia crebra	VU	O
Adenanthos velutinus	EN	N	Diuris drummondii	VU	O
Cooperookia georgei	EN	O	Adenanthos pungens subsp. pungens	VU	P
Darwinia collina	EN	O	Andersonia pinaster	VU	P
Darwinia wittwerworum	EN	O	Banksia goodii	VU	P
Darwinia sp. Stirling Range	EN	O	Banksia verticillata	VU	P

<i>Apium prostratum</i> ssp. <i>phillipii</i>	EN	O	<i>Caladenia harringtoniae</i>	VU	P
<i>Davisia obovata</i>	EN	O	<i>Conostylis misera</i>	VU	P
<i>Eucalyptus burdettiana</i>	EN	O	<i>Eremophila denticulata</i> ssp. <i>denticulata</i>	VU	P
<i>Eucalyptus coronata</i>	EN	O	<i>Eremophila vueneta</i>	VU	P
<i>Grevillea infundibularis</i>	EN	O	<i>Laxmannia jamesii</i>	VU	P
<i>Lambertia fairallii</i>	EN	O	<i>Meziella trifida</i>	VU	P
<i>Sphenatoma drummondii</i>	EN	O	<i>Pleurophascum occidentale</i>	VU	P
<i>Verticordia pityrops</i>	EN	O	<i>Ricinocarpos trichophorus</i>	VU	P
<i>Villarsia calthifolia</i>	EN	O	<i>Verticordia helichrysantha</i>	VU	P
<i>Xyris exilis</i>	EN	O	<i>Bentleya spinescens</i>	VU	P

## 7.2 Threatened Fauna

Table 3 below shows the threatened fauna present in the South Coast Region. A summary of threatened non-marine taxa in the region is shown in Table 3(a) indicating 6.3% of this fauna is currently listed as threatened. A further 8.9% appears in the Priority list.

Table 3(a): A summary of threatened terrestrial and freshwater fauna in the South Coast Region.

	No.of Taxa	Endemic	Threatened				Priority 1 - 4
			Total	CR	EN	VU	
Birds	270	6	10	1	2	7	16
Mammals	42	2	10	1	2	7	7
Reptiles	70						4
Frogs	22	2	1			1	
Fish	10						2
Invertebrates	N/A	5	5		4	1	8
<b>Total</b>	<b>414</b>	<b>16</b>	<b>26</b>	<b>2</b>	<b>8</b>	<b>16</b>	<b>37</b>

In addition the threatened marine fauna of the South Coast includes: 16 birds (1 CR, 3 EN, 12 VU); 3 mammals (1 EN, 2 VU); 2 reptiles (1 EN, 1 VU); 2 fish (2 VU). A total of **23 species**.

The South Coast's 49 threatened fauna species (terrestrial and marine) represents 33% of the Western Australian total of 148. Almost half (47.6%) of the threatened terrestrial birds in the State occur here and 21.7% of the threatened terrestrial mammals. A suite of endemic ground-dwelling birds (Noisy Scrub-bird *Atrichornis clamosus*, Western Bristlebird *Dasyornis longirostris*, Western Whipbird *Psophodes nigrogularis nigrogularis* and Western Ground Parrot *Pezoporus wallicus flaviventris*) is 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 2000). The Region obviously has an important role to play in the protection and recovery of threatened fauna. Recovery programs for South Coast threatened species are outlined in Section 8.

Table 3(b): Threatened Fauna of the South Coast Region

The table shows whether the Threatened Species is endemic to the South Coast Region (SC) or to the SW botanical province, its conservation status and distribution within sub-bioregions (IBRA) and the eco-zones as defined by McQuoid (ref) (see key below). The table also indicates the recovery plans and recovery teams associated with the management of these species (see section 8.2).

Species	Endemic to South Coast Region (SC)	Endemic to SW bot. prov.	IUCN status	IBRA Bio-region	Eco-zone *	Recovery Team	Recovery plan
<b>BIRDS (TERRESTRIAL)</b>							
Western Ground Parrot <i>Pezoporus wallicus flaviventris</i>	√	√	EN/CR	ESP1, ESP2	AF, YB	South Coast Threatened Birds Recovery Team	IRPlan 1996-1999 (Burbidge <i>et al</i> 1997); Recovery outline in (Garnett & Cowley 2000); New Recovery Plan in prep (2004)
Carnaby's Black-Cockatoo <i>Calyptorhynchus latirostris</i>		√	EN	WAR, JF2, ESP1, ESP2, AW, MAL	GR, AF, AW, ES, PF, QR, S, YB	Carnaby's Cockatoo Recovery Team	Draft Recovery Plan 2000-2009 (Cale Draft).
Western Long-billed (Muir's) Corella <i>Cacatua pastinator pastinator</i>	√	√	EN	JF2,	PF	Muir's Corella Recovery Team	Recovery outline in (Garnett & Cowley 2000); Draft Recovery Plan 2000-2009
Noisy Scrub-bird <i>Atrichornis clamosus</i>	√	√	VU	JF2	AF, S	South Coast Threatened Birds Recovery Team	Recovery Plan (Danks <i>et al</i> 1996); New Recovery Plan in prep (2004)
Western Bristlebird <i>Dasyornis longirostris</i>	√	√	VU	JF2, ESP1	AF, QR, S, YB	South Coast Threatened Birds Recovery Team	Research Plan (Cale & Burbidge 1993); New Recovery Plan in prep (2004)
Western Whipbird (western heath) <i>Psophodes nigrogularis nigrogularis</i>	√	√	VU	JF2, ESP1, WAR	GR, AF, PF, QR, S, YB	South Coast Threatened Birds Recovery Team	Research Plan (Cale & Burbidge 1993); Recovery outline in (Garnett & Cowley 2000); New Recovery Plan in prep. (2004)

Species	Endemic to South Coast Region (SC)	Endemic to SW bot. prov.	IUCN status	IBRA Bio-region	Eco-zone *	Recovery Team	Recovery plan
Baudin's Black-Cockatoo <i>Calyptorhynchus baudinii</i>		√	VU	JF2, ESP1, WAR,	AF, AW, PF, QR, S, YB		Recovery outline in (Garnett & Cowley 2000).
Malleefowl <i>Leipoa ocellata</i>			VU	JF2, ESP1, ESP2, AW, MAL1, MAL2	GR, AF, S, YB	(National) Malleefowl Recovery Team Malleefowl Preservation Group	Recovery outline in (Garnett & Cowley 2000).
Australasian Bittern <i>Botaurus poiciloptilus</i>			VU	JF2, WAR, ESP1	AF, AW, ES, PF, S		Recovery outline in (Garnett & Cowley 2000).
Recherche Cape Barren Goose <i>Cereopsis novaehollandiae grisea</i>	√	√	VU	ESP1, ESP2	AF		Recovery outline in (Garnett & Cowley 2000).
Western Whipbird (sth WA subsp; western mallee) <i>Psophodes nigrogularis oberon</i>		√	P4	ESP1, ESP2	GR, AF, ES, QR, S, YB	South Coast Threatened Birds Recovery Team	Research Plan (Cale & Burbidge 1993); Recovery outline in (Garnett & Cowley 2000); New Recovery Plan in prep (2004)
<b>BIRDS (MARINE)</b>							
Southern Great Petrel <i>Macronectes giganteus</i> White-chinned Petrel <i>Procellaria aequinoctialis</i> Amsterdam Albatross <i>Diomedea amsterdamensis</i> Tristan Albatross <i>Diomedea dabbenena</i> Southern Royal Albatross <i>Diomedea epomophora</i> Wandering Albatross <i>Diomedea exulans</i> Gibson's Albatross <i>Diomedea gibsoni</i> Northern Royal Albatross <i>Diomedea sanfordi</i> Sooty Albatross <i>Phoebetria fusca</i> Light-mantled Albatross <i>Phoebetria palpebrata</i> Indian Yellow-nosed Albatross <i>Thalassarche carteri</i> Shy Albatross <i>Thalassarche cauta</i> Atlantic Yellow-nosed Albatross <i>Thalassarche chlororhynchos</i> Grey-headed Albatross <i>Thalassarche chrysostoma</i> Salvin's Albatross <i>Thalassarche poiciloptilus</i> Subantarctic Skua (southern) <i>Catharacta lonnbergi lonnbergi</i>					These 16 threatened seabirds are oceanic species occurring off the South Coast. They do not breed on the mainland or islands of the Region.		Recovery outline in (Garnett & Cowley 2000).

Species	Endemic to SC	Endemic to SW bot. prov.	IUCN status	IBRA Bioregion	Eco-zone *	Recovery Team	Recovery plan
<b>MAMMALS (TERRESTRIAL)</b>							
Gilbert's Potoroo <i>Potorous gilbertii</i>	√	√	CR	JF2	AF	Gilbert's Potoroo Recovery Team	Interim Recovery Plan. (1995); Draft Recovery Plan (Courtenay & Friend Draft of 2003).
Dibbler <i>Parantechinus apicalis</i>		√	EN	JF2, ESP1	AF, ES, QR, S, YB	Dibbler Recovery Team	Interim Recovery Plan. Draft Recovery Plan (Friend 2003).
Red-tailed Phascogale <i>Phascogale calura</i>		√	EN	ESP1, MAL2	AF, ES, YB		National Plan to be prepared over next 12 months.
Numbat <i>Myrmecobius fasciatus</i>			VU	JF2, AW, ESP1	QR, S, YB	Numbat Recovery Team	Recovery Plan 1995-2004 (Friend 1994); New National Plan to be prepared
Heath Rat <i>Pseudomys shortridgei</i>		X	VU	ESP1, MAL2	GR, QR, S, YB		
Chuditch <i>Dasyurus geoffroii</i>		√	VU	JF2, ESP1, ESP2, MAL2	GR, AW, ES, PF, QR, S, YB	Chuditch Recovery Team	Recovery Plan (Serena <i>et al</i> 1991).
Western Ringtail Possum <i>Pseudocheirus occidentalis</i>		√	VU	WAR, JF2,	AF, AW, S	Western Ringtail Recovery Team	Interim Recovery Plan (Burbidge & de Tores 1998).
Quokka <i>Setonix brachyurus</i>		√	VU	WAR, JF2	AF, AW, QR, YB		
Recherche Rock-wallaby <i>Petrogale lateralis hackettii</i>	√	√	VU	ESP2	AF (Recherche Arch)		
Black-flanked Rock-wallaby <i>Petrogale lateralis lateralis</i>			VU	AW, MAL2, ESP2	AF		

Species	Endemic to SC	Endemic to SW bot. prov.	IUCN status	IBRA Bioregion	Eco-zone *	Recovery Team	Recovery plan
<b>MAMMALS (MARINE)</b>							
Blue Whale ('true' subsp.) <i>Balaenoptera musculus musculus</i>			EN		Marine		Cetacean Action Plan (Bannister JL, Kemper CM, Warneke RM, 1996)
Southern Right Whale <i>Eubalaena australis</i>			VU		Marine, calving on South Coast		Cetacean Action Plan (Bannister JL, Kemper CM, Warneke RM, 1996)
Humpback Whale <i>Megaptera novaeangliae</i>			VU		Marine		Cetacean Action Plan (Bannister JL, Kemper CM, Warneke RM, 1996)
<b>REPTILES (MARINE)</b>							
Loggerhead Turtle <i>Caretta caretta</i>			EN		Marine		
Leatherback Turtle <i>Dermochelys coriacea</i>			VU		Marine		
<b>FISH (MARINE)</b>							
Grey Nurse Shark			VU		Marine		
Great White Shark			VU		Marine		In progress.
<b>FROGS</b>							
Sunset Frog <i>Spicospina flammocaerulea</i> ,	√	√	VU	WAR	AF	Sunset Frog Recovery Team	Recovery Outline in Action Plan for Australian Frogs, (Tyler, M. 1997); Recovery Plan Burbidge, A. A. and Roberts, j. D. 2002)

Species	Endemic to SC	Endemic to SW bot. prov.	IUCN status	IBRA Bio-region	Eco-zone *	Recovery Team	Recovery plan
<b>INVERTEBRATES (TERRESTRIAL)</b>							
Stirling Range Rhytidid Snail Undescribed <i>Rhytidid</i> sp.	√	√	EN	ESP1	QR	South Coast Threatened Invertebrates Recovery Team	
Stirling Range Moggridgea Spider <i>Moggridgea</i> sp.	√	√	EN	ESP1	QR	South Coast Threatened Invertebrates Recovery Team	
Tingle Trapdoor Spider <i>Moggridgea tingle</i> ,	√	√	EN	WAR	AF, AW	South Coast Threatened Invertebrates Recovery Team	
<i>Cynotelopus notabilis</i> , WA Pill Millipede	√	√	EN	WAR	AW, AF	South Coast Threatened Invertebrates Recovery Team	
Western Archaeid Spider <i>Austrarchaea mainae</i>	√	√	VU	WAR	AF	South Coast Threatened Invertebrates Recovery Team	

**KEY**

<b>IBRA BIOREGION</b>	
ESP 1	Esperance Sandplain (west)
ESP 2	Esperance Sandplain (east)
MAL 1	Mallee (east)
MAL 2	Mallee (west)
WAR	Warren
JF 2	Southern Jarrah Forest
AW	Avon Wheatbelt

<b>ECO-ZONE</b>	
GR	Greenstone Range
AF	Albany Fraser Granite
AW	Albany/Walpole Flats
ES	Esperance Sandplain
PF	Porongurup Forest
QR	Quartzite Range System
S	Spongolite
YB	Yilgarn Block

**7.3 Threatened Ecological Communities**

Recognisable plant or animal communities that are considered to be under threat of extinction can be listed as Threatened Ecological Communities in much the same way as individual species of plants and animals. Nominations for listing are considered by the Western Australian Threatened Ecological Communities Scientific Committee. Threatened Ecological Communities are placed in threat categories (Critically Endangered CR, Endangered EN, Vulnerable VU) using similar criteria to those for plant and animal species.

Communities that do not meet the criteria for listing as threatened because of insufficient information (including lack of survey and/or inadequacy of definition) are placed on the Priority Ecological Community List in Priorities 1, 2 or 3. Communities that have a restricted area of occurrence but are not threatened, that have been recently removed from the threatened list, and those that require monitoring are placed in Priority 4.

Listed threatened and priority ecological communities within the South Coast Region are shown in Table 4.

Table 4. Threatened and Priority Ecological Communities in the South Coast Region

ID	Common Name	Threat Category	Occurrence Count
Montane	Montane Thicket of the Eastern Stirling Range	CR	6
Mt Lindesay	Mt Lindesay and Little Lindesay Vegetation Complex	EN	1

<i>Eucalyptus acies</i> mallee-heath	Thumb Peak-Mid Mt Barren- Woolburnup Hill (Central Barren Ranges) <i>Eucalyptus acies</i> mallee-heath	VU	3
Bandalup Hill	<i>Eucalyptus purpurata</i>	P 1	2
Green Range Granite Hill	Green Range Granite Hill heath and woodland community	P 1	1
Montane Mallee	Montane mallee thicket community	P 1	10
Reedia Swamps	<i>Reedia spathacea-Emposidsma gracillimum-Schoenus multiglumis</i> dominated peat paluslopes and sandy mud floodplains of the Warren Region	P 1	1
Pink Lake	Stromatolite community Number 3 of coastal hypersaline lakes	P 1	1
Ironstone Heath (wet)	Wet ironstone heath community (Albany)	P 1	1
Esperance Sandplain	Scrub-heath on Esperance Sandplain	P 3	2
Stirling Range Upland Yate Woodlands	Stirling Range upland Yate woodlands	P 4	1

## 8. Biodiversity Conservation in the South Coast Region

Conservation of biodiversity requires the preservation and management of species, their habitats and the ecological processes that support them. Four broad approaches to biodiversity conservation have been identified: ensuring existence of functional landscapes, providing a comprehensive, adequate and representative (CAR) conservation reserve system, protecting and recovering special ecosystems, and recovery of threatened species. These strategies must be supported by the development and maintenance of a comprehensive biodiversity inventory.

The aerial extent of the South Coast Region is 5.5 million hectares (Table 5). Since European settlement began 170 years ago, about 3.4 million hectares have been cleared, mainly for agriculture, leaving about 2.1 million hectares of native vegetation. This area of vegetation - often referred to as remnant vegetation - contains the remaining natural and relatively unmodified terrestrial ecosystems of the region. Conservation of biodiversity in the South Coast depends fundamentally on the maintenance and protection of this vegetation.

The largest areas of native vegetation in the region are in the mallee areas in the east, the Fitzgerald River - Ravensthorpe Range area, Stirling Range and the forests between the Frankland and Hay Rivers. Significant areas of vegetation are also present along the coast and there are smaller, scattered patches inland in the Albany and Esperance areas.

### 8.1 Conservation Reserve System

In Western Australia, under the Conservation and Land Management Act 1984, CALM is responsible for the management of a state-wide conservation reserve system that today totals 21.7 million hectares.

Table 5 shows the area occupied by various types of CALM-managed reserve in the South Coast Region and the geographic spread of these reserves is shown in Fig 2. The main components of the system are national parks (totalling 517 407 ha) and nature reserves (165, 185 ha) and all together the system covers an area of 809, 918 hectares in the region. These lands are vested in the Western Australian Conservation Commission (WACC) and managed by CALM primarily for conservation under the Conservation and Land Management Act 1984. In national parks (and some nature reserves) public recreation is also facilitated as long as this does not compromise conservation goals. Many areas of Unvested Crown Land (UCL) proposed as additions to the conservation estate are managed as if they were national park or nature reserve.

In addition, in July 2003, CALM was given management responsibilities for UCL and Unmanaged Crown Lands (UMR) outside townsites across Western Australia. In the South Coast Region the area of UCL amounts to 447 218 hectares, mainly northeast of Ravensthorpe and to the northeast of Esperance. In all, CALM is responsible for the management of 1,455,013 hectares of conservation land in the South Coast Region. This is nearly 27% of the total area of the South Coast and is 67% of the native vegetation remaining in the region.

Table 5: Area of Conservation Reserves in the South Coast

CATEGORY	AREA OCCUPIED IN SCRIPT SOUTH COAST REGION (Ha)
Nature Reserve	165 185
National Park	517 407
State Forest	117 435
Timber Reserve	5785
Misc and 5(g) etc	4106
	<b>809 918</b>
Proposed National Park	192 253
Other proposed reserves	5624
UCL	447 218
<b>TOTAL</b>	<b>1 455 013</b>
PERCENT OF TOTAL SCRIPT AREA (5 424 450 ha)	<b>26.82%</b>

Some of the larger and more important conservation reserves managed by CALM within the South Coast are listed in Table 6. The two largest reserves are Fitzgerald River National Park (FRNP) and Stirling Range National Park (SRNP). Together these two reserves total 435,000 ha set aside for conservation. Stirling Range NP contains the entire Stirling Range including the five highest peaks in southern Western Australia. As has already been mentioned (Section 4.2) the park is a recognised centre for plant diversity and contains many endemic plants. It is also a significant area for endemic terrestrial invertebrate fauna (Section 4.6). The FRNP also contains a large number of plants endemic to the park and contains more native mammal species within its borders than any other conservation reserve in southern Western Australia. These include many threatened mammals locally extinct in other areas.

Generally, larger sized reserves are more valuable for conservation than smaller reserves. A larger area to perimeter ratio means central parts of a reserve are less influenced by edge effects and disturbance. Nevertheless, small reserves are often the only means of protecting small populations of rare species or communities and can contain unusually high concentrations of threatened species. Two Peoples Bay Nature Reserve for instance, despite being only about 5000 ha in extent, contains a similar number of threatened species as the very much larger FRNP.

Table 6: Major CALM-managed conservation reserves in the South Coast Region

Name	Area (ha)	Name	Area (ha)
Fitzgerald River National Park	320,000	Truslove Nature Reserve	6260
Stirling Range National Park	115,000	Griffiths Nature Reserve	5417
Cape Le Grand National Park	31 578	Two Peoples Bay Nature Reserve	4744
Mt Frankland National Park	30,830	Burdett South Nature Reserve	4467
Walpole-Nornalup National Park	20,000	Corackerup Nature Reserve	4334
Kau Rock Nature Reserve	15 813	Waychinicup National Park	3982
Baumont Nature Reserve	11 758	Torndirrup National Park	3936
Lake Shaster Nature Reserve	10 504	Helms Forestry Reserve	3748
Stokes National Park	9726	Munz Nature Reserve	3617
Cheadnup Nature Reserve	6813	West Cape Howe National Park	3517
Jerdacuttup Lakes Nature Reserve	6619	Camel Lake Nature Reserve	3214
Recherche Archipelago NR	6495	Porongurup National Park	2621

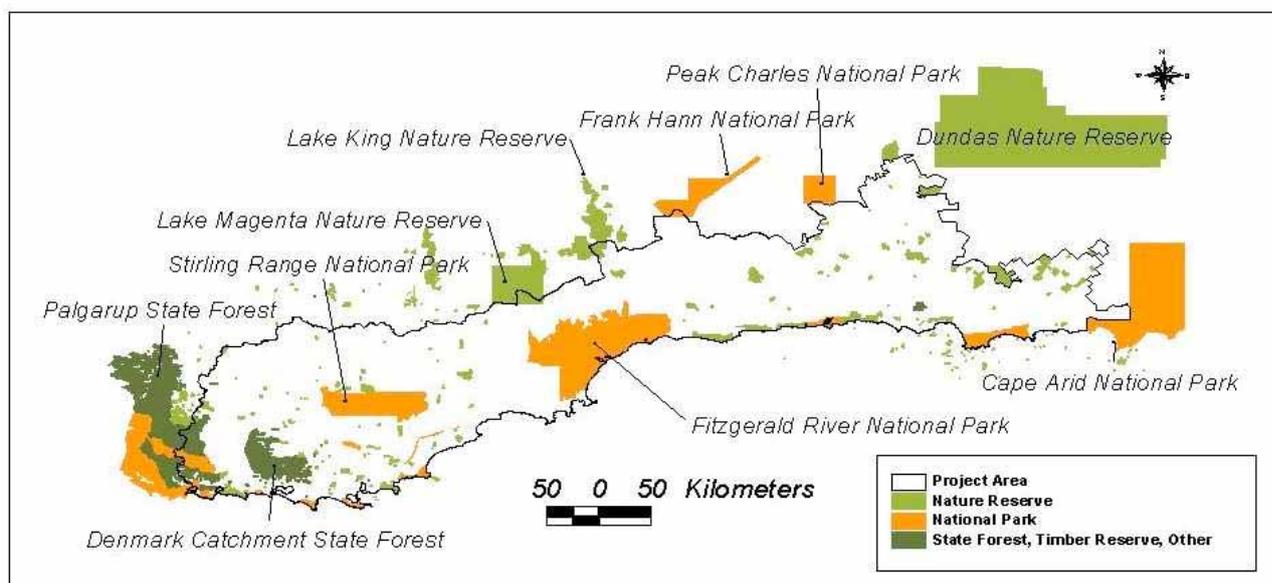
The Region has several significant national parks in the 10,000 to 50,000 ha range and a large number of reserves (mostly nature reserves) in the 1000 - 5000 ha range. The proposed Walpole Wilderness Area will add a further 100,000 hectares to the Region's reserve system.

Almost all the South Coast islands are nature reserves. The Recherche Archipelago Nature Reserve includes over 100 islands off the Esperance coast in one nature reserve.

In addition, several large national parks or nature reserves sit on or near the South Coast Region boundary and play a role in the conservation of the Region's ecosystems. These include Lake Magenta Nature Reserve, Dunn Rock and

Lake King Nature Reserves, Frank Hann National Park, Peak Charles National Park, Dundas Nature Reserve, Cape Arid National Park, Nuytsland Nature Reserve and D'Entrecasteaux National Park

Figure 2: The terrestrial National Parks and nature reserves system of the South Coast Region



To effectively conserve the biodiversity of the region a conservation reserve system needs to be a comprehensive, adequate and representative (CAR) system as outlined by national Department of Environment and Heritage guidelines (<http://www.deh.gov.au/parks/nrs/sciguide/nrsgui-prt1.html>). 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.

The IBRA Biodiversity Audit for the Esperance Sandplain bioregion identified 15 out of 63 vegetation associations in ESP1 and ESP2 that were not currently represented in the reserve system. Unfortunately many of these communities have already been lost due to clearing. This severely limits the opportunities to achieve a representative reserve system. The situation is not so bad in some neighbouring sub-regions. In the Southern Jarrah Forest for instance almost all of the recognised vegetation associations are represented in the reserve system (McKenzie et al 2003).

### 8.1.1 Management of the reserve system

Conservation reserves need to be managed to protect their biodiversity values over long periods of time. Intensive management may be needed in some cases to prevent large scale wildfires, control other threatening processes or ensure public visitation does not compromise biodiversity conservation values. With over 1 million hectares of land to manage, a major part of CALM's resources in the South Coast are concerned with on-ground management operations in the reserve system.

Management Plans for national parks and nature reserves are prepared by CALM for the vesting body – the Western Australian Conservation Commission. These plans set out overall management objectives, strategies for the control of wildfire or other threatening processes and guidelines for the management of visitor facilities. Management plans cover a ten year period and are developed through a public consultation process and when complete signed by the Minister for the Environment. Increasingly, plans for multiple reserves are prepared under a single plan. All management plans prepared under the CALM Act remain as statutory documents until revised or replaced even when the ten year time frame has passed. Where full management plans have not been developed, Interim Management Guidelines (IMG) may be written. Current management plans for CALM-managed reserves in the South Coast are shown in Table 6.

Table 7: Current CALM Regional and Area Management Plans

South Coast Regional Management Plan	1992-2002
Fitzgerald River National Park Management Plan	1991-2001

West Cape Howe National Park Management Plan	1995-2005
Two Peoples Bay Nature Reserve Management Plan	1995-2005
Esperance Lakes Nature Reserves Management Plan	1999-2009
Stirling Range and Porongurup National Parks	1999-2009
Walpole-Nornalup National Park Management Plan	1992-2002
Southern Forest Management Plan	1998-2008

Table 8: Priorities for new Regional and Terrestrial Area Management Plans:

Esperance Coastal Reserves	Commenced 2001
Walpole Wilderness Area	Commenced 2002
Albany Coastal Reserves	Commenced 2004
Revision of Fitzgerald River National Park (1991-2001)	
Revision of South Coast Regional Plan (1992-2002)	

Table 9: Approved Interim Recovery Plans –Threatened Ecological Communities

Montane Heath and Thicket of the South West Botanical Province, above approximately 900 m above sea level (Eastern Stirling Range Montane Heath and Thicket Community)	Feb 2000
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## 8.2 Recovery of Threatened Species and Ecological Communities

The aim of threatened species recovery is to improve the security, viability and conservation status of the threatened taxon or community so that in the longer term it can be removed from the threatened species lists. Managing threats (See Section 6.2), manipulating habitat or aspects of life history may take many decades and require considerable resources to achieve full recovery. Since the early 1990s a RecoveryPlan/Recovery Team approach has become the norm in threatened species management.

For instance, efforts to save the Noisy Scrub-bird have been in action since the rediscovery of the species in 1961. A recovery program was essential to guide this long term process and in 1985 a Management Program for the Noisy Scrub-bird was published. In 1996 this was replaced by the Noisy Scrub-bird Recovery Plan (Danks et al 1996). The recovery plan sets out objectives and management actions designed to ensure the survival of the species. A Recovery Team is usually composed of people with expert knowledge of the threatened species, representatives of research and teaching institutions, local government and the community. The Recovery Team oversees implementation, reviews progress and makes necessary changes to the plan.

### 8.2.1 South Coast Threatened Species and Communities Recovery Teams

As would be expected for a region with a relatively large number of threatened species, there are many Recovery Teams operating in the South Coast. Some of these are engaged in programs for species found entirely or mainly in the South Coast (the South Coast endemics), others deal with species that occur in the region but have major populations outside.

**Albany District Threatened Flora Recovery Team** covers 75 threatened flora in the Albany area. Major activities include population survey and monitoring, weed control and a phosphite spraying program for Critically Endangered flora in the Stirling Range National Park.

**Esperance District Threatened Flora Recovery Team** deals with 19 species of threatened flora in the Esperance District. The re-establishment of *Lambertia echinata echinata* through translocation in Cape Le Grand National Park and the monitoring and survey of poorly known species are major actions.

**Stirling Range Montane Heath Recovery Team** is concerned with the Critically Endangered thicket community of the Stirling Range peaks. Monitoring the effects of herbivores, phosphite spraying and monitoring.

**South Coast Threatened Invertebrates Recovery Team** deals particularly with threatened invertebrates in the Stirling Range and Walpole areas. Efforts have focussed on identification of potential invertebrate refugia, survey, population monitoring and education.

**South Coast Threatened Birds Recovery Team** covers the Noisy Scrub-bird, Western Bristlebird, Western Ground Parrot and Western Whipbird. Surveys to establish the size and location of the Critically Endangered Western Ground Parrot are a current priority. Translocations of Noisy Scrub-bird and Western Bristlebird, long-term population monitoring and fire management are also important strategies.

**Gilbert's Potoroo Recovery Team** is focussed on the research and management of the Critically Endangered Gilbert's Potoroo. Captive breeding, cross-fostering, predator control, research into genetics and behaviour, surveys to find additional populations, monitoring recruitment.

**Dibbler Recovery Team** oversees a reintroduction program (Peniup Reserve) based on captive breeding at Perth Zoo.

**Muir's Cockatoo Recovery Team** deals with recovery actions for this threatened Cockatoo in the Rocky Gully area.

**Sunset Frog Recovery Team** is concerned with management of the highly restricted Sunset Frog populations in the Walpole area.

The following Recovery Teams deal with species for which there are recovery actions occurring within the South Coast Region but which have major populations of the species occur outside the Region:

**Carnaby's Cockatoo Recovery Team**  
**Numbat Recovery Team**  
**Chuditch Recovery Team**  
**Western Ringtail Possum recovery Team**

#### **Malleefowl Preservation Group**

The Malleefowl populations have declined across southern Australia and the species is classified as a Vulnerable threatened species. Local concern in the Jerramungup-Gnowangerup area led to the formation of the community-based Malleefowl Preservation Group. This group has been very active over many years carrying out on-the-ground activities such as fox control, corridor establishment and survey. Their work has spread to other parts of southern Western Australia (Harold and Dennings 1998).

#### **Community support for recovery programs**

Volunteers play an important role in threatened species recovery. Recovery Team membership is spread across various institutions, community groups and individuals who give their time to this task. Many people also volunteer their time to do hands-on work assisting in research and management for threatened species. The Albany-based Gilbert's Potoroo Action Group for instance was founded to provide an avenue for direct community support for the Gilbert's Potoroo recovery program through fund raising, project assistance, providing information and raising public awareness of the potoroo. The Friends of the Western Ground Parrot performs similar support for the Western Ground Parrot recovery program.

### 8.2.3 South Coast Region Threatened Species Recovery Plans

The Recovery Plan approach to the conservation of threatened species entails detailed planning of strategies and actions to achieve stated objectives. Recovery Plans are usually for a period of ten years. Interim Recovery Plans address urgent actions over a three-year period with the writing of a full recovery plan at the end of this period. Recovery Plans are published and publicly available documents.

In the long term the objective of a Recovery Plans is to improve the overall status of the species or community in question. Management actions are focussed on achieving this. Where more knowledge of biology and life history is needed to develop management actions, research may be required. Management actions may involve habitat management, fire management, predator and competitor control, disease control and establishment of new populations.

The writing of a Recovery Plan involves a small team of people with expert knowledge of the species and input from many others. The approach for both flora and fauna is usually focussed on single species. An integrated multi-species approach is currently being developed for five South Coast Threatened birds.

Recovery Plans developed by CALM for South Coast threatened species are listed below. The list is a draft of all programs and plans currently published for the South Coast Region.

Table 10: Approved Threatened Fauna Recovery Plans

	<b>Date Approved</b>
Noisy Scrub-bird Recovery Plan	1992
Woylie Recovery Plan	1992
Chuditch Recovery Plan	1994
Gilbert's Potoroo Recovery Plan (Draft)	1998
Sunset Frog Recovery Plan	2001
Carnaby's Cockatoo Recovery Plan	2002
Dibbler Recovery Plan	2003

Table 11: Approved Threatened Fauna Interim Recovery Plans

	<b>Date Approved</b>
Gilbert's Potoroo, <i>Potorous tridactylus gilbertii</i>	Feb 1995
Night Parrot, <i>Pezoporus occidentalis</i>	Mar 1996
Western Ground Parrot, <i>Pezoporus wallicus flaviventris</i>	May 1997
Western Ringtail Possum, <i>Pseudocheirus occidentalis</i>	Mar 1998
Dibbler <i>Parantechinus apicalis</i>	Sep 1998

Table 12: Approved Threatened Flora Interim Recovery Plans

	<b>Date Approved</b>
Norseman Pea <i>Daviesia microcarpa</i>	May 1997
Kamballup Dryandra <i>Dryandra ionthocarpa</i>	May 1997
Stirling Range Dryandra <i>Dryandra montana</i>	May 1997
Giant Andersonia <i>Andersonia axilliflora</i>	Aug 1999
Western Prickly Honeysuckle <i>Lambertia echinata</i> subsp <i>occidentalis</i>	Sep 1999
Dwarf Spider Orchid <i>Caladenia bryceana</i> subsp <i>bryceana</i>	Sep 1999
Small-flowered Snottygobble <i>Persoonia micranthera</i>	Nov 1999
Late Hammer Orchid, <i>Drakaea confluens</i> ms	Apr 2001
Albany Cone Bush <i>Isopogon uncinatus</i>	Apr 2001
Stirling Range Beard Heath <i>Leucopogon gnaphthalioides</i>	Apr 2001
Drummond's Grass <i>Deyeuxia drummondii</i>	May 2001
South Stirling Morning Iris <i>Orthrosanthus Muelleri</i>	May 2001
Maxwell's Grevillea, <i>Grevillea maxwellii</i>	Jun 2001
Maroon-flowered Daviesia, <i>Daviesia glossosema</i>	Jun 2001
Stirling Range Daviesia, <i>Daviesia pseudaphylla</i>	Jun 2001
Prickly Honeysuckle, <i>Lambertia echinata</i> subsp. <i>echinata</i>	Jun 2001
Mountain Paper Heath, <i>Sphenotoma drummondii</i> (Summary of Actions)	Jun 2001
Cactus Dryandra, <i>Dryandra anatona</i>	Sep 2002
Round-leaved Lambertia, <i>Lambertia orbifolia orbifolia</i>	Sep 2002
Salt Myoporum, <i>Myoporum turbinatum</i>	Sep 2002

Table 13: Approved Threatened Flora Management Programs

	<b>Date Approved</b>
Declared Rare and Poorly Known Flora in the Albany District	1995
Declared Rare and Poorly Known Flora in the Esperance District	2000

Table 14: Approved Threatened Ecological Communities interim recovery plans

	<b>Date Approved</b>
Montane Heath and Thicket of the South West Botanical Province, above approximately 900m above sea level (Eastern Stirling Range Montane Heath and Thicket Community)	2000

## 8.4 Functional Landscapes

Functional landscapes, ie. regional scale landscapes with intact ecological processes and viable communities of native species, will make a major contribution to conservation of biodiversity. Achieving functional landscapes will depend on having a set of protected areas and sites, recovery of threatened species and ecological communities (and other significant species/ecological communities) and supporting habitat that maintain species and ecological processes and addressing landscape threatening processes.

Connectivity at a landscape scale is important factor in the viability of populations of native species. Many local projects are involved in the creation of corridors of vegetation through planting native species. The South Coast Macro Corridor project mapped existing vegetation in the region that forms regional scale linkages between major areas of native vegetation and looked at the potential to improve this network of corridors (Watson and Wilkins 1999). It is recognised that the long term viability of even large areas of bush may depend on the presence of connections with other areas of vegetation to allow dispersal, recolonisation and gene flow between populations.

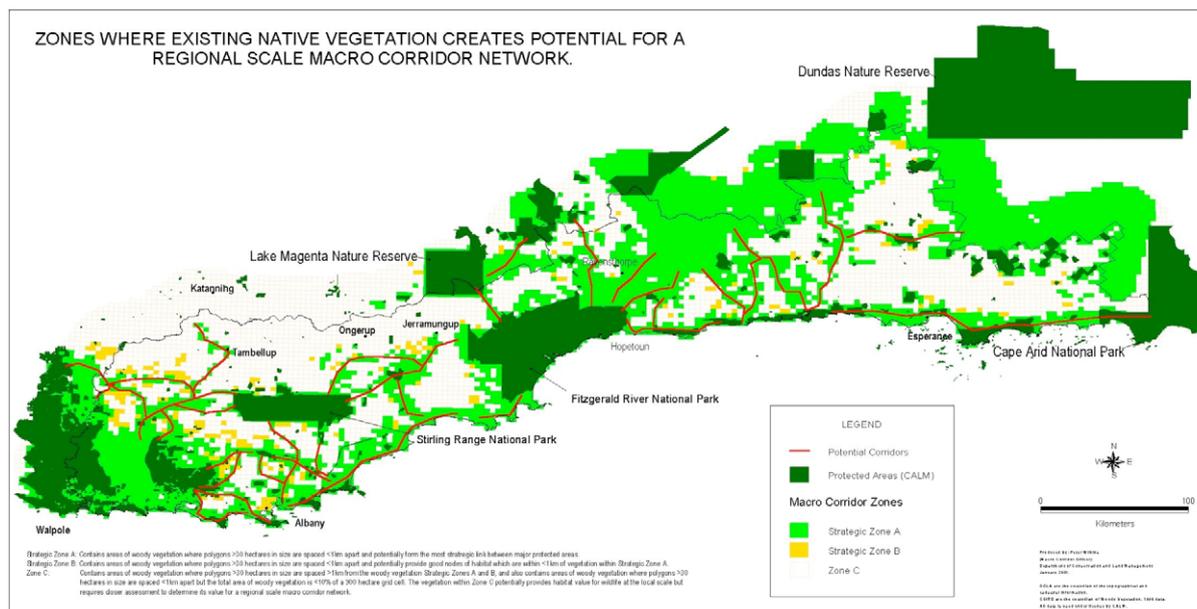


Figure 3: South Coast Macro Corridor: zones where native vegetation provides potential for a Regional scale corridor network.

Major regional linkage exists in a relatively narrow corridor of native vegetation along the coast. This corridor provides connection between the western forests, the Fitzgerald River National Park and the semi-arid shrublands east of Esperance. Other linkages occur between the coast and the inland particularly along rivers and from FRNP via Ravensthorpe Range to the mallee and woodlands of the Goldfields. The Macro Corridor Project highlighted the relative isolation of the Stirling Range and identified areas where linkages with the forests, Porongurup National Park and the Fitzgerald River National Park might best be restored. Improving the connectivity in these areas through revegetation and protection of existing native vegetation is a high priority.

Crown reserves managed by Local Government Authorities make an important contribution to the protection of native vegetation.

The protection and management of native vegetation on private property across the region can contribute significantly to biodiversity conservation. Excluding stock by fencing will assist regeneration and improve the condition of patches of native bush. Privately owned bushland can also be given long term protection through covenanting agreements.

The goal of CALM's **Land For Wildlife program** is to increase the area of habitat under private and Local Government management that is actively managed for wildlife conservation. In this program Landholders are helped to make more informed management decisions through provision of up to date information on biodiversity and wildlife habitat requirements. Land For Wildlife Officers work alongside Landcare project officers and agency staff and organise training workshops and field demonstrations in response to community demand. To date the scheme has 150 registrations in the South Coast Region resulting in 5500 ha of bushland selected as Land For Wildlife sites.

A number of organisations are pursuing the acquisition of privately owned areas of native vegetation for management as conservation reserves in the South Coast. These include Australian Bush Heritage, Greening Australia (WA), Friends of the Porongurups and Gondwana Link.

The Fitzgerald River National Park was listed as one of two Western Australian biosphere reserves under the UNESCO Man and Biosphere Program in 1978. It is now recognised that the park forms the core area of a larger notional Fitzgerald Biosphere Reserve which includes areas surrounding the national park where land owners are encouraged to manage their land in harmony with the goals of the park. A proposal for a similar arrangement in the Walpole-Denmark area is being developed.

Community involvement in the management of national parks has been long established in the South Coast. Such groups as the Walpole-Nornalup National Park Association, Friends of the Fitzgerald, Friends of the Porongurup and Fitzgerald River Advisory Committee have been operating for many years and provide useful input into the management as well as promoting the conservation values of the various national parks.

The Albany and Esperance Wildflower Societies are community-based organisations dedicated to the establishment and maintenance of regional herbaria. The herbaria are located in CALM buildings and volunteers collect specimens under permit, maintain the collections and databases and provide information about the region's flora to the community.

**The Gondwana Link program** is an example of a community-driven functional landscape project. Gondwana Link is a partnership between Australian Bush Heritage, Greening Australia, Fitzgerald Biosphere Group, The Wilderness Society, Malleefowl Preservation Group and Friends of the Fitzgerald. The project aims to protect and restore ecological function, through the application of a diverse range of mechanisms and demonstrate responses, actions and opportunities for conservation. Activities include securing areas of bush; rehabilitation of degraded bush; restoration of habitat in areas that are critical for maintaining and restoring function or for enhancing poorly represented vegetation associations. The group also aims to manage threatening processes such as pest species, inappropriate fire regimes, impacts from adjoining agriculture; and the development of compatible economic enterprises and lifestyle opportunities.

## 8.5 Legislation

Various national and international agreements and legislation will assist the conservation of biodiversity:

- 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;

## 9. Increasing Knowledge and Understanding

Effective conservation of the region's biodiversity depends very much on the state of knowledge of that biodiversity. Currently, only a partial inventory of the components of biodiversity in the South Coast is available. The better-known groups like vertebrate fauna and vascular flora are reasonably well known but knowledge of the distributions of fungi, macro-invertebrates and micro-organisms lag a long way behind with many known species undescribed and many still awaiting discovery. More surveys aimed at these under-reported groups are needed in the South Coast Region.

Understanding the ecological roles of species and communities also informs our management decisions and there remains a great deal to do to improve knowledge of this kind. Disseminating such knowledge and understanding of biodiversity and its importance among the wider community is needed to support changes in way land is managed.

## Bibliography and References

Allen, G. R. (1982). *Inland Fishes of Western Australia*. Western Australian Museum, Perth.

- Armstrong, R. (1998). *Western Shield - Bringing back Wildlife from the Brink of Extinction. Fox and Rabbit Control Workshop Proceedings*. SCRIPT.
- Austin, C. M. and Knott, B. (1996). *Systematics of the freshwater crayfish genus Cherax Erichson (Decapoda: Parastacidae) in south-western Australia: Electrophoretic, morphological and habitat variation*. *Australian Journal of Zoology* **44**: 223-258.
- Barrett, S. (1996). *Biological Survey of Mountains of Southern Western Australia*. Department of Conservation and Land Management, Perth.
- Beard, J.S. (1980). *Vegetation Survey of Western Australia*, 1:250,000 Series. Vegmap, Perth.
- Beard, J. (1990). *Plant life of Western Australia*. Kangaroo press, Kenthurst.
- Beard, J. (1999). In Mittermeier, R. A., Myers, N and Mittermeier, C. G. (eds) (1999). *Hotspots: Earth's biologically richest and most endangered ecoregions*. CEMEX, Mexico. Pp 405-414.
- Bougher, N. L. and Syme, K. (1998). *Fungi of Southern Australia*. University of Western Australia Press, Perth.
- Bradby K et al. (2003) Unpublished report. *Gondwana Link Project Draft Strategic Plan*. Gondwana Link Partners Albany WA
- Brooker, M. I. H. and Kleinig, D. A. (2001). *Field Guide to the Eucalypts*. Vol 2, South-western and Southern Australia. 2<sup>nd</sup> edition. Bloomings Books, Melbourne.
- Brown, A., Thompson-Dans, C. and Marchant, N. (eds) (1998). *Western Australia's Threatened Flora*. Department of Conservation and Land Management. Perth.
- Burbidge, A. A. and de Tores, P. (1998). *Western Ringtail Possum (Pseudocheirus occidentalis) Interim Recovery Plan*. Interim Recovery Plan No. 17. Department of Conservation and Land Management.
- Christensen, P. (1992). *The Karri Forest – its conservation, significance and management*. Department of Conservation and Land Management, Perth.
- Common, I. F. B. (1990). *Moths of Australia*. Melbourne University Press, Melbourne.
- Common, I. F. B. and Waterhouse, D. F. (1982). *Butterflies of Australia: field edition*. Angus and Robertson, Sydney.
- Corrick, M. (2002). *Wildflowers of Southern Western Australia*. The Five Mile Press, Melbourne.
- Danks, A., Burbidge, A. A., Burbidge, A. H. and Smith, G. T. (1996). *Noisy Scrub-bird Recovery Plan. Wildlife Management Program No. 12*. Department of Conservation and Land Management.
- Department of Conservation and Land Management (1991). *Fitzgerald River National Park Management Plan 1991-2001*. Department of Conservation and Land Management, Perth.
- Department of Conservation and Land Management (1992). *South Coast Region Management Plan 1992-2002*. Department of Conservation and Land Management, Perth.
- Department of Conservation and Land Management (1992). *Walpole-Nornalup National Park Management Plan 1992-2002*. Department of Conservation and Land Management, Perth.
- Department of Conservation and Land Management (1995). *Two Peoples Bay Nature Reserve Management Plan 1995-2005*. Department of Conservation and Land Management, Perth.
- Department of Conservation and Land Management (1999). *Stirling Range and Porongurup National Parks Management Plan 1999-2009*. Department of Conservation and Land Management, Perth.
- Garnett, S. (1992). *The Action Plan for Australian Birds*. Australian National Parks and Wildlife Service. Endangered Species Program Project Number 21.
- George, A. S. (1996). *The Banksia Book*. Third Edition. Kangaroo Press, Sydney.
- Gilfillan, S. (2000). *Terrestrial Fauna of the South Coast - a review*. A supporting document to *Southern Shores - a strategy to guide coastal and marine planning and management in the south coast region of Western Australia*.

- Hangay, G. and German, P. (2000). *Insects of Australia*. Reed New Holland, Sydney.
- Harold, G and Dennings, S (1998). *The First Five Years 1992-1997: a report by the Malleefowl Preservation Group*. Malleefowl Preservation Group, Ongerup.
- Hoffman, N and Brown, A. (1998). *Orchids of South-West Australia*. Second Edition. University of Western Australia Press, Perth.
- Hopkins, A. J. M., Beeston, G. R., Harvey, J. M., Lemin, H. and Shepard, D. P (2001). *A Database on the Vegetation of Western Australia. Stage 1*. Technical Report No. 21, Department of Agriculture, Western Australia.
- Hopper, S. D. (1993). *Kangaroo Paws and Catspaws: a natural history and field guide*. Department of Conservation and Land Management, Perth.
- Hopper, S. D., Harvey, M. S., Chappill, J. A., Main, A. R. and Main, B. Y. (1996). *In Gondwanan Heritage: past, present and future of the Western Australian biota*. Hopper, S. D., Chappill, J. A., Harvey, M. S. and George, A. S. (eds). Surrey, Beatty and Sons, Chipping Norton.
- Hopper, S. D. Chappill, J. A., Harvey, M. S. and George, A. S. (eds). (1996). *Gondwanan Heritage: past, present and future of the Western Australian biota*. Surrey, Beatty and Sons, Chipping Norton.
- Horwitz, P. and Adams, M. (2000). *The systematics, biogeography and conservation status of species in the freshwater crayfish genus Engaewa* (Riek) Decapoda: Parastacidae) from south-western Australia. *Invertebrate Taxonomy* **14**: 655-680.
- McKenzie, N. L., May, J. E. and McKenna, S. (eds). *Bioregional summary of the 2002 Biodiversity Audit for Western Australia*. Department of Conservation and Land Management, Perth.
- McQuoid, N.K (2004 in prep) *The Natural Patterns and Eco-zones of the WA South Coast Natural Resource Management Region*. Greening Australia (WA) SCRIPT
- McQuoid, N.K. (2003) *Reasons for Richness, the Nature of the Fitzgerald Biosphere Vegetation*. Australian Government Natural Heritage Trust, SCRIPT
- McQuoid, N.K. (2003 in prep) *Annotated Checklist of the Eucalypts of the Fitzgerald Biosphere*.
- McQuoid, N.K and Hopper S.D. (2001) *Eucalyptus calyerup* (Myrtaceae), a new species of possible hybrid origin from south-western Australia. Nuytsia 15.1 CALM Perth
- Main, B. Y. (1984). *Spiders*. Collins, Sydney.
- Menkhorst, P. W. (2001). *A Field Guide to the Mammals of Australia*. Oxford University Press. Melbourne.
- Mittermeier, R. A., Myers, N and Mittermeier, C. G. (eds) (1999). *Hotspots: Earth's biologically richest and most endangered ecoregions*. CEMEX, Mexico.
- Morgan, D. L., Gill, H. S. and Potter, I. C. (1998). *Distribution, identification and biology of freshwater fishes in south-western Australia*. Records of the Western Australian Museum, Supplement No 56.
- Myers, N. (1990). *The biodiversity challenge: expanded hotspot analysis*. *The Environmentalist* **10**: 243-55.
- Nauman, I. D. (ed) (1992). *The Insects of Australia*. CSIRO/MUP, Melbourne.
- Pizzey, G. (1997). *A Field Guide to the Birds of Australia*. Angus and Roberstson. Australia.
- Storr, G. M., Smith, L. A. and Johnstone, R. E. (1990). *Lizards of Western Australia 3: Geckos and Pygopods*. Western Australian Museum, Perth.
- Storr, G. M., Smith, L. A. and Johnstone, R. E. (1999). *Lizards of Western Australia 1: Skinks*. Western Australian Museum, Perth.
- Storr, G. M., Smith, L. A. and Johnstone, R. E. (2002). *Snakes of Western Australia*. Western Australian Museum, Perth.

Thackaway, R. and Cresswell, I. D. (eds) (1995). *An Interim Biogeographic Regionalisation for Australia: A framework for setting priorities in the national reserve system cooperative program*. Australian Nature Conservation Agency, Canberra.

Trayler, K.M., Davis, J. A., Horwitz, P. and Morgan, D. (1996). *Aquatic fauna of the Warren Bioregion, south-west Western Australia: does reservation guarantee preservation?*. J. Roy. Soc. WA, 79:281-291.

Thompson, C, Hall, G and Friend, G. (1993). *Mountains of Mystery: a natural history of the Stirling Range*. Department of Conservation and Land Management, Perth.

Tyler, M. J., Smith, L. A. and Johnstone, R. E. (2000). *Frogs of Western Australia*. Western Australian Museum, Perth.

Watson, J. and Wilkins, P. (1999). *The Western Australian South Coast Macro Corridor Project - a bioregional strategy for nature conservation*. PARKS, 9, (3), 7-16.

White, M. E. (1986). *The Greening of Gondwana*. Reed Books, Sydney.

White, M. E. (1994). *After the Greening*. Kangaroo Press, Sydney.

Wilson, E. O. (1992). *The Diversity of life*. Harvard University Press.