SOUTHERN & SOUTH–WESTERN FLATLANDS NRM CLUSTER

CLIMATE CHANGE IN AUSTRALIA

IMPACTS & ADAPTATION INFORMATION FOR AUSTRALIA'S NRM REGIONS

Southern and South-Western Flatlands climate change project:

Data layers explained

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SOUTHCOAST NATURAL RESOURCE MANAGEMENT

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Executive summary

This report describes and explains the methodology and outputs of species distribution modelling to assist NRM groups incorporate climate change into their management practices. In addition, the report contains general metadata for the GIS data produced by the project.

The report contains five main sections. Firstly, the introduction provides a brief description of the Southern and South-Western Flatlands cluster, followed by the objectives of the Stream 2 research project. In the second section, species distribution (bioclimatic) modelling is explained and the modelled species are listed, with the rationale behind their selection indicated. Following this, the collection and selection of data for the species distribution modelling is described. The types of GIS data created from the project are described and explained in the third and fourth sections, and in the final section GIS data file naming formats are described.

1. Introduction

1.1 Southern and South-Western Flatlands cluster

In 2012, the Australian Government launched its Regional Natural Resource Management Planning for Climate Change Fund (‘NRM Fund’), an initiative which aimed to help guide the location of carbon and biodiversity activities over the next five years. This NRM Fund has two streams: Stream 1 which funds NRM regional organisations to update their NRM plans to include adaptation and mitigation of climate change impacts; and Stream 2, which coordinates research to produce regional-level climate change information. The latter stream includes the Impacts and Adaptations Grants Program, which is delivered through eight ‘clusters’ of NRM regions. One of these clusters is the Southern and South-Western Flatlands (hereafter, ‘Flatlands’), incorporating south-western Australia and parts of South Australia (Figure 1.1).

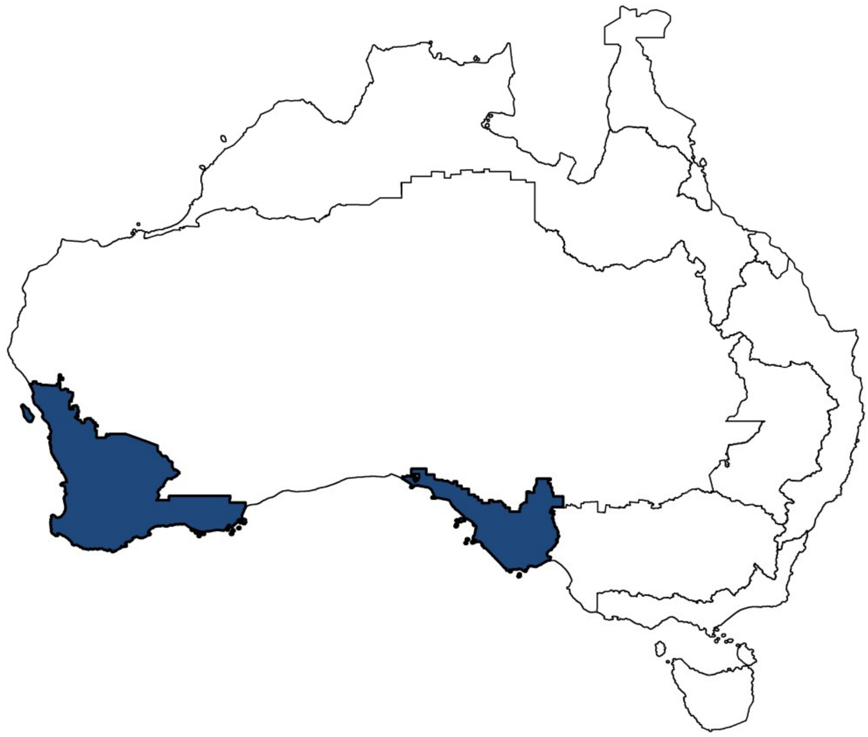

Figure 1.1: Map of Australia showing location of the Southern and South-Western Flatlands cluster.

The Flatlands cluster includes two geographically distinct regions: the Southern and South-Western Flatlands West (SSWFW) sub-cluster located in Western Australia; and the Southern and South-Western Flatlands East (SSWFE) sub-cluster located in South Australia. Together these two sub-clusters incorporate 10 NRM regions: South Coast, South West, Perth, Wheatbelt, Peel-Harvey, and Northern Agricultural are within the SSWFW sub-cluster; and the SSWFE sub-cluster is comprised of Eyre Peninsula, Kangaroo Island, Adelaide and Mount Lofty Ranges, and Northern and Yorke. The SSWFW sub-cluster coincides with a globally recognised biodiversity hotspot, defined by high levels of plant diversity and endemism, coupled with significant landscape modification. Orographic features of note in this cluster include the Stirling and Porongurup Ranges, Darling Scarp and Mt Lofty Ranges.

The Flatlands cluster encompasses one of the five Mediterranean ecosystems that occur globally. These five areas support 20% of the Earth's known vascular plant diversity. High levels of land conversion for agriculture, development and other human uses have resulted in these areas being considered a global conservation priority. Most of this region is characterised by a Mediterranean-type climate, with warm, dry summers and cooler, wet winters. The increasing temperatures and decreasing rainfall associated with future climate change is expected to further threaten biodiversity in the Australian Mediterranean ecosystem.

1.2 Flatlands Stream 2 research project

Like other Stream 2 projects, the Flatlands project was aimed at producing regional level climate change information to support medium term regional NRM and land use planning. Thus, the project delivered information on the potential impacts of climate change on biodiversity in the cluster, and provided guidance on how to use this information in NRM planning. Climate change information was produced through four sub-projects:

1. A review and synthesis of existing information
2. Preparation of spatial data layers based on existing studies
3. New bioclimatic modelling
4. Ongoing support for planning using spatial data

The project commenced with workshops in Perth and Adelaide in 2013. These workshops aimed to identify data priorities of the NRM regional organisations in the Flatlands cluster, and clarify which planning tools would be used by the NRM regions to incorporate climate change into NRM planning. On-going consultation following these workshops led to the identification of key biodiversity and agricultural information requirements including: the impacts of climate change on threatened species and their habitats; key and/or iconic flora species; key vegetation habitat types; linkages and corridors; and fire. Several of the regions are using the Multi-Criteria Analysis Shell for Spatial Decision Support (MCAS-S) tool for planning using spatial data. In doing so they have utilised data layers produced by the Flatlands project.

1.3 Objectives of report

This report provides a summary of the species distribution modelling (SDM) work undertaken (sub-project 3) as part of the Flatlands project.

1. Section 2 describes the modelling inputs, outputs, and methodology used in the species distribution modelling. We explain each of the seven steps used in the process, illustrating

how these were based on the needs of the NRM community, and how they build on existing work.

2. Section 3 outlines the range of derived layers – products built from outputs of multiple species distribution models. Each of the seven derived types of data are illustrated with examples, and explanations of its implications for resource managers included.
3. Section 4 outlines a different type of modelling – vegetation community modelling – and the implications of using whole communities in place of species for bioclimatic distribution modelling.
4. Section 5 provides detailed information on the datasets produced by this project, including full lists of the species modelled, the derived products, and the climate layers used.

NRM regions involved in the Flatlands project have been provided with all the results from the project. Individuals or other organisation wishing to access the results need to contact the project authors provided at the end of this report.

2. Bioclimatic modelling

Bioclimatic modelling (also referred to as species distribution modelling) is a commonly used tool for predicting the impacts of climate change on biodiversity (Pearson and Dawson 2003; Phillips et al. 2006; Yates et al. 2010). This approach provides reasonably good estimates of potential range shifts with climate change (Elith et al. 2006; Hijmans and Graham 2006), and is thus thought to be a valuable tool for developing an understanding of the potentially dramatic impacts of climate change on species' distributions. Briefly explained, authors model the bioclimatic envelope of selected species under current climatic conditions to identify climatic variables that limit the species current distribution. Based on these results, they then predict the distribution of the climatic envelope of the species into the future according to various climate change scenarios. When estimating whether species will experience either range contractions or expansions, it is assumed that species can either track shifting climatic envelopes (unlimited dispersal scenario), or will only persist in areas where current and future climate envelopes overlap (no dispersal scenario).

The Flatlands project has used bioclimatic modelling to predict the likely impacts of climate change on over 700 species of plants and animals, and 21 vegetation communities occurring in the Flatlands cluster. This report section explains the steps that were taken during this modelling process, and provides a glossary of terms used. These steps are as follows:

STEP 1: Selection of species to be modelled

STEP 2: Collection of occurrence records for species of interest

STEP 3: Selection of future scenarios and timeframes

STEP 4: Selection of suitable bioclimatic and environmental variables

STEP 5: Modelling of a subset of the species occurrence records (the 'training' data)

STEP 6: Validation of the model using a subset of records (the 'test' data)

STEP 7: Mapping of the predicted species' distribution under present and future scenarios

2.1 STEP 1: Selection of species to be modelled

Lists of species to be modelled were developed following workshops, face-to-face meetings, e-mail correspondence and telephone communication. Once the broad categories of spatial data layer needs were identified, the NRM regions were requested to prioritise these needs. Their collective prioritisations are shown in Figure 2.1 below.

Much of the work requested by NRM groups was out of the scope of this current project, but some has been covered in other Stream 2 projects (for example - weeds). Other aspects – such as linkages and corridors – have been covered through the NRM regions' own Stream 1 projects. The areas that were within the scope included threatened species, key/iconic/surrogate species and key vegetation/habitat types. As a result and in conjunction with on-going consultation, six groups of species were selected for modelling.

	Data required	NACC	SWCC	South Coast	Wheatbelt	Perth NRM
Biodiversity	Threatened species	medium	medium	High	High	High
	Threatened species habitats	medium	medium	High	High	High
	Key/ iconic/ surrogate species	medium	medium	medium	High	medium
	Key vegetation/ habitat types	medium	medium	high	high	High
	Linkages and corridors	high	high	high	high	High
	Weeds	low	medium	medium	medium	medium
	Plant pathogens	low	medium	low	medium	medium
	Pest animals	low	low	low	low	low
	Fire	high		high	medium	high

Figure 2.1: Priority data needs for the SSWFW sub-cluster.

2.1.1 Threatened species

Three of five regions in the SSWFW sub-cluster identified the need for climate change information on threatened species as ‘high priority’. Modelling of threatened fauna species was focused on vertebrates (Table A 1). Overall, a total of 18 mammals, 23 birds, nine reptiles, four amphibians and five fish species were modelled for south-western Australia.

A total of 11 threatened faunal species occurring in South Australia were also modelled (Table A 2). Although not listed under either State or Federal government legislation, the Pygmy Copperhead (*Austrelaps labialis*) is rated as ‘Vulnerable’ in the Action Plan for Australian Reptiles. Similarly, the Bassian Thrush (*Zoothera lunulata halmaturina*), considered as ‘rare’ under State legislation, has been given a status of ‘Vulnerable’ by the Adelaide and Mount Lofty Ranges region as its distribution in this region is disjunct and isolated from other populations in South Australia.

Modelling of threatened flora occurring in south-western Australia was focussed on those species which are most at risk. A total of 34 threatened flora species were modelled (Table A 3); 26 of these species are considered to be critically endangered.

A total of 15 threatened plant species from South Australia were modelled (Table A 4). The conservation status of these species ranged from ‘Endangered’ to not being listed under the EPBC Act.

2.1.2 Iconic plant species

Based on various (unidentified) selections made by each of the regions in both sub-clusters, 45 iconic plant taxa (predominantly tree species, subspecies and varieties) of interest were modelled (Table A 5).

2.1.3 Geographically restricted species occurring on Kangaroo Island

The Kangaroo Island (KI) NRM region identified their endemic flora as being a priority with respect to management of biodiversity under climate change. The Kangaroo Island endemic species were identified as the flora and fauna in the “Regional Species Conservation Assessments for the Kangaroo Island NRM region” where at least 80% of total observed sightings of a species occurred on Kangaroo Island. As a result, a total of 64 flora and four fauna are largely, if not entirely, restricted to Kangaroo Island (Table A 6).

2.1.4 Revegetation species

A number of regions are actively revegetating degraded lands. Modelling of species used in these revegetation projects was focussed on three groups of species, (i) species used to revegetate properties that form part of the Gondwana Link project, (ii) species used by NACC for revegetation in its region, and (iii) species used in South Australia by the Eyre Peninsula and Kangaroo Island regions (Table A 7).

2.1.5 Coastal vegetation

Coastal vegetation species occurring in south-western Australia that were flagged as important by NRM regions were modelled (Table A 8). To populate the coastal vegetation species list, the dominant coastal species from each of the coastal regions in Beard (1990) were assembled. Following this, expert opinion (S. Hopper, pers.com.) was utilised to ensure the list was correct and to provide any additions. This list includes species which are not only associated with dune systems (i.e. *Carpobrotus* spp), but also those found in the general coast area (i.e *Agonis flexuosa*), and species which are also found out of the coastal environment (i.e. *Nuytsia floribunda*).

2.1.6 Sandalwood plantation species

NACC identified Sandalwood host species as being important in identifying areas where future Sandalwood farming could be conducted under various climate change scenarios (Table A 9).

2.1.7 Carbon planting species

NACC requested species which have potential in carbon sequestration plantings, but in areas where future suitable climate had not been assessed (Table A 10).

2.1.8 Salt tolerant species

NACC requested species which have demonstrated tolerance to elevated salinity, but in areas where future suitable climate had not been assessed (Table A 11)

2.1.9 Fodder species

NACC requested species which have potential as fodder for livestock, but in areas where future suitable climate had not been assessed (Table A 12)

2.1.10 National Vegetation Inventory System (NVIS)

To assess the impacts of climate change on vegetation communities within south-western Australia and southern South Australian, current distributions of vegetation communities within these areas were extracted using GIS (ArcMap 10) from the National Vegetation Information System (NVIS) (http://www.environment.gov.au/topics/science-and-research/databases-and-maps/national-vegetation-information-system). The NVIS is a comprehensive data system that provides information on the extent and distribution of vegetation types in Australian landscapes. As many of the communities within the study area have distributions which extend outside south-western Australia and southern South Australia, the community distribution was extracted at the continental scale. All 37 vegetation communities occurring in the study area were initially modelled to assess the contribution of climate to their distribution. Of the 37 communities, 21 were found to have climate as a significant driver of the modelled distribution and these 21 were then modelled for future climate scenarios.

2.2 STEP 2: Collection of occurrence records for species

The biological input into the modelling process was geo-referenced species occurrence records. Figure 2.2 provides an example of occurrence records for Carnaby's Cockatoo (*Calyptorhynchus latirostris*). For both threatened and non-threatened species, these records were collected at the geographical extent of the State of Western Australia. Non-threatened species records were obtained through Atlas of Living Australia (http://www.ala.org.au), and Nature Map (http://naturemap.dec.wa.gov.au). However, due to the sensitive nature of the threatened species records, advanced registration for access to Nature Map data on threatened species was provided by the Department of Parks and Wildlife (DPaW). Hence, for modelling of threatened species, occurrence records (at the required resolution) were all sourced from Nature Map.

As the rainfall in south-western Australia has undergone a marked decrease since the 1970's, with a noticeable step reduction in 1975 (Hope et al. 2006), only occurrence records from 1976 onwards were incorporated in the analyses. Furthermore, records with a spatial uncertainty greater than 5000m were also removed prior to analyses to ensure the spatial resolution was congruent between the biological records and the grain size of the climatic and environmental layers. Species for which fewer than 10 records were available after the application of the above criteria, were not included in the analyses.

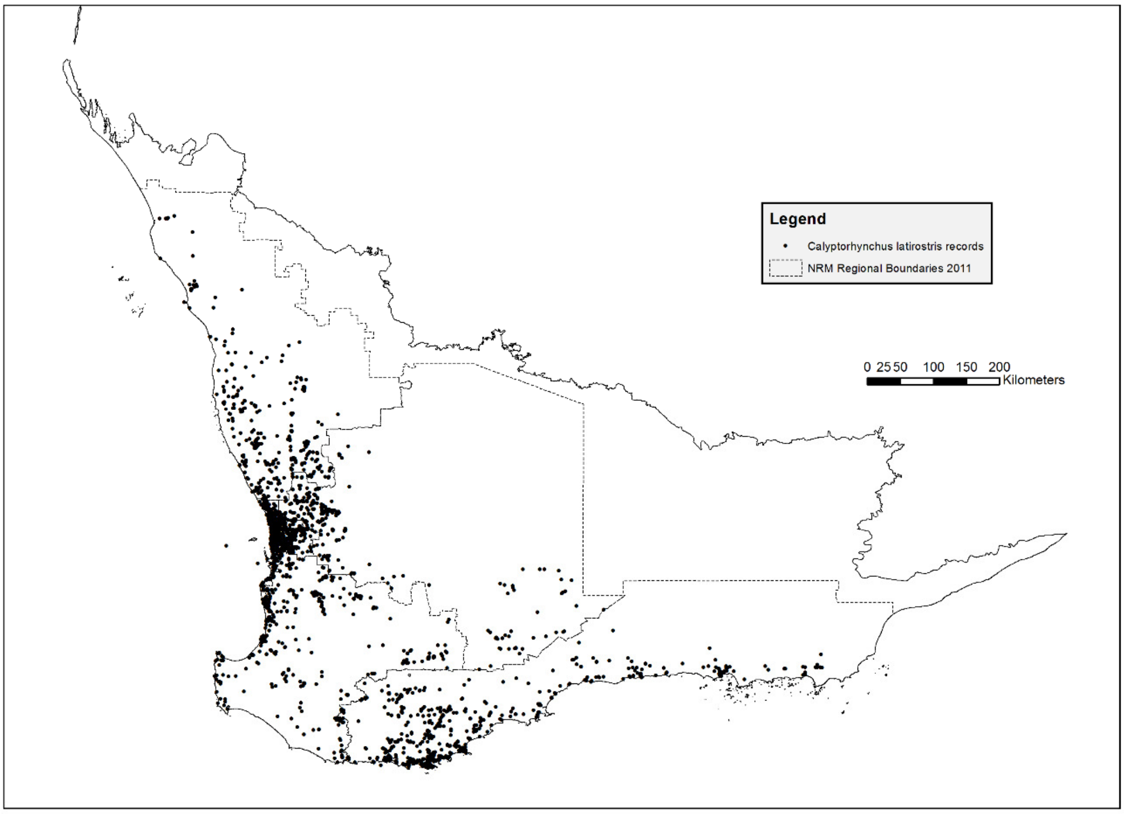

Figure 2.2: Occurrence records for Carnaby's Cockatoo. Each point represents a record.

2.3 STEP 3: Selection of future scenarios and timeframes

There is a very large range of Global Climate Models (GCMs) available that model future climate. These models vary in how they work, and their projections for future climate reflect these differences. Projections are available for different years as well as for different future emission scenarios (assumptions about the level of CO_2 and other greenhouse gasses which are emitted by human society). This great complexity of potential results means care must be taken when selecting appropriate GCMs.

The Coupled Model Intercomparison Project Phase 3 (CMIP3) models, typically used in conjunction with the Special Report on Emissions Scenarios (SRES) scenarios were released in 2007 and are projections of greenhouse gas emissions which include: Carbon Dioxide (CO_2); Carbon Monoxide (CO); Hydrochlorofluorocarbons (HCFCs); Hydrofluorocarbons (HFCs); Methane (CH_4); Nitrous Oxide (N_2O); Nitrogen Oxides (NOx); Non-Methane Hydrocarbons

(NMVOCs); Perfluorocarbons (PFCs); Sulfur Dioxide (SO_2); and Sulfur Hexafluoride (SF_6). These projected emissions are based on several potential differences in the technological, social, and economic activities of humans (Nakicenovic and Swart 2000). CMIP3 models and SRES scenarios have since been superseded by the CMIP5 models and Representative Concentration Pathways (RCP) scenarios. RCP scenarios, instead of being based on greenhouse gas emissions, are scenarios based on radiative forcing (additional heat energy (W/m^2)) at the surface of the earth due to increases in greenhouse gas concentrations by 2100 (Van Vuuren et al. 2011). In their comparison of CMIP3 and CMIP5 data, Knutti and Sedláček (2013) found the projections of change in precipitation and temperature between the suites of models to be similar.

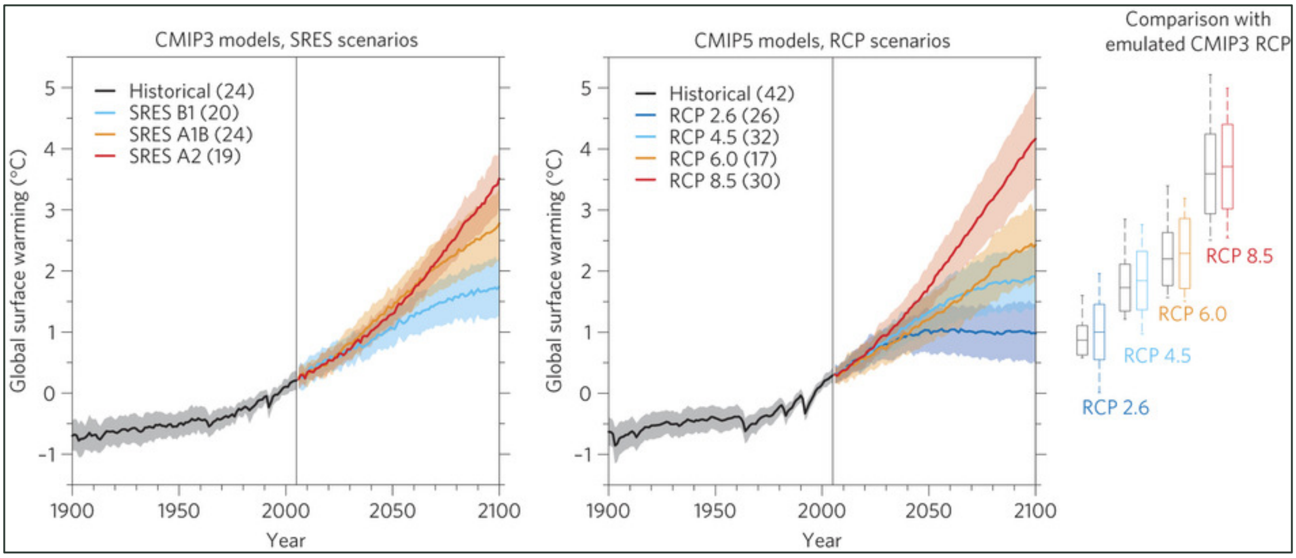

Figure 2.3: Comparison of CMIP3/SRES and CMIP5/RCP projections. Figure from Knutti & Sedláček (2013).

A comparison of SRES and RCP projections of changes in temperature and rainfall for south-western Australia using the A2 and 8.5 scenarios by 2080 is provided in Figure 2.4. While the general patterns of projected change are comparable, the magnitude differs. Both scenarios project reduced increases in temperature along the coast (Figure 2.4 A & B). However, the RCP 8.5 scenario projects greater increases in temperature inland and along the west coast. In rainfall projections, both scenarios project decreases in rainfall, with the greatest reduction in the southwest corner of the region (Figure 2.4 C & D). Conversely to temperature projections, the SRES A2 scenario projects greater reductions in rainfall than the RCP 8.5 scenario.

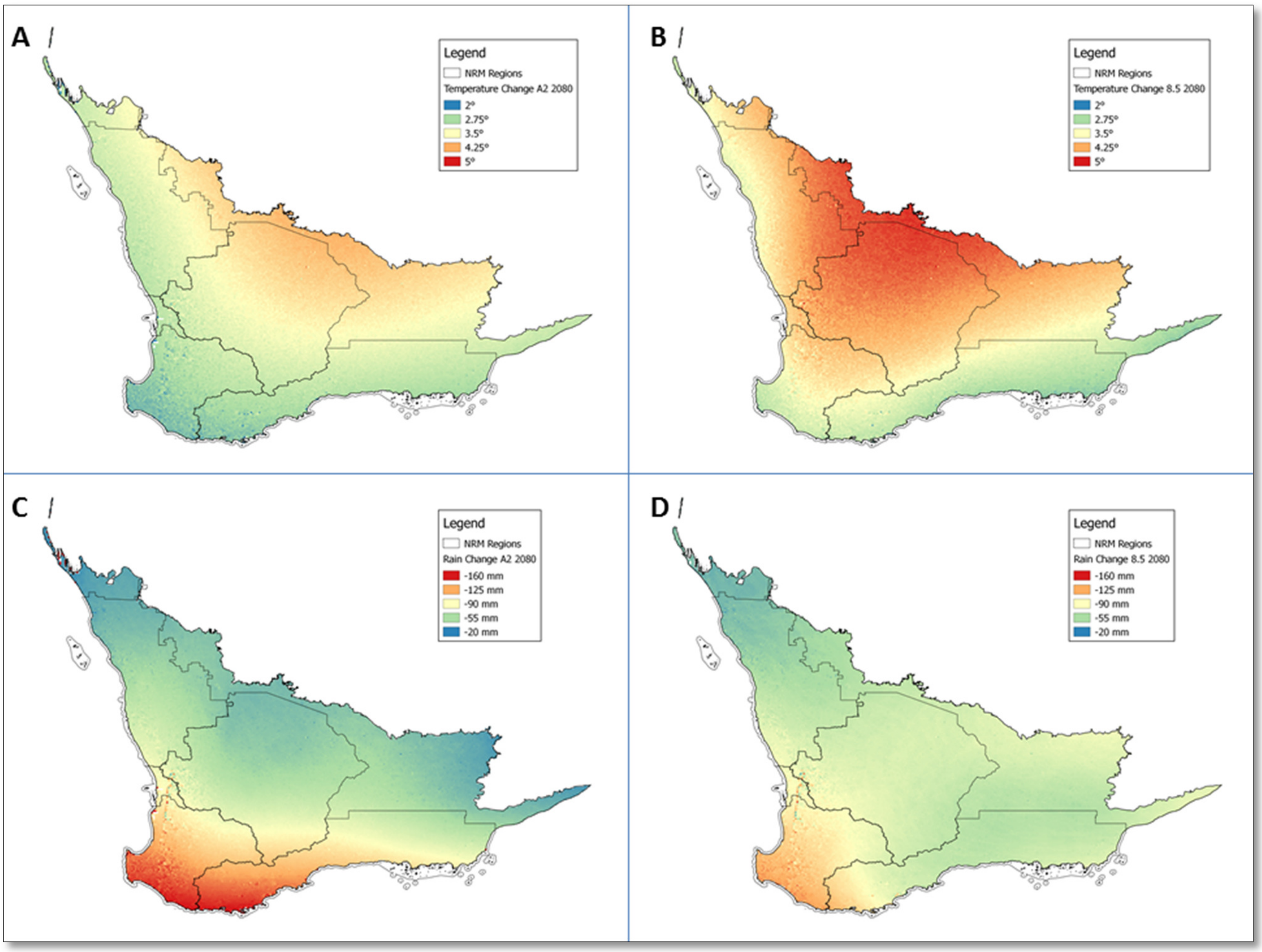

Figure 2.4: Comparison of A2 SRES (A & C) and 8.5 RCP (B & D) scenarios for projections of changes in temperature (A & B) and rainfall (C & D) in south-western Australia.

For species that occurred in south-western Australia, modelling was performed for current (baseline) conditions and three future emission scenarios – low (B1), medium (A1B), and high (A2). SRES scenarios were utilised as RCP scenarios were not available at the time. These emission scenarios are described in the Intergovernmental Panel on Climate Change's (IPCC) Special Report on Emissions Scenarios (Nakicenovic and Swart 2000). Briefly defined, these scenarios depict: a convergent world with rapid change in economic structures, "dematerialization" and introduction of clean technologies (B1); a future world of very rapid economic growth and a balance across all energy sources (A1B); and a very heterogeneous world with continuously increasing global population and slower growth and technological change (A2: the 'business as usual scenario').

Selection of suitable GCMs was facilitated by the use of the Climate Futures Tool that can be found on the Climate Change in Australia website (http://www.climatechangeinaustralia.gov.au/en/). This tool organises climate models according to their simulated changes in rainfall and temperatures. The three models selected (CSIRO Mk 3.5, MIUB ECHO-G, and MIROC-M) all fell into the maximum consensus climate box, and the modelling used an average of these three Global Climate Models (GCMs). Modelling was carried out at 2.5arc minute (≈5km) resolution.

The emission scenarios used were those described in the Intergovernmental Panel on Climate Change's (IPCC) Special Report on Emissions Scenarios (SRES) (Nakicenovic and Swart 2000). Although the Representative Concentration Pathways (RCPs) (Moss et al. 2010; Van Vuuren et al. 2011) and the SRES scenarios do not correspond directly to each other, carbon dioxide concentrations under RCP4.5 (intermediate emissions) are similar to that of the B1 scenario, and concentrations under RCP8.5 (high emissions) are similar to that of A1F1 scenario.

Future scenarios were modelled for 2030 and 2080, reflecting a near future (within the lifespan of most readers) and a time near the endpoint of current modellings. For the purposes of this summary report, future predictions illustrated are only for 2080s under high emission scenario (A2: the 'business as usual scenario').

2.4 STEP 4: Selection of suitable bioclimatic and environmental variables

The climatic variables used in these analyses were obtained from the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) website (http://www.ccafs-climate.org/). Table 1 contains the climatic and environmental variables incorporated into the modelling. Annual temperature was found to be highly correlated to other climatic variables and was not included in the modelling. In addition to climate variables, altitude was also obtained from CCAFS and soil was created using the "Geologic Unit Polygons 1M" polygon obtained from Geoscience Australia (http://mapconnect.ga.gov.au/MapConnect/).

Table 1: Climate and environmental variables used in bioclimatic modelling.

Variable	Description
BIO2	Mean Diurnal Range
BIO3	Isothermality
BIO4	Temperature Seasonality
BIO5	Max Temperature of Warmest Month
BIO6	Min Temperature of Coldest Month
BIO7	Temperature Annual Range
BIO8	Mean Temperature of Wettest Quarter
BIO9	Mean Temperature of Driest Quarter
BIO10	Mean Temperature of Warmest Quarter
BIO11	Mean Temperature of Coldest Quarter
BIO12	Annual Precipitation
BIO13	Precipitation of Wettest Month
BIO14	Precipitation of Driest Month
BIO15	Precipitation Seasonality
BIO16	Precipitation of Wettest Quarter
BIO17	Precipitation of Driest Quarter
BIO18	Precipitation of Warmest Quarter
BIO19	Precipitation of Coldest Quarter
Altitude	Altitude
Soil	Soil

2.5 STEP 5: Modelling of training species occurrence data

The Maxent process determines how tightly occurrence records track a value of each of the environmental variables included and determines the relative importance of each variable. In the case of Carnaby's Cockatoo, precipitation of the coldest quarter explained 63% of the occurrence records, and annual precipitation explained 22% of the occurrence records. This indicates that this species tightly tracks specific values of winter rain. When the relative importance of each climate variable and the tracked value of each variable has been determined, areas of climatic suitability can be identified.

Figure 2.5 displays the predicted current climate suitability (or likelihood of occurrence) of Carnaby's Cockatoo based on the climatic variables incorporated into the modelling. Areas of higher concentrations of occurrence records align with areas of greater climate predicted climate suitability, indicating that the modelling has made a prediction of occurrence that matches well with existing records of occurrence. In this report "climatic suitability" and "likelihood of occurrence" will be used interchangeably as increased climate suitability is one aspect which results in increased likelihood of occurrence.

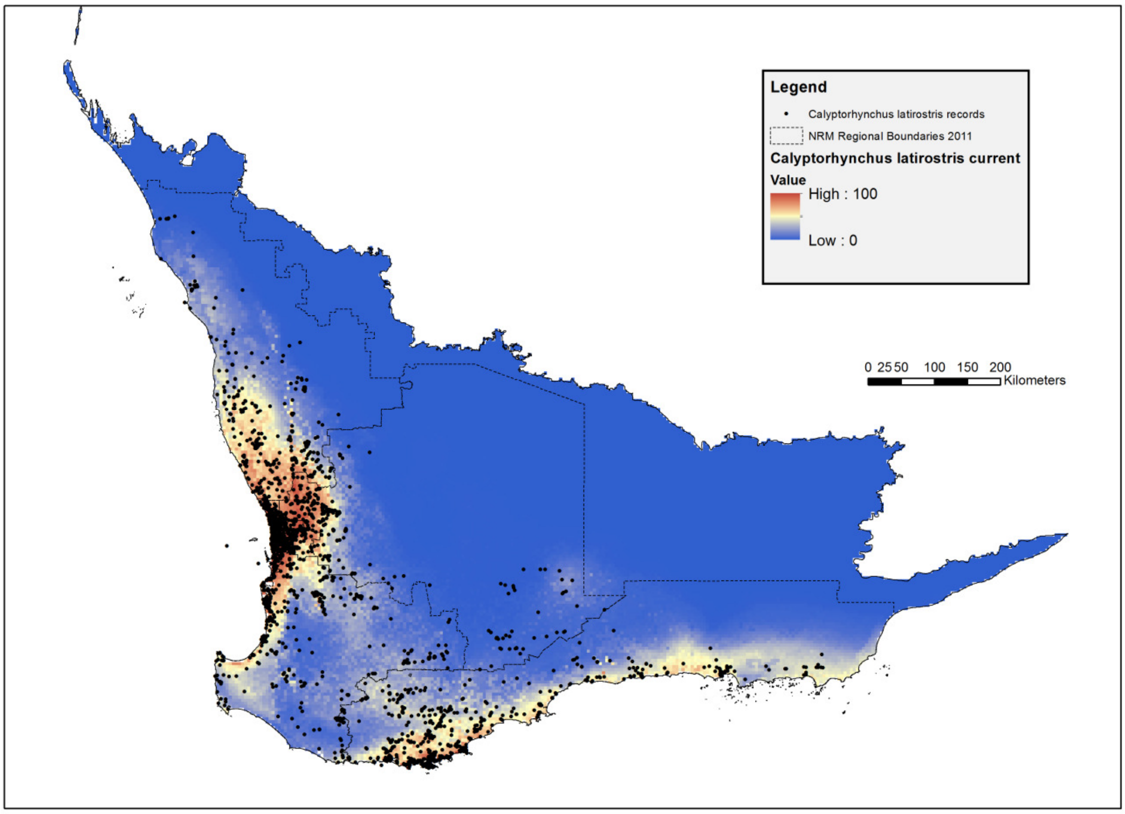

Figure 2.5: Occurrence records for Carnaby's Cockatoo and predicted current climate suitability for Carnaby's Cockatoo.

The Maxent process then applies the values which determined the species current climate envelope and detects where this combination of values exists in the projected future climate variables. In other words, it predicts where the species could occur in a future climate. The area deemed as climatically suitable for Carnaby's Cockatoo by 2080 under a high emission scenario is shown in Figure 2.6. As with many other species modelled as part of this project, the suitable climate of Carnaby's Cockatoo is predicted to contract and shift towards the southwest corner of Western Australia. Despite this shift in the climate envelope of Carnaby's Cockatoo, it can be noted that the majority of occurrence records are still within the future suitable climate envelope.

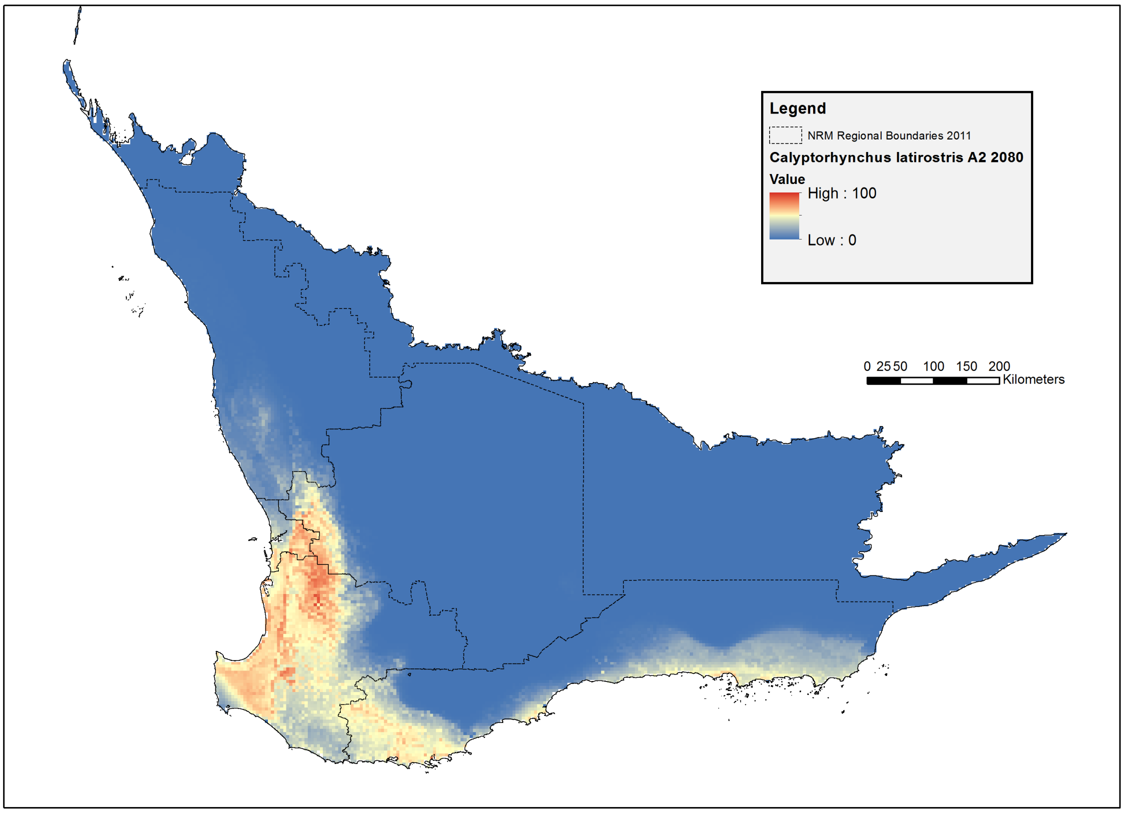

Figure 2.6: Predicted climate suitability for Carnaby's Cockatoo by 2080 under high emissions scenario.

Many of the derived layers in Section 3 are based on presence/absence information for each species. This information was calculated as all cells within the climate envelope where the likelihood of occurrence is greater than a species specific lower threshold of climate suitability. The threshold value is an output of the Maxent modelling process. Carnaby's Cockatoo current climate envelope in presence/absence format is displayed in Figure 2.7.

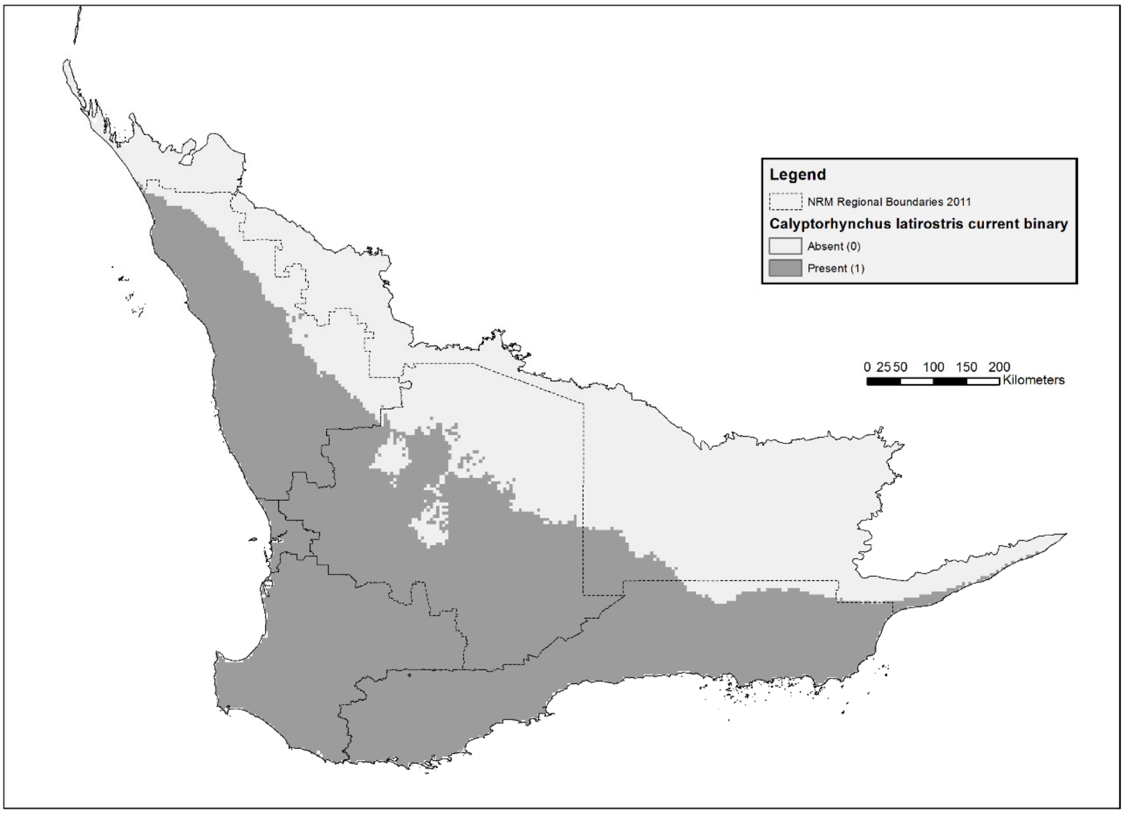

Figure 2.7: Presence/absence format of Carnaby's Cockatoo current climate suitability. Grey represents the climate envelope.

3. Derived layers

3.1 Richness

In order to estimate richness, the presence/absence climate envelopes (i.e. Figure 2.7) were summed. Thus, in this report, richness refers to the sum of climate envelopes. Figure 3.1 displays the predicted current richness for 220 species of southwest Western Australia (SW WA) flora. While the use of only 220 species does not truly represent the vegetation of SW WA, the general pattern of climate envelope richness appropriately reflects true species richness (number of species) in the region, with increased numbers of climate envelopes located in the northern and southern sandplain regions.

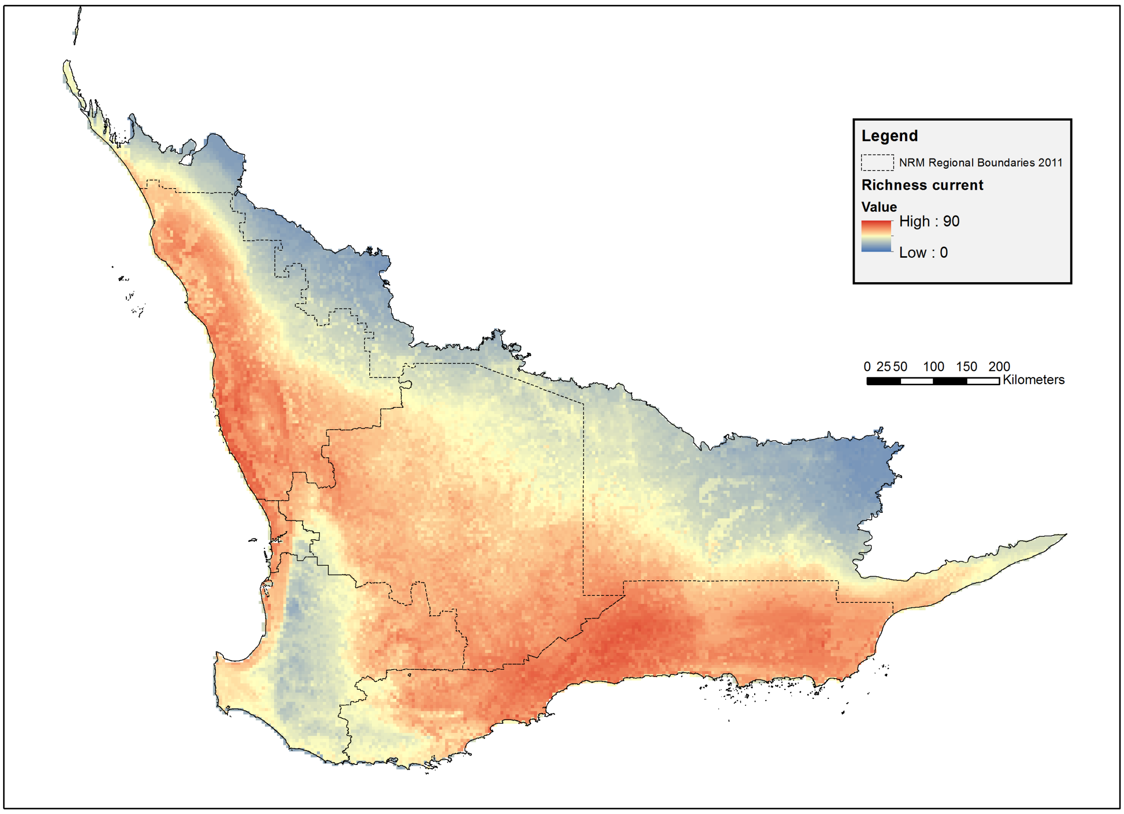

Figure 3.1: Current richness of modelled flora (220 species) climate envelopes.

Figure 3.2 demonstrates the richness of climate envelopes of the 220 species of flora by 2080 under the high emission scenario. As with the Carnaby's Cockatoo example, the areas of higher climate envelope richness can be observed to be contracting and shifting to the southwest corner.

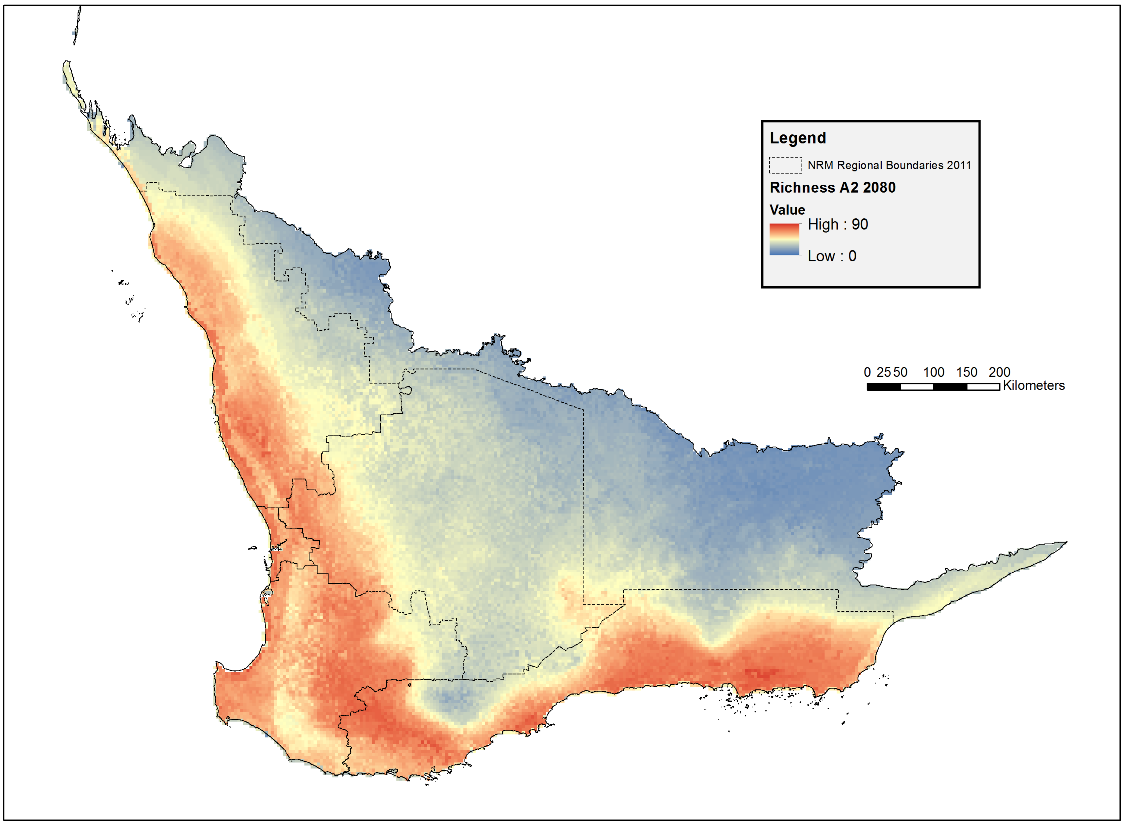

Figure 3.2: Richness of modelled flora (220 species) by 2080 under high emission scenario.

3.2 Response groups

Cluster analysis was performed in order to group species by their "response" to the climate variables. In other words, species were clustered based on how similar the relative importance of their climate variables was found to be. Figure 3.3 provides a dendrogram of species responses to climate variables, where the termination of a "branch" denotes a species, and the colours on the right indicate the clusters of species. The further to the left two species are connected, the greater the difference (distance) in their important climate variables. From this analysis, the driving variable(s) (i.e. winter rain, summer temp, etc) for each group was determined. The plot displayed 11 response groups of species, with 8 species displaying individualistic climate responses. These latter species were not included in analyses utilising the response groups.

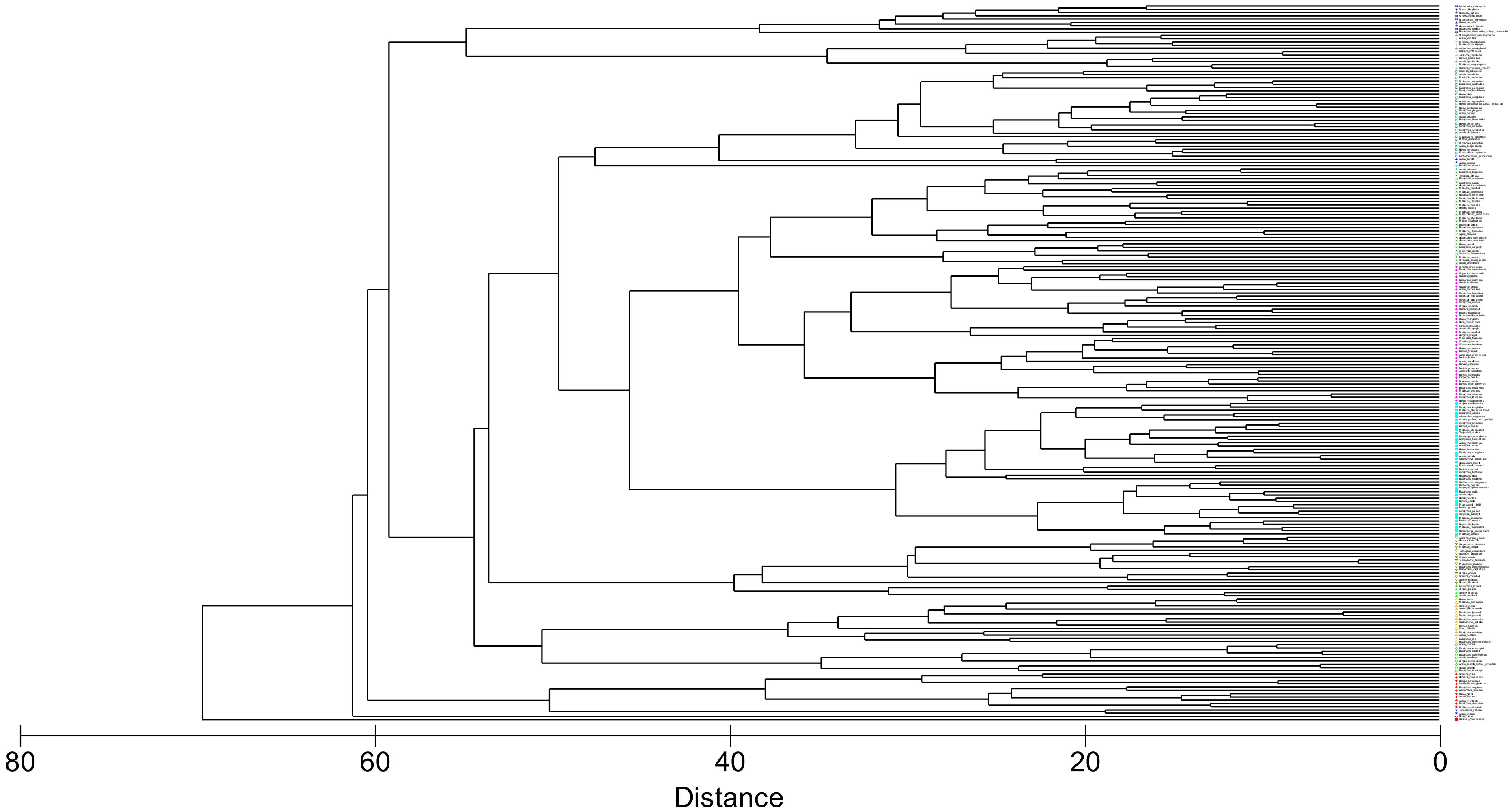

Figure 3.3: Results of cluster analysis used to identify groups of flora species with similar responses to climate variables.

3.3 Refugia – NCCARF method

Reside et al. (2013) determined refugia for terrestrial animals in Australia. Figure 3.4 to Figure 3.6 demonstrates the methodology of this approach and the result when applied to the 212 species of flora.

Reside et al. (2013) based their analyses on four groups of vertebrates (amphibians, birds, reptiles, and mammals). To achieve a comparable result utilising only flora, the response groups described above (Figure 3.3) were incorporated.

For each of the response groups, percentiles of immigrants and emigrants were calculated for each cell as a proportion of current climate envelope richness. Immigrants are defined as species whose climate envelope is not in a cell under current climate but is under the projected future climate, and emigrants are the opposite (currently in a cell, but not in the future). To detect areas which lost the least number of species (emigrants), the areas containing less than the 10th percentile of emigrants were identified. Figure 3.4 provides an example of winter rain response group emigrants by 2080 under the high emission scenario. The black shading thus represents areas which lose the least amount of species from this response group.

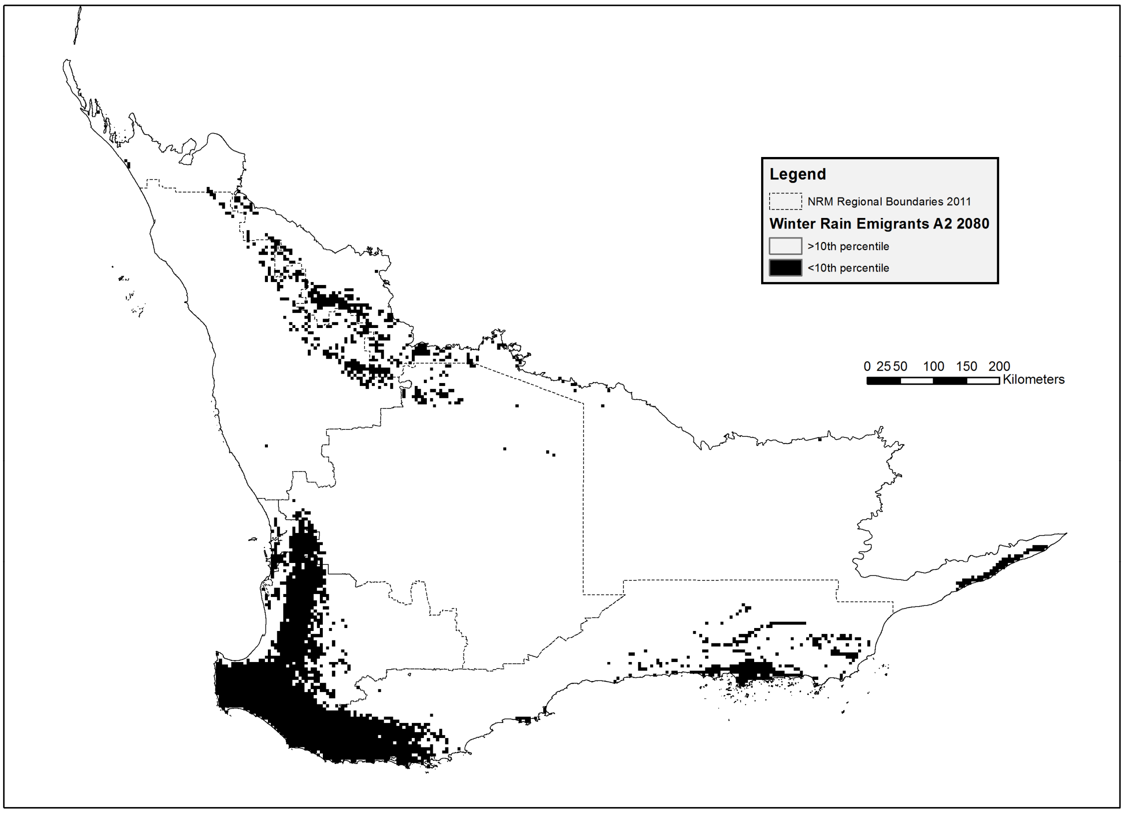

Figure 3.4: Areas identified as containing less than the 10th percentile of winter rain response group emigrants by 2080 under high emission scenario.

To identify areas which gained the most species (immigrants), areas which contained greater than the 90th percentile of immigrants were determined. An example of winter rain response group immigrants by 2080 under the high emission scenario is shown in Figure 3.5.

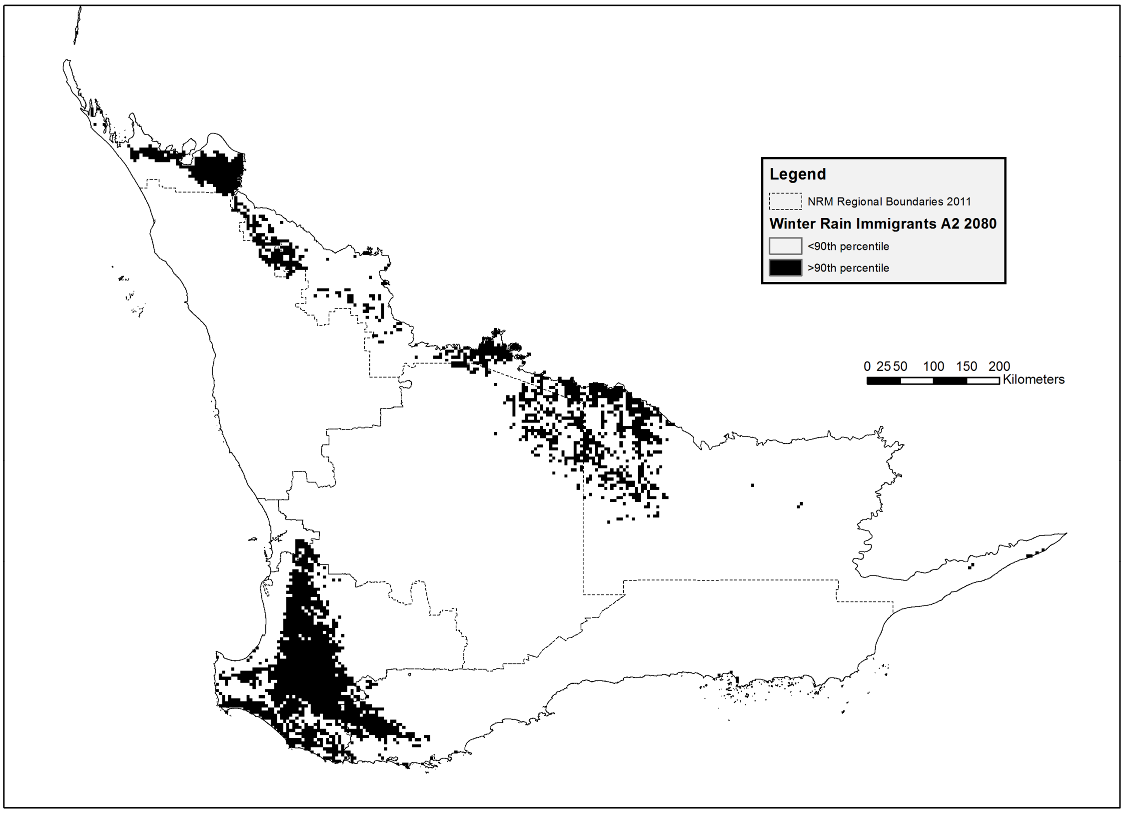

Figure 3.5: Areas identified as containing greater than the 90th percentile of winter rain response group immigrants by 2080 under high emission scenario.

To find the refugia for each group, areas where the immigrants and emigrants of that group overlapped were then determined. The refugia for winter rain response group species can be seen as the black areas in Figure 3.6, and the grey shaded areas contain either immigrants or emigrants, not both. In this example, following the methodology of Reside et al. (2013), the black areas in Figure 3.6 represent the climate refugia for the winter rain response group of species. Thus, the 'Jarrah forest' in SW WA is predicted to be a climate refuge for flora species which have distributions strongly related to values of winter rain.

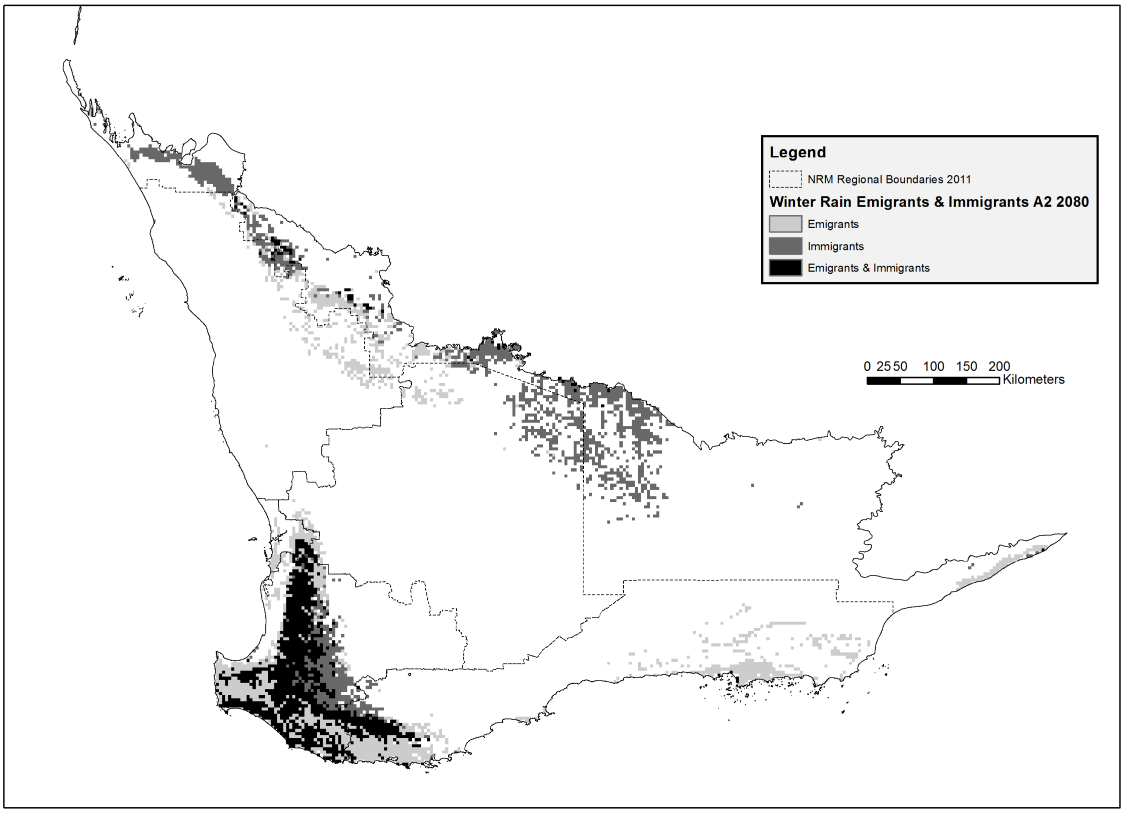

Figure 3.6: Areas identified as containing less than the 10th and greater than the 90th percentiles of winter rain response group emigrants and immigrants respectively by 2080 under high emission scenario.

Finally, the refugia identified (the black area in Figure 3.6) for each response group are summed. The refugia identified through this method for the 212 flora species (after individualistic response species removed) is displayed in Figure 3.7. The potential maximum of 22 (11 groups x (immigrants + emigrants)) was not achieved as no cell contained both immigrants and emigrants for all groups. However, the Jarrah forest area, and to a lesser extent the Esperance region can still be identified as potential flora refugia areas, as they are predicted to gain the most species, and lose the least species for each of the response groups.

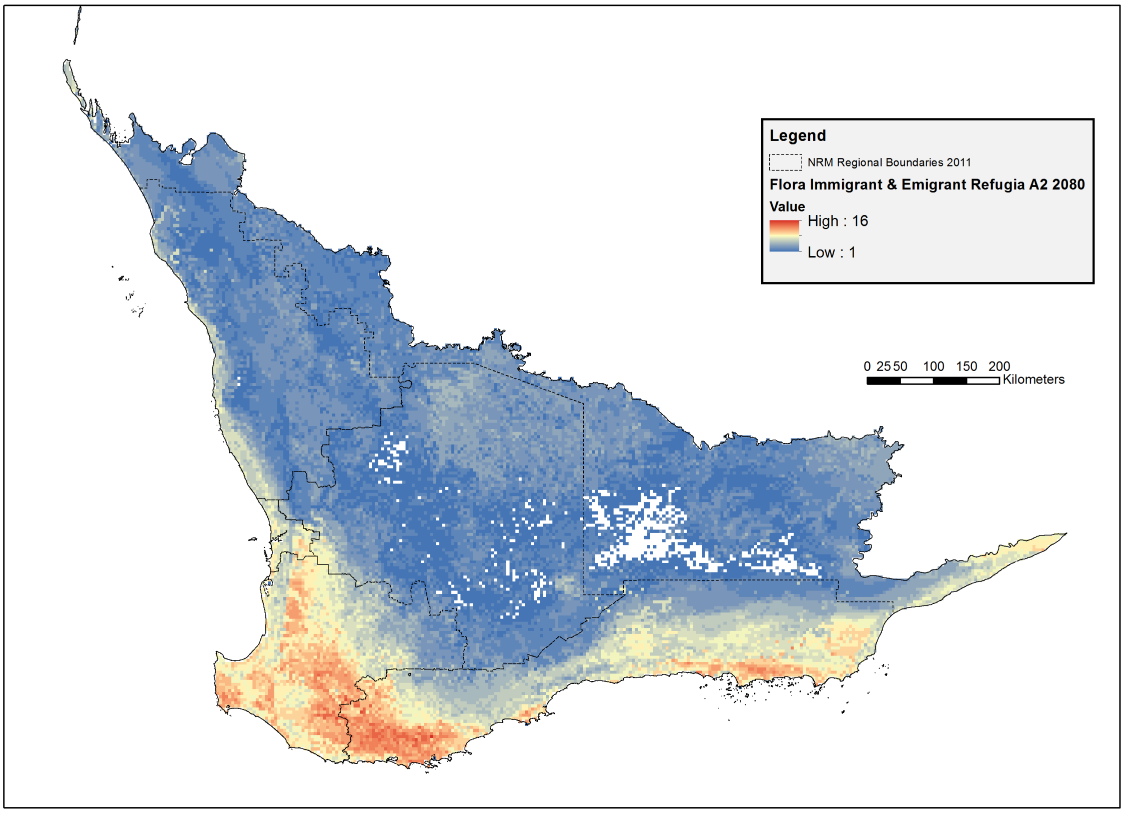

Figure 3.7: Flora refugia as identified as the sum of response group refugia.

3.4 Refugia – Envelope overlap

Refugia can also be thought of as "habitats that components of biodiversity retreat to, persist in and can potentially expand from under changing environmental conditions" (Keppel et al. 2012). To detect locations of potential refugia under this definition, areas where the current and future climate envelopes of each species overlapped were identified. The areas of current and future climate envelop overlaps have been mapped for Rock Sheoak (*Allocasuarina huegliana*) by 2080 under the high emission scenario (Figure 3.8). Here it can be observed that by this timeframe and under this emission scenario, the climate envelope of this species has greatly contracted along its northeast edge (red area), although there is still a reasonable area which is climatically suitable for this species currently and in the future (blue area). This species does not demonstrate much range extension with changing climate as its future area (green) is relatively small. From this perspective, the blue area can be viewed as potential refugia for this species.

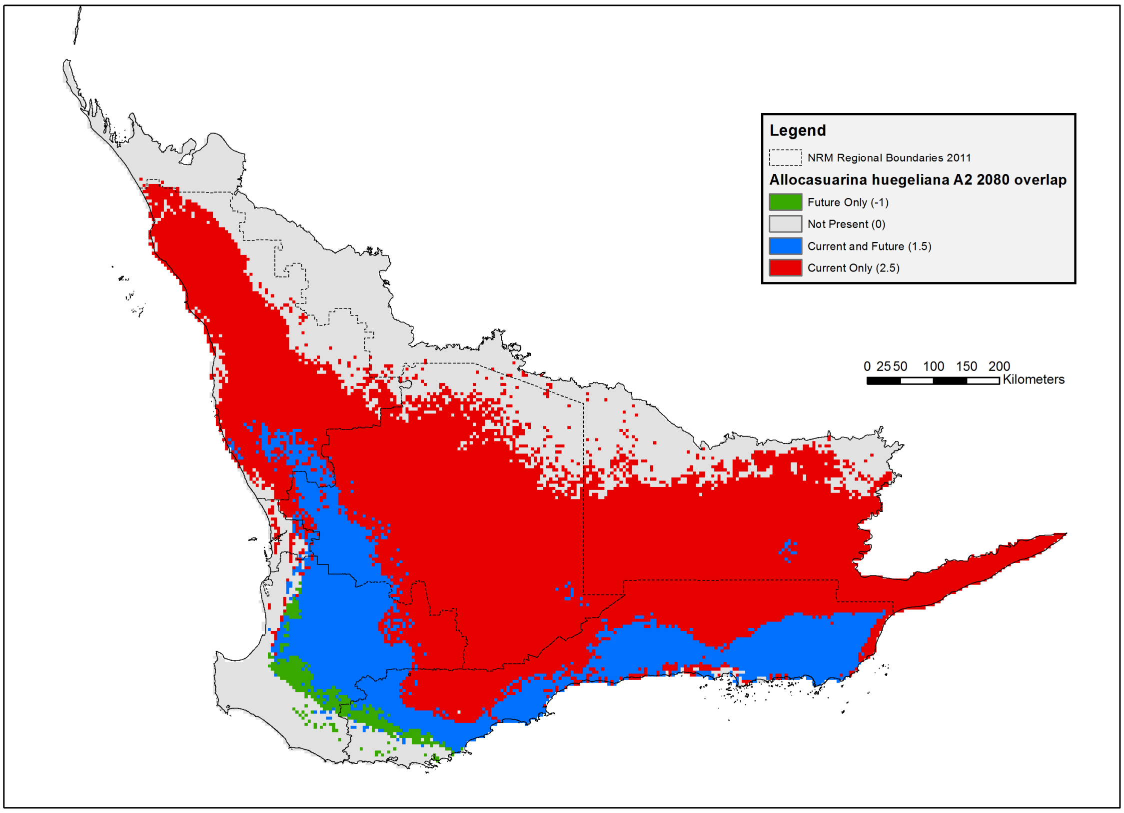

Figure 3.8: Area of current and future climate envelope overlap for Allocasuarina huegliana by 2080 under high emission scenario.

At the community level, overlap refugia can then be viewed as the number of climate envelope overlaps as a proportion of the number of current climate envelopes. This indicates areas where both the current and future climates are suitable for the community (212 flora species in this case). Figure 3.9 displays the overlap refugia for the 212 flora species. As with the immigrants and emigrants refugia, the Jarrah forests and Esperance region appear to be potential refugia. However, this method also detects corridors of overlap along the west coast and another of lesser magnitude parallel to the northeast boundary of the southwest ecoregion.

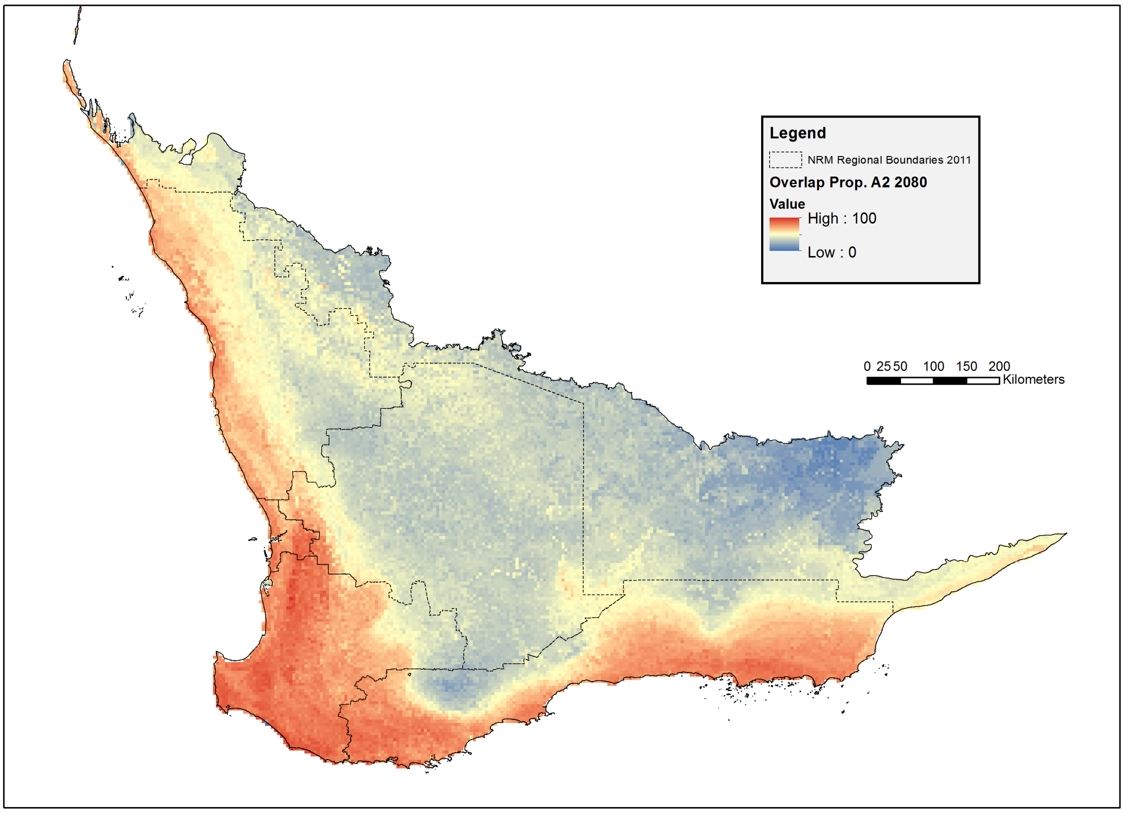

Figure 3.9: Refugia identified as the number of future climate envelope overlaps as a proportion of current envelope richness.

3.5 Movement vectors

A coarse way to visualise the direction and movement of species' climate envelopes as a result of a changing climate can be achieved through "movement vectors". The "start point" or tail of the arrow refers to the medians of the current latitudinal range and longitudinal range, while the "end point" or arrow head is the medians of the future latitudinal range and longitudinal range. The "movement vector" of Rock Sheoak is superimposed upon its current, future, and overlap climate envelopes by 2080 under the high emission scenario in Figure 3.10. For this species, this method reasonably identifies the median locations of its current and future climate envelopes, however, some species envelopes are not well represented (i.e. a species found along both west and south coasts).

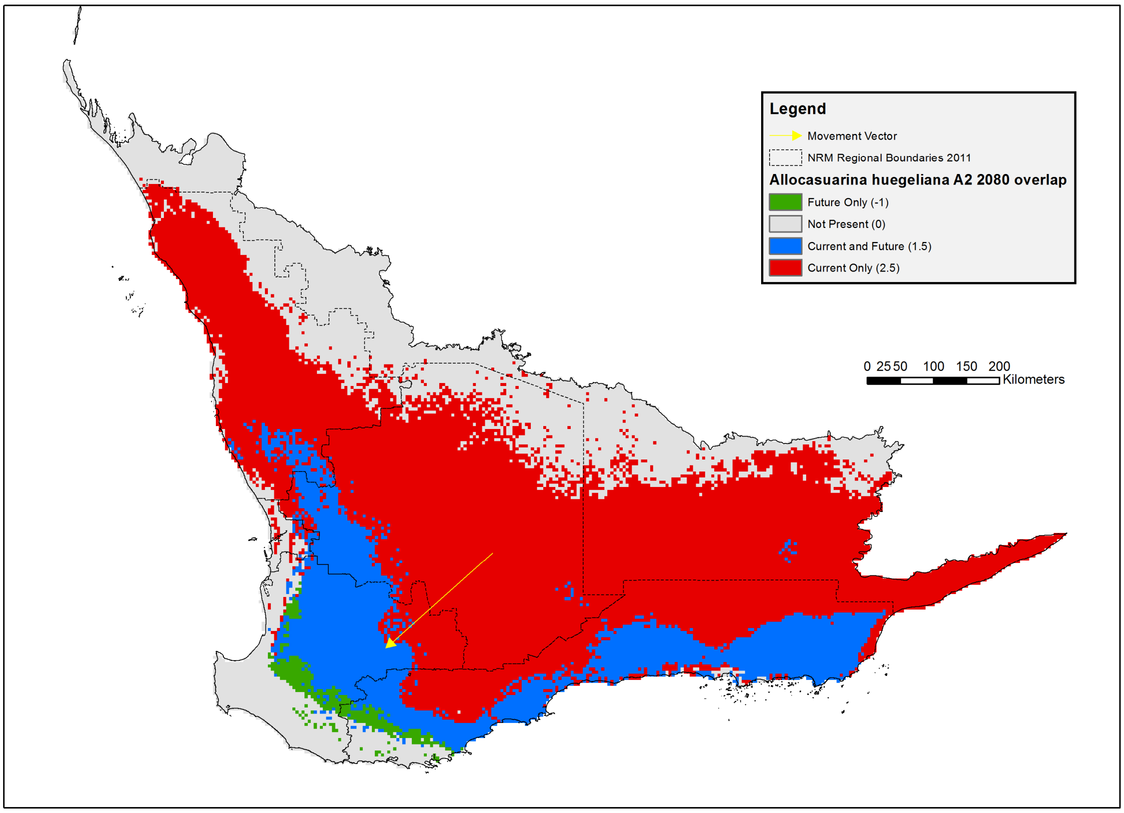

Figure 3.10: Areas of current and future climate envelopes and movement vector for Allocasuarina huegliana by 2080 under high emission scenario.

Figure 3.11 displays the movement vectors for the 212 flora species by 2080 under the high emission scenario. In this situation the vectors demonstrate general climate envelope shifts of north to south along the west coast, and from east to west along the south coast, with some of the greatest magnitude shifts from the north.

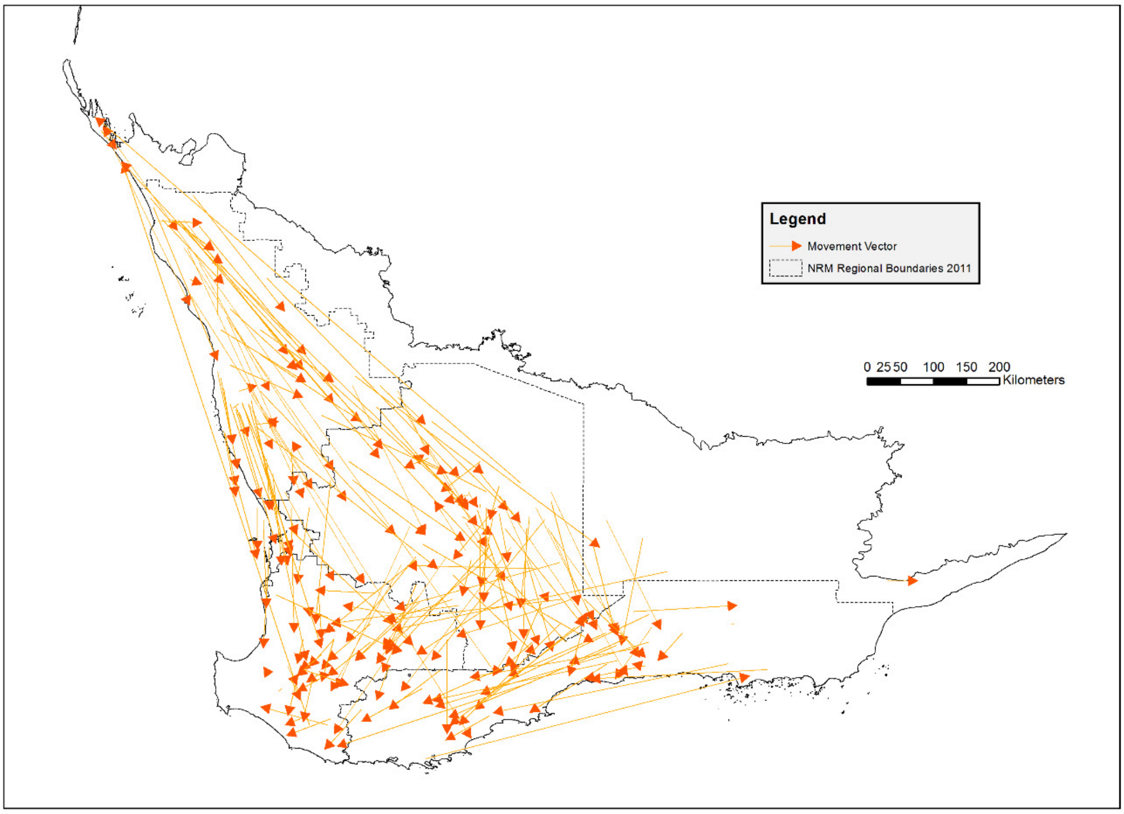

Figure 3.11: Movement vectors of flora species for 2080 under high emission scenario.

3.6 Species turnover

Species turnover was calculated by comparing the suite of species with current suitable climate envelopes, to the future suite of species with suitable climate envelopes. This was done for each cell, enabling a value of 0 – 100% to be assigned to each cell. This value indicates the extent of difference in suites of species with climate envelopes between current and future conditions for each cell. Figure 3.12 provides an example of species turnover using the 212 flora species. Values of 50% indicate a 50% difference in current and future suites of species within a cell. This measure does not provide an indication of good or bad, it is only a prediction of similar or different. In Figure 3.12 it can be seen that the greatest species compositional change is along the northeast border of the region, particularly to the southeast of the region. This result may be an artefact of the species incorporated into the analysis. Conversely, the Jarrah forest, and to a lesser extent, the south and west coasts display less turnover (or greater similarity) in their species compositions between current and future climates.

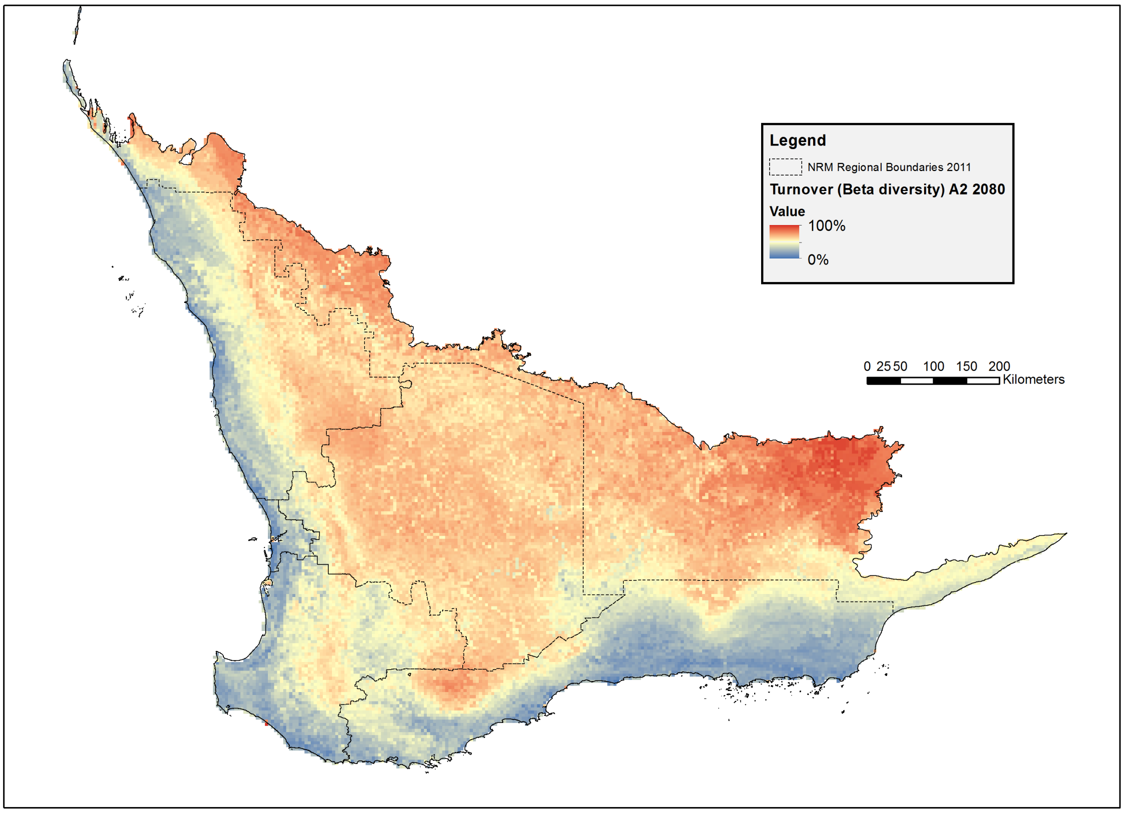

Figure 3.12: Turnover of species composition by 2080 under high emission scenario. 50% indicates a 50% dissimilarity in species composition.

3.7 Response group community composition

To investigate the changes to the overall community structure we identified areas which contained at least half the species for each response group. These results were then summed to determine how many groups in a cell contained at least half their response group species. Figure 3.13 demonstrates this for revegetation species under current climate on Kangaroo Island. It can be observed that the vast majority of the island is suitable for at least half the species in seven or eight of the eight response groups. By 2080 under a high emission scenario (Figure 3.14), the climate suitability in the northeast region of the island has decreased, being suitable for at least half the species in only three or four response groups. Figure 3.15 and Figure 3.16 provide a similar example with NACC revegetation species. Six response groups were incorporated into this analysis, and while only a small area under current conditions contains at least 50% of species in all six groups, the vast majority of the NACC region contains four or five of the response groups with at least half of their species (Figure 3.15). By 2080 under a high emission scenario, much of the NACC region still contains four response groups with at least half their species, despite the southward shift of species (Figure 3.16). Thus, although the suite of species chosen for this revegetation project are not likely to persist throughout the NACC region, a 'corridor' of suitable future climate for the (coarsely measured) community can be observed roughly through the centre of the NACC region.

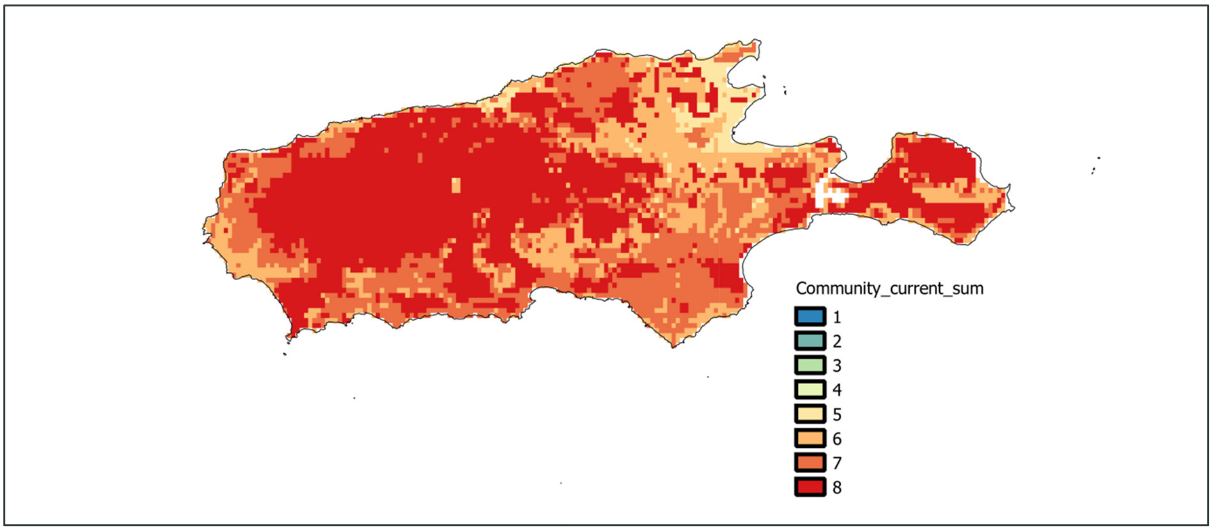

Figure 3.13: Sum of Kangaroo Island revegetation response groups containing at least 50% of their species under current conditions.

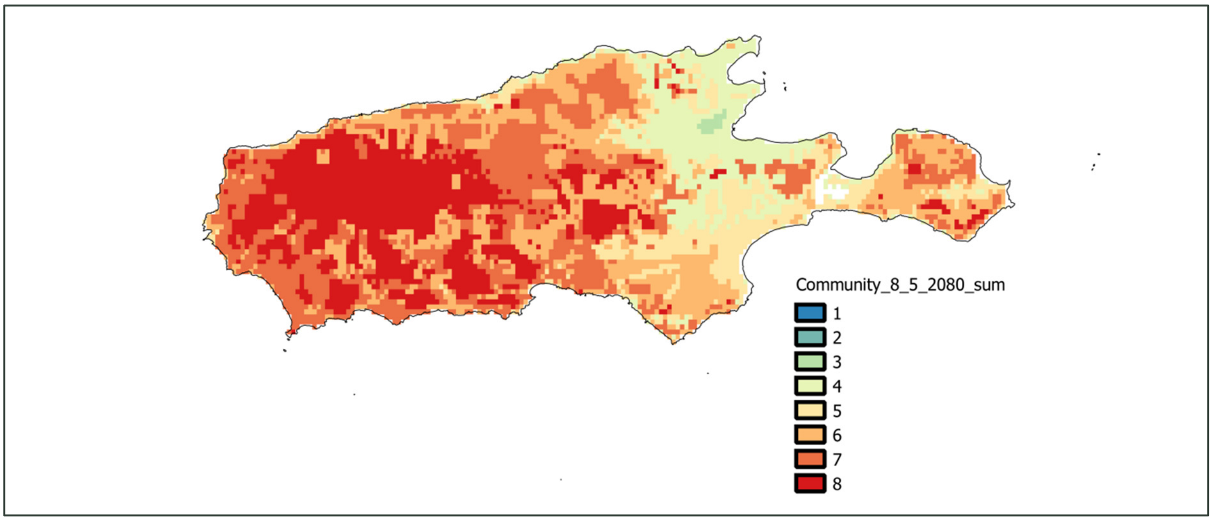

Figure 3.14: Sum of Kangaroo Island revegetation response groups containing at least 50% of their species by 2080 under high emission scenario.

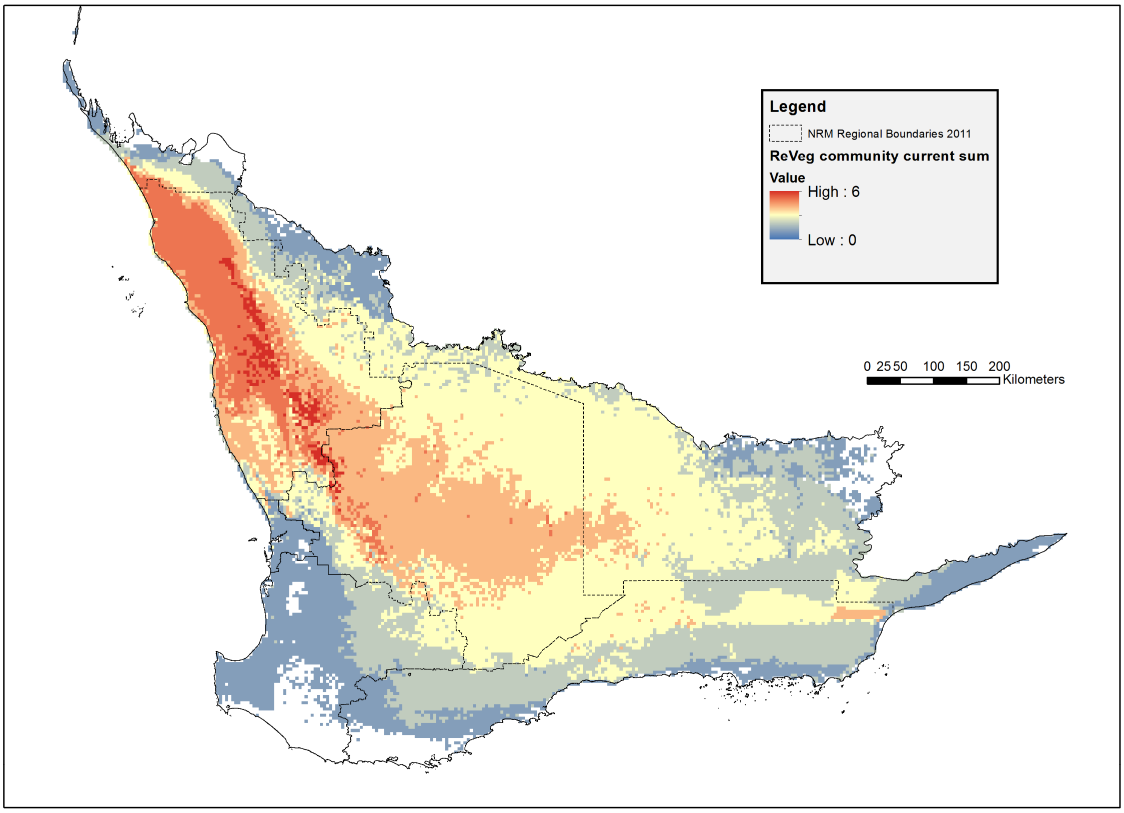

Figure 3.15: Sum of NACC revegetation response groups containing at least 50% of species under current climate.

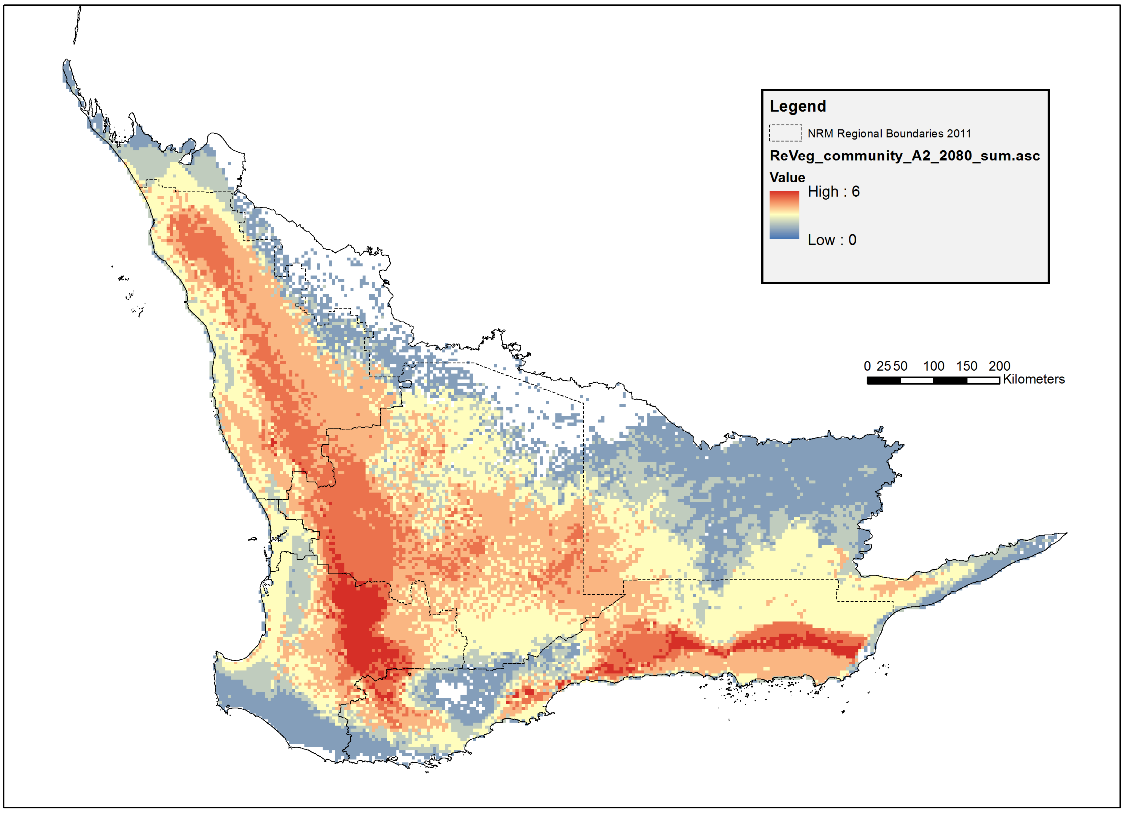

Figure 3.16: Sum of NACC revegetation response groups containing at least 50% of species by 2080 under high emission scenario.

4. NVIS modelling

4.1 Vegetation type communities

To investigate changes in NVIS vegetation communities, the current climate suitability value was subtracted from the future climate suitability value for each cell. Negative values indicate a decrease in the probability of the community occurring, whilst positive values depict an increase in the probability of the community occurring, and a zero value indicates no change. This means that there are cells where the community may be present in the future but are not currently, or where they occur currently, but not in the future. As a result, the total area covered may be larger than either the current or future distributions. It should be noted the yellow area on the maps are areas of low climate suitability, hence, any changes in these marginal areas are likely to be small and therefore may not be detected (e.g. if a cell declines or increases by 2% this would still be displayed as yellow on the map). It should also be noted that a negative value does not necessarily mean that the community is projected to no longer occur in that location, rather, the suitability of climate in the future is less that it is currently (e.g. if the current suitability of climate is 90% and the future suitability is 80%, the cell will have a negative value of -10%, despite the community still maintaining a high future suitability value). Figure 4.1 provides an example of this output using the “Open mallee woodlands and sparse mallee shrublands with a dense shrubby understorey communities” vegetation type from NVIS.

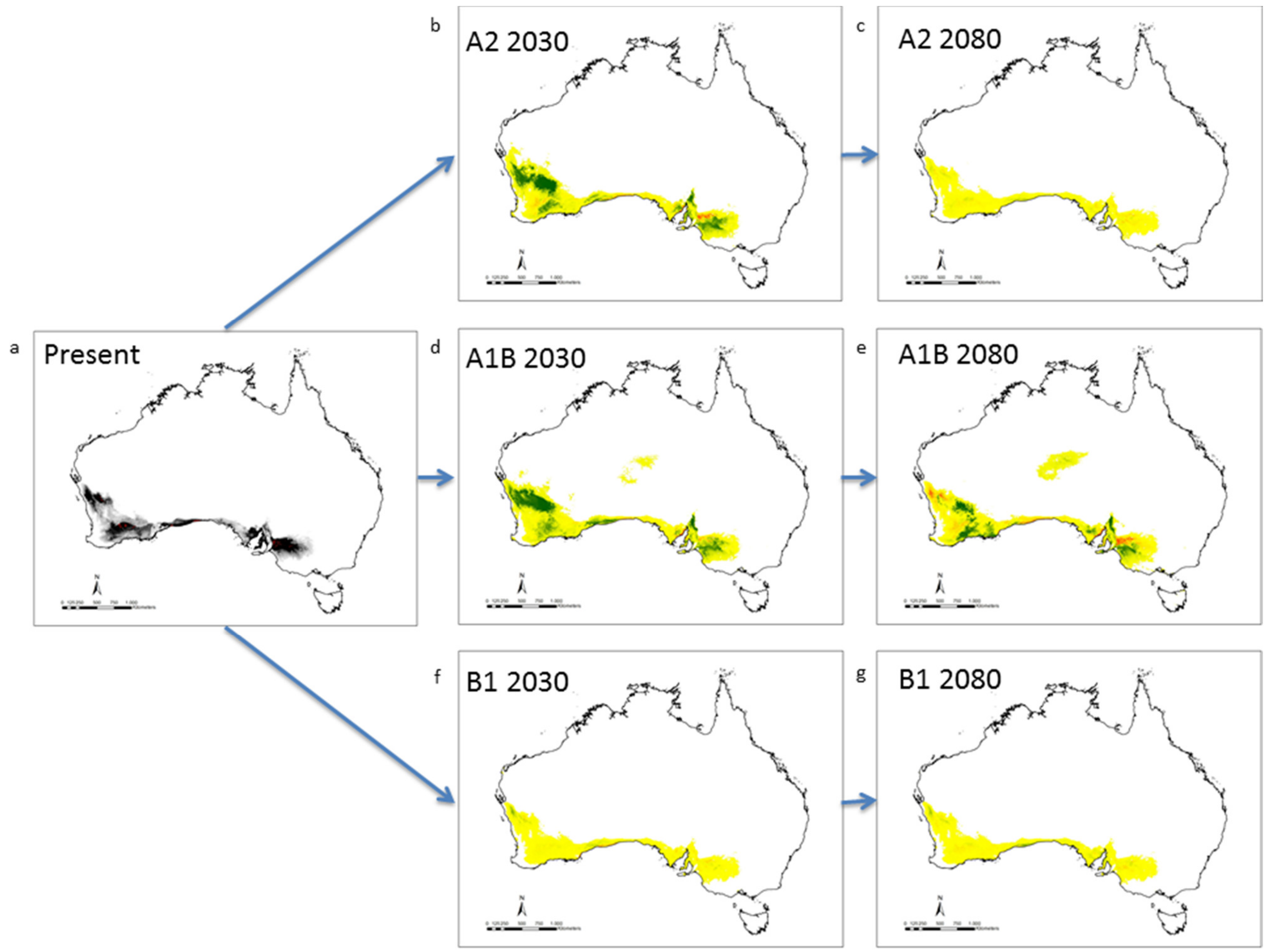

Figure 4.1: SDM results for Open mallee woodlands and sparse mallee shrublands with a dense shrubby understorey communities. (a) current climate suitability, (b) – (g): yellow = no change, green = increased climate suitability, red = decreased climate suitability.

5. Data file naming format

5.1 Individual species layers

For GIS layers of individual species, the naming format is –

Genus_species_scenario_timeframe (i.e. Calyptorhynchus_latirostris_A2_2080.asc)

These layers are continuous data measuring the climatic suitability of each cell. A value of 0 indicates 0% suitability, while a value of 100 indicates 100% climatic suitability for that species.

Many subsequent analyses were based upon presence/absence of suitable climate (see Figure 2.7 and associated text). GIS layers in presence/absence format are named as -

Genus_species_scenario_timeframe_binary (i.e. Calyptorhynchus_latirostris_A2_2080_binary.asc)

These layers contain values of 1 or 0. 1 indicates areas of climate suitability, 0 indicates non suitable climate regions.

For some species, GIS layers were created which indicate areas of: current and future suitable climate; areas of current only suitable climate; and areas of future only suitable climate. The naming format of these layers is -

Genus_species_scenario_timeframe_overlap (i.e. Calyptorhynchus_latirostris_A2_2080_overlap.asc)

For the overlap layers, a value of 1.5 indicates current and future envelope overlap, and value of 2.5 indicates current only suitable climate, and a value of -1 indicates future only suitable climate for that species.

5.2 Derived layers

Derived layers are those which were created through multiple individual species layers. In general the naming format for GIS derived layers is -

Derived method_scenario_timeframe (i.e. Richness_A2_2080.asc)

Richness was calculated as the sum of suitable climate envelopes in a cell (based on presence/absence layers). For a particular group of species (i.e. revegetation species) the naming format is -

Reveg_rich_scenario_timeframe (i.e. Reveg_rich_A2_2080.asc)

In some cases, “richness” was used to name the file instead of “rich”. Values in these layers represent counts of suitable climate envelopes of the group of species of interest. See Figure 3.2 for an example of a richness layer.

Derived layers identifying refugia based on maximum immigrants and minimum emigrants (see Section 3.3) for the particular group are named as -

NCCARF_Refugia_scenario_timeframe (i.e. NCCARF_Refugia_A2_2080.asc)

Values in these layers represent a sum of where emigrant (Figure 3.4) and/or immigrant (Figure 3.5) criteria have been matched for each response group (Figure 3.3). Thus for each response group, a maximum value of two can be obtained for each cell, resulting in a maximum obtainable cell value of twice the number of response groups.

Derived layers created by summing the number of climate overlaps of individual species (see Section 5.1) display where higher numbers of climate overlap exist for the suite of species of interest (i.e. potential revegetation species). The overlap layers are named as follows -

Group_overlap_scenario_timeframe (i.e. Reveg_overlap_A2_2080.asc)

Values of these layers represent the sum of climate overlaps of the individual species in each cell.

An extension of summing climate envelope overlaps is to view the number of overlaps as a proportion of current richness (see above). The naming format for overlap proportion layers is -

Overlap_prop_scenario_timeframe (i.e. overlap_prop_A2_2080.asc)

Values in these layers range from 0 to 100, with values representing the number of envelope overlaps as a proportion of current richness (i.e. 100 indicates the 100% of species with current suitable climate in that cell also have future suitable climate in that cell).

Species turnover (beta diversity - Figure 3.12) was calculated using the climate suitability presence/absence layers, comparing current and future suites of species of interest. Turnover layers are named as follows -

Beta_scenario_timeframe (i.e. Beta_A2_2080)

Values in these layers represent dissimilarity of the suite of species with suitable climate in each cell between current and future timeframes, and range from 0 to 1. In these layers 0 represents no dissimilarity (or complete similarity), and 1 represents complete dissimilarity (or no similarity).

Derived layers which coarsely represent communities (Figure 3.13 to Figure 3.16) are calculated by summing the response groups (Figure 3.3) in a cell which contain more than 50% of their species. The naming format of these layers is -

Group_community_scenario_timeframe (i.e. ReVeg_community_A2_2080_sum.asc)

Values in these layers are a count of the number of response groups which contain at least 50% of their species in each cell. Thus values range from 0 (no groups) to the number of response groups (all groups).

5.3 Climate layers

The climate layers are those which were incorporated into the species distribution modelling. The current climate variables are named –

#_Condensed variable name (i.e. 2_DiurnTempRange.asc)

Where the # is the bioclimatic variable number from WorldClim (http://www.worldclim.org/bioclim), and the condensed variable name is a condensed format of the variables listed in Table 1. The two exceptions to this are altitude and soil, which don't have climatic variable numbers or condensed names.

The future climate variables are the average of three GCMs (2.3 STEP 3: Selection of future scenarios and timeframes), thus the future climate variable layers are found in the "AverageGCM" folder. The Maxent process requires current and future climate layers to be named identically therefore the future climate variables can be identified to their appropriate emission scenario and timeframe via their location within the relevant folders. The folder structure is –

AverageGCM -> emission scenario -> timeframe (i.e. AverageGCM -> A2 -> 2080).

As mentioned above, the naming format of the future climate layers is identical to that of the current climate layers.

Some derivative layers have been created from the current and future precipitation and temperature layers. These derivatives were not included in the modelling, but are included to potentially assist in the interpretation of the species distribution modelling outputs. Isohyets and isotherms are provided for current temperature and precipitation. For each emission scenario/timeframe combination, future projections of: total change from current values; and percent change from current values, are provided for temperature and precipitation, in addition to isotherms and isohyets.

A1. Abbreviations/acronyms

Term	Definition
A1B	Medium emission scenario. Represents a future world of very rapid economic growth and a balance across all energy sources.
A2	High emission scenario. Represents a very heterogeneous world with continuously increasing global population and slower growth and technological change.
B1	Low emission scenario. Represents a convergent world with rapid change in economic structures, "dematerialization" and introduction of clean technologies.
CCAFS	CGIAR Research Program on Climate Change, Agriculture and Food Security (http://ccafs.cgiar.org/)
CMIP (3/5)	Coupled Model Intercomparison Project Phase 3/5
CSIRO Mk 3.5	A GCM developed by CSIRO.
GCM	Global/general climate model
MIROC-M	A GCM developed by Center for Climate System Research, University of Tokyo (CCR). National Institute for Environmental Studies. Frontier Research Center for Global Chance, Japan Agency for Marine-Earth Science and Technology (JAMSTEC).
MIUB ECHO-G	A GCM developed by Meteorological Institute of the University of Bonn (MIUB, Germany) and Institute of KMA (Korea) and Model and Data group.
NACC	Northern Agricultural Catchments Council
NCCARF	The National Climate Change Adaptation Research Facility (http://www.nccarf.edu.au/)
NVIS	National Vegetation Information System (http://www.environment.gov.au/land/native-vegetation/national-vegetation-information-system)
RCP	Representative concentration pathway
SCNRM	South Coast Natural Resource Management
SDM	Species distribution modelling
SRES	Special report on emissions scenarios
SWCC	South West Catchments Council

A2. Glossary

Term	Definition
Beta diversity	See turnover.
Climate envelope	Area which is climatically suitable for a species.
Cluster analysis	Statistical method to identify similar samples/species.
Dendrogram	Graphical representation of cluster analysis.
Emigrants	For use in NCCARF refugia, areas which lose the least number of species
Emission scenario	Projections of potential scenarios of future emissions (CO_2 etc).
Immigrants	For use in NCCARF refugia, areas which gain the greatest number of species
Likelihood of occurrence	Likelihood of species occurrence based on suitability of climate
Maxent	SDM method/software.
Occurrence records	Georeferenced records of species occurrences
Overlap	Area where current and future climate envelopes overlap. Can be viewed as a potential climate change refugia.
Presence/absence	Cells identified as either climatically suitable (presence) or not (absence).
Refugia - NCCARF	Potential climate change refugia identified as locations which lose the least and gain the most species envelopes.
Refugia - overlap	See overlap.
Response groups	Species sharing similar important driving climatic variables as defined by cluster analysis.
Richness - climate envelope	Count of number of climate envelopes.
Richness - species	Count of number of species.
Species envelope	See Climate envelope.
Turnover	Change in composition of species' suitable climates within a grid cell. High turnover indicates dissimilar species composition between times. Measured as beta diversity.
Vector	A value defined by both magnitude and direction.

A3. Supplementary Tables

Table A 1: **State listed threatened fauna species from south-western Australia that were modelled. CR = critically endangered, EN = endangered, VU = vulnerable, P1-4 = priority 1-4, SPF = specially protected fauna.**

Group	Scientific name	Common name	Status
Mammals	*Bettongia penicillata ogilbyi*	Woylie	CR
	Dasyurus geoffroii	Chuditch	VU
	Falsistrellus mackenziei	Western False Pipistrelle	P4
	Hydromys chrysogaster	Water-rat	P4
	Isoodon obesulus fusciventer	Quenda	P5
	Macropus eugenii derbianus	Tammar Wallaby	P5
	Macropus Irma	Western Brush Wallaby	P4
	Macrotis lagotis	Bilby, Dalgyte, Ninu	VU
	Myrmecobius fasciatus	Numbat, Walpurti	VU
	Nyctophilus major	Central Long-eared Bat	P4
	Parantechinus apicalis	Dibbler	EN
	Petrogale lateralis lateralis	Black-flanked Rock-wallaby	VU
	Phascogale calura	Red-tailed Phascogale	EN
	Phascogale tapoatafa tapoatafa	Brush-tailed Phascogale, Wambenger	VU
	Pseudocheirus occidentalis	Western Ringtail Possum	EN
	Pseudomys occidentalis	Western Mouse	P4
	Pseudomys shortridgei	Heath Mouse, Dayang	VU
	Setonix brachyurus	Quokka	VU
Birds	*Ardeotis australis*	Australian Bustard	P4
	Atrichornis clamosus	Noisy Scrub-bird	EN
	Botaurus poiciloptilus	Australasian Bittern	EN
	Burhinus grallarius	Bush Stonecurlew	VU
	Cacatua leadbeateri	Major Mitchell's Cockatoo	SPF
	Cacatua pastinator pastinator	Muir's Corella	SPF
	Calamanthus campestris montanellus	Rufous Fieldwren (western wheatbelt)	P4
	Calyptorhynchus banksii naso	Forest Red-tailed Black Cockatoo	VU
	Calyptorhynchus baudinii	Baudin's Cockatoo	EN
	Calyptorhynchus latirostris	Carnaby's Cockatoo	EN
	Cereopsis novaehollandiae grisea	Recherche Cape Barren Goose	VU
	Cinclosoma alisteri	Nullarbor Quail-thrush	P4
	Dasyornis longirostris	Western Bristlebird	VU
	Falco peregrinus	Peregrine Falcon	SPF
	Falcunculus frontatus leucogaster	Crested Shrike-tit (SW ssp)	P4
	Hylacola cauta whitlocki	Shy Heathwren (western ssp)	P4
	Leipoa ocellata	Malleefowl	VU
	Ninox connivens connivens	Barking Owl (southwest pop)	P2
	Numenius madagascariensis	Eastern Curlew	VU
	Pezoporus flaviventris	Western Ground Parrot	CR

Group	Scientific name	Common name	Status
	Platycercus icterotis xanthogenys	Western Rosella (inland ssp)	P4
	Psophodes nigrogularis oberon	Western Whipbird (sthn WA subsp)	P4
	Tyto novaehollandiae novaehollandiae	Masked Owl (SW ssp)	P3
Reptiles	*Acanthophis antarcticus*	Southern Death Adder	P3
	Aspidites ramsayi	Woma python	SPF
	Ctenotus delli	Dell's Skink	P4
	Ctenotus ora	Coastal Plains Skink	P3
	Lerista lineata	Lined Skink	P3
	Morelia spilota imbricata	Carpet Python	SPF
	Neelaps calonotos	Black-striped Snake	P3
	Pseudemydura umbrina	Western Swamp Tortoise	CR
	Pseudonaja affinis exilis	Rottnest Dugite	VU
Amphibians	*Geocrinia alba*	White-bellied Frog	CR
	Geocrinia lutea	Nornalup Frog	P4
	Geocrinia vitellina	Orange-bellied Frog	VU
	Spicospina flammocaerulea	Sunset Frog	VU
Fish	*Galaxias truttaceus hesperius*	Western Trout Minnow	EN
	Galaxiella munda	Western Mud Minnow	VU
	Galaxiella nigrostriata	Black-stripe Minnow	P3
	Geotria australis	Pouched Lamprey	P1
	Nannatherina balstoni	Balston's Pygmy Perch	VU

***Table A 2*: Threatened faunal species from South Australia that were modelled. EN = endangered, VU = vulnerable.**

Scientific name	Common name	EPBC	State
Aprasia pseudopulchella	Flinders Ranges Worm-lizard	VU	-
Austrelaps labialis	Pygmy copperhead	-	-
Isoodon obesulus obesulus	Southern brown bandicoot	EN	VU
Leipoa ocellata	Malleefowl	VU	VU
Pachycephala (Timixos) rufogularis	Red-lored Whistler	VU	VU
Pedionomus torquatus	Plains Wanderer	VU	EN
Petrogale xanthopus xanthopus	Yellow-footed Rock-Wallaby	VU	VU
Psophodes (Phodopses) nigrogularis	Western Whipbird	EN	-
Sminthopsis psammophila	Sandhill Dunnart	EN	VU
Stipiturus malachurus parimeda	Southern Emu-wren	VU	EN
Zoothera (Zoothera) lunulata	Bassian Thrush (South Australian)	-	-

***Table A 3*: State listed threatened flora species from south-western Australia that have been modelled. CR = critically endangered, EN = endangered, VU = vulnerable.**

Scientific Name	Common Name	Status
Acacia cochlocarpa velutinosa	Velvety Spiral Pod Wattle	CR
Acacia unguicula	A shrub	CR
Banksia anatona	Cactus Dryandra	CR
Banksia aurantia	Orange Dryandra	VU
Banksia fuscobractea	Dark-bract Banksia	CR
Banksia serratuloides perissa	Northern Serrate Dryandra	CR
Brachyscias verecundus	A herb	CR
Caladenia lodgeana	Lodge's spider-orchid	CR
Caladenia melanema	Ballerina Orchid	CR
Caladenia procera	Carbunup King Spider Orchid	CR
Calectasia cyanea	Blue Tinsel Lily	CR
Conostylis setigera dasys	Boscabel Conostylis	CR
Darwinia foetida	Muchea Bell	EN
Dasymalla axillaris	Native Foxglove	CR
Daviesia glossosema	Maroon-flowered Daviesia	CR
Eremophila rostrata trifida	A shrub	CR
Gastrolobium diabolophyllum	Bodallin Poison	CR
Gastrolobium luteifolium	Yellow-leafed Gastrolobium	CR
Grevillea brachystylis grandis	Large-flowered short-styled grevillea	CR
Guichenotia seorsiflora	A shrub	CR
Gyrostemon reticulatus	Net-veined Gyrostemon	CR
Haloragis platycarpa	Broad-fruited Haloragis	CR
Hemigenia ramosissima	Branched Hemigenia	CR
Hibbertia priceana	A shrub	EN
Hybanthus cymulosus	Ninghan Violet	CR
Isopogon robustus	Robust Coneflower	CR
Lysiosepalum abollatum	Woolly Lysiosepalum	CR
Muehlenbeckia horrida abdita	Remote Thorny Lignum	EN
Paragoodia crenulata	A pea	VU
Philotheca falcata	Sickle-leaved Waxflower	EN
Reedia spathacea	A sedge	EN
Scaevola macrophylla	Large-flowered Scaevola	CR
Tetratheca nephelioides	A shrub	EN
Verticordia apecta	Scruffy Verticordia	CR

***Table A 4*: Threatened flora species from South Australia that have been modelled. EN = endangered, VU = vulnerable.**

Scientific name	Common name	EPBC	State
Acacia enterocarpa	Jumping-jack Wattle	EN	EN
Beyeria subtecta	Kangaroo Island Turpentine Bush	VU	EN
Caladenia sanguinea	Crimson Daddy-long-legs	-	Rare
Caladenia tensa	Greencomp Spider-orchid	EN	-
Cheiranthera volubilis	Twining Finger Flower	-	-
Correa backhouseana var. *orbicularis*	Kangaroo Is. Round-leaf Correa	-	Rare
Dodonaea procumbens	Trailing Hop-bush	VU	VU
Eucalyptus dalrympleana dalrympleana	Broad-leaved Ribbon Gum	-	Rare
Eucalyptus paludicola	Marsh Gum	EN	EN
Eucalyptus viminalis viminalis	Ribbon Gum	-	Rare
Euphrasia collina osbornii	Osborn's Eyebright	EN	EN
Olearia pannosa pannosa	Silver Daisy-bush	VU	VU
Ptilotus beckerianus	Ironstone Mulla Mulla	VU	VU
Spyridium eriocephalum var. *glabrisepalum*	MacGillivray Spyridium	VU	EN
Swainsona pyrophila	Yellow Swainson-pea	VU	Rare

Table A 5: **Iconic plant species modelled.**

Subcluster	Scientific name	Common name
SSWFW	*Acacia acuminata*	Jam
	Acacia aneura	Mulga
	Acacia lasiocalyx	Silver Wattle
	Acacia saligna	Orange Wattle
	Acacia tetragonophylla	Kurara
	Allocasuarina campestris	Tamma
	Allocasuarina huegeliana	Rock Sheoak
	Banksia attenuata	Candle Banksia
	Casuarina obesa	Swamp Sheoak
	Corymbia calophylla	Marri
	Eucalyptus accedens	Powder bark Wandoo
	Eucalyptus astringens	Brown Mallet
	Eucalyptus brevistylis	Rate's Tingle
	Eucalyptus decipiens	Limestone Marlock
	Eucalyptus diversicolor	Karri
	Eucalyptus eremophila	Eastern Goldfields Horned Mallee
	Eucalyptus gomphocephala	Tuart
	Eucalyptus guilfoylei	Yellow Tingle
	Eucalyptus jacksonii	Red Tingle
	Eucalyptus longicornis	Red Morrel
	Eucalyptus loxophleba	York Gum
	Eucalyptus marginata	Jarrah
	Eucalyptus occidentalis	Flat-topped Yate
	Eucalyptus patens	Blackbutt
	Eucalyptus platypus	Moort
	Eucalyptus rudis	River Gum
	Eucalyptus salmonophloia	Salmon Gum
	Eucalyptus salubris	Gimlet
	Eucalyptus staeri	Albany Blackbutt
	Eucalyptus todtiana	Coastal Blackbutt
	Eucalyptus wandoo	Wandoo
	Leptospermum erubescens	Roadside Teatree
	Melaleuca preissiana	Modong
	Melaleuca strobophylla	A Paperbark
	Persoonia longifolia	Snottygobble
SSWFE	*Eucalyptus diversifolia*	Soap mallee
	Eucalyptus diversifolia diversifolia	Soap mallee
	Eucalyptus diversifolia hesperia	Soap mallee
	Eucalyptus diversifolia megacarpa	Soap mallee

Subcluster	Scientific name	Common name
	Eucalyptus goniocalyx goniocalyx	Long-leaved Box
	Eucalyptus obliqua	Australian Oak
	Eucalyptus ovata var. ovata	Swamp Gum
	Eucalyptus viminalis cygnetensis	Rough-barked manna Gum
	Gahnia trifida	Coast Saw-Sedge
	Leucopogon parviflorus	Coast Beard Heath

***Table A 6*: Kangaroo Island geographically restricted species modelled.**

Scientific name	Common name
Achnophora tatei	Kangaroo Island River Daisy
Acrotriche halmaturina	Kangaroo Island Ground-berry
Adenanthos macropodianus	Kangaroo Island Gland-flower
Allocasuarina muelleriana notocolpica	Kangaroo Island Oak-bush
Asterolasia muricata	Lemon Star-bush
Asterolasia phebalioides	Downy Star-bush
Bauera rubioides	Wiry Bauera
Bertya rotundifolia	Round-leaf Bertya
Beyeria subtecta	Kangaroo Island Turpentine Bush
Boronia edwardsii	Edwards' Boronia
Brachyloma ericoides bicolor	Kangaroo Island Brush Heath
Caladenia sanguinea	Crimson Daddy-long-legs
Calytrix glaberrima	Smooth Heath-myrtle
Calytrix smeatoniana	Kangaroo Island Heath-myrtle
Cheiranthera volubilis	Twining Hand-flower
Coronidium adenophorum	Branched Everlasting
Correa backhouseana var. *orbicularis*	Round-leaf Correa
Correa reflexa var. *insularis*	Round-leaf Correa
Dampiera lanceolata var. *insularis*	Kangaroo Island Dampiera
Daviesia asperula asperula	Kangaroo Island Bitter-pea
Drosera schmutzii	
Eucalyptus cneorifolia	Kangaroo Island Narrow-leaf Mallee
Eucalyptus remota	Kangaroo Island Mallee Ash
Gahnia hystrix	Spiky Saw-sedge
Grevillea halmaturina halmaturina	Prickly Grevillea
Grevillea lavandulacea rogersii	Rogers' Spider-flower
Grevillea muricata	Rough Spider-flower
Grevillea quinquenervis	Five-veined Grevillea
Hakea aenigma	Enigma Hakea
Hibbertia obtusibracteata	
Hydrocotyle comocarpa	Fringe-fruit Pennywort
Hydrocotyle crassiuscula	Spreading Pennywort
Irenepharsus phasmatodes	Kangaroo Island Cress
Leionema equestre	Kangaroo Island Phebalium
Lepyrodia valliculae	Kangaroo Island Scale-rush
Logania insularis	Kangaroo Island Logania
Logania scabrella	Rough Logania
Olax obcordata	
Olearia ciliata	Kangaroo Island Fringed Daisy-bush
Olearia ciliata var. *squamifolia*	Kangaroo Island Fringed Daisy-bush

Scientific name	Common name
Olearia microdisca	Small-flower Daisy-bush
Orthrosanthus multiflorus	Morning Flag
Petrophile multisecta	Kangaroo Island Conesticks
Pimelea macrostegia	Kangaroo Island Riceflower
Pomaderris halmaturina halmaturina	Kangaroo Island Pomaderris
Pultenaea insularis	Beyeria Bush-pea
Pultenaea teretifolia var*. brachyphylla*	Short-leaf Bush-pea
Pultenaea trifida	Kangaroo Island Bush-pea
Pultenaea villifera var*. glabrescens*	Splendid Bush-pea
Pultenaea viscidula	Dark Bush-pea
Spyridium coalitum	Flinders Chase Spyridium
Spyridium eriocephalum var*. glabrisepalum*	Macgillivray Spyridium
Spyridium halmaturinum	Kangaroo Island Spyridium
Spyridium halmaturinum var*. halmaturinum*	Kangaroo Island Spyridium
Spyridium halmaturinum var*. integrifolium*	Kangaroo Island Spyridium
Spyridium halmaturinum var*. scabridum*	Kangaroo Island Spyridium
Spyridium scabridum	
Spyridium waterhousei	Waterhouse's Cryptandra
Stylidium tepperianum	Kangaroo Island Trigger-plant
Tetratheca halmaturina	Leafless Kangaroo Island Tetratheca
Tetratheca insularis	Kangaroo Island Tetratheca
Thryptomene ericaea	Heath Thryptomene
Thysanotus fractiflexus	Zig-zag Fringe-lily
Zieria veronicea insularis	Pink Zieria

Table A 7: **Revegetation species modelled.**

Subcluster - Region/Project	Scientific name	Common name
SSWFW – Gondwana Link	*Acacia assimilis*	A wattle
	Acacia assimilis atroviridis	A wattle
	Acacia consobrina	A wattle
	Acacia dictyoneura	Musa Scented Wattle
	Acacia harveyi	A wattle
	Acacia microbotrya	Manna Wattle
	Acacia myrtifolia	Myrtle Wattle
	Acacia pulchella	Prickly Moses
	Acacia pulchella var. goadbyi	A wattle
	Acacia redolens	Vanilla Wattle
	Eucalyptus annulata	Open-fruited Mallee
	Eucalyptus ecostata	A Eucalypt
	Eucalyptus flocktoniae	Merrit
	Eucalyptus thamnoides	A Eucalypt
	Eucalyptus thamnoides thamnoides	A Eucalypt
	Eucalyptus uncinata	Hook-leaved Mallee
	Gastrolobium parviflorum	Box Poison
	Gastrolobium spinosum	Prickly Poison
	Hakea corymbosa	Cauliflower Hakea
	Hakea laurina	Pincushion Hakea
	Hakea nitida	Frog Hakea
	Hakea pandanicarpa	A Hakea
	Hakea pandanicarpa crassifolia	A Hakea
	Melaleuca acuminata	A Melaleuca
	Melaleuca hamata	A Melaleuca
	Melaleuca thymoides	Sand Wattle-Myrtle
	Templetonia retusa	Cockies Tongues
SSWFW – NACC - Revegetation	*Acacia acuminata*	Jam
	Acacia aneura	Mulga
	Acacia burkittii	Sandhill Wattle
	Acacia coolgardiensis	Spinifex Wattle
	Acacia cyclops	Coastal Wattle
	Acacia erinacea	
	Acacia hemiteles	
	Acacia lasiocarpa	Panjang
	Acacia neurophylla	
	Acacia rostellifera	Summer-Scented Wattle
	Acacia saligna	Orange Wattle
	Acacia tetragonophylla	Kurara
	Allocasuarina acutivalvis	

Subcluster - Region/Project	Scientific name	Common name
	Allocasuarina campestris	Tamma
	Allocasuarina corniculata	
	Allocasuarina huegeliana	Rock Sheoak
	Allocasuarina humilis	Dwarf Sheoak
	Alyogyne huegelii	Lilac Hibiscus
	Atriplex amnicola	Swamp Saltbush
	Atriplex nummularia	Old Man Saltbush
	Banksia attenuata	Candle Banksia
	Banksia prionotes	Acorn Banksia
	Banksia sessilis	Parrot Bush
	Calothamnus quadrifidus	One-sided Bottlebrush
	Calothamnus sanguineus	Silky-leaved Blood flower
	Casuarina obesa	Swamp Sheoak
	Dianella revoluta	Blueberry Lily
	Dodonaea inaequifolia	
	Enchylaena tomentosa	Barrier Saltbush
	Eremophila glabra	Tar Bush
	Eucalyptus arachnaea	Black-stemmed Mallee
	Eucalyptus beardiana	Beard's Mallee
	Eucalyptus camaldulensis	River Gum
	Eucalyptus loxophleba	York Gum
	Eucalyptus salicola	Salt Gum
	Eucalyptus salubris	Gimlet
	Eucalyptus todtiana	Coastal Blackbutt
	Grevillea candelabroides	
	Grevillea pinaster	
	Hakea incrassata	Marble Hakea
	Hakea lissocarpha	Honey Bush
	Hakea preissii	Needle Tree
	Hakea pycnoneura	
	Hakea recurva	Djarnokmurd
	Jacksonia hakeoides	
	Labichea lanceolata	Tall Labichea
	Leptospermum erubescens	Roadside Teatree
	Maireana brevifolia	Small Leaf Bluebush
	Maireana tomentosa	Felty Bluebush
	Melaleuca brevifolia	
	Melaleuca hamulosa	
	Melaleuca lateriflora	Gorada
	Melaleuca megacephala	
	Melaleuca uncinata	Broom Bush
	Pittosporum phillyreoides	Weeping Pittosporum

Subcluster - Region/Project	Scientific name	Common name
	Rhagodia drummondii	
	Rhagodia preissii preissii	
	Santalum acuminatum	Quandong
	Scaevola spinescens	Currant Bush
SSWFW – NACC – Coastal revegetation	*Acacia cyclops*	Coastal Wattle
	Acacia rostellifera	Summer-Scented Wattle
	Acanthocarpus preissii	
	Atriplex cinerea	Grey Saltbush
	Atriplex isatidea	Coast Saltbush
	Carpobrotus virescens	Coastal Pigface
	Macropidia fuliginosa	Black Kangaroo Paw
	Myoporum insulare	Blueberry Tree
	Nitraria billardierei	Nitre Bush
	Olearia axillaris	Coastal Daisybush
	Ptilotus divaricatus	Climbing Mulla Mulla
	Rhagodia preissii	
	Scaevola crassifolia	Thick-leaved Fan-flower
	Spinifex longifolius	Beach Spinifex
	Templetonia retusa	Cockies Tongues
SSWFE – Eyre Peninsula	*Acacia anceps*	A wattle
	Acacia brachybotrya	Grey Mulga
	Acacia calamifolia	Reed-leaf Wattle
	Acacia cupularis	Coastal Umbrella Bush
	Acacia hakeoides	Hakea Acacia
	Acacia ligulata	Dune Wattle
	Acacia longifolia sophorae	Coast Wattle
	Acacia nematophylla	A wattle
	Acacia notabilis	Flinders Wattle
	Acacia sclerophylla	Hard-leaf Wattle
	Acacia sclerophylla var*. sclerophylla*	Hard-leaf Wattle
	Acacia sp. Winged (C.R.Alcock 4936)	A wattle
	Acacia spinescens	Hard-leaf Wattle
	Acacia triquetra	A wattle
	Acrotriche patula	Ridged Ground-berry
	Adriana quadripartita	Coast Bitter-bush
	Allocasuarina verticillata	Drooping Sheoak
	Alyxia buxifolia	Sea Box
	Atriplex cinerea	Grey salt bush
	Atriplex paludosa	Marsh Saltbush
	Atriplex paludosa cordata	Marsh Saltbush
	Atriplex paludosa paludosa	Marsh Saltbush
	Atriplex semibaccata	Australian Saltbush

Subcluster - Region/Project	Scientific name	Common name
	Austrostipa elegantissima	Elegant Spear-grass
	Beyeria lechenaultii	Pale Turpentine Bush
	Bursaria spinosa	Sweet Bursaria
	Bursaria spinosa lasiophylla	
	Bursaria spinosa spinosa	
	Callistemon rugulosus	Scarlet Bottle-brush
	Callitris canescens	Cypress Pine
	Callitris gracilis	Slender Cypress-pine
	Calytrix tetragona	Common Fringe-myrtle
	Correa pulchella	
	Dianella brevicaulis	Blueberry Lily
	Dianella revolute	Black-anther Flax-lily
	Dianella revoluta var. *divaricata*	
	Dianella revoluta var. *revoluta*	
	Dodonaea hexandra	Horned Hop-bush
	Dodonaea viscosa	Broad leaf Hopbush
	Dodonaea viscosa angustissima	Narrow-leaf Hop-bush
	Dodonaea viscosa cuneata	Wedge-leaf Hop-bush
	Dodonaea viscosa spatulata	Sticky Hop-Bush
	Enchylaena tomentose	Barrier Saltbush
	Enchylaena tomentosa var. *glabra*	A Saltbush
	Enchylaena tomentosa var. *tomentosa*	Ruby Saltbush
	Eucalyptus camaldulensis	River Red Gum
	Eucalyptus camaldulensis arida	
	Eucalyptus camaldulensis camaldulensis	River Red Gum
	Eucalyptus camaldulensis minima	
	Eucalyptus camaldulensis obtusa	Red River Gum
	Eucalyptus diversifolia	Coast Gum
	Eucalyptus diversifolia diversifolia	Coastal white mallee
	Eucalyptus gracilis	Red Mallee
	Eucalyptus leptophylla	March Mallee
	Eucalyptus oleosa	Red Mallee
	Eucalyptus oleosa ampliata	
	Eucalyptus oleosa oleosa	Red morrell
	Eucalyptus porosa	Black Mallee
	Eucalyptus rugosa	Kingscote mallee
	Eucalyptus socialis	Christmas Mallee
	Eucalyptus socialis eucentrica	
	Eucalyptus socialis socialis	Red mallee
	Eucalyptus socialis victoriensis	
	Eucalyptus socialis viridans	Red mallee
	Eucalyptus yalatensis	Yalata mallee

Subcluster - Region/Project	Scientific name	Common name
	Eutaxia microphylla	Common Eutaxia
	Exocarpos aphyllus	Current Bush
	Exocarpos syrticola	Coast Ballart
	Gahnia filum	Chaffy Saw-sedge
	Geijera linearifolia	Oilbush
	Goodenia varia	Sticky Goodenia
	Isolepis nodosa	Knobby Club Rush
	Kennedia prostrata	Running Postman
	Leucophyta brownii	Cushion Bush
	Leucopogon parviflorus	Coast Beard heath
	Maireana oppositifolia	Heathy Bluebush
	Melaleuca acuminata	
	Melaleuca acuminata acuminata	Mallee Honey-myrtle
	Melaleuca brevifolia	Mallee Honey-myrtle
	Melaleuca decussata	Cross leaf Honey Myrtle
	Melaleuca gibbosa	Slender Honey-myrtle
	Melaleuca halmaturorum	Blistered Paper-bark
	Melaleuca lanceolata	Moonah
	Melaleuca pauperiflora	
	Melaleuca pauperiflora mutica	
	Myoporum insulare	Blue-berry Tree
	Nitraria billardierei	Dillon Bush
	Olearia axillaris	Coast Daisy-bush
	Pittosporum angustifolium	Weeping Pittosporum
	Prostanthera calycina	Red Mintbush
	Rhagodia candolleana	
	Rhagodia candolleana argentea	
	Rhagodia candolleana candolleana	Seaberry Saltbush
	Rhagodia crassifolia	Fleshy Saltbush
	Santalum acuminatum	Quandong
	Scaevola crassifolia	Thick-leaved Fanflower
	Senna artemisioides	Silver Cassia
	Senna artemisioides alicia	
	Senna artemisioides filifolia	
	Senna artemisioides helmsii	Blunt-leaved Cassia
	Senna artemisioides oligophylla	Blunt-leaved Cassia
	Senna artemisioides quadrifolia	
	Senna artemisioides x artemisioides	Silver Cassia
	Senna artemisioides x coriacea	
	Senna artemisioides x petiolaris	Woody Cassia
	Senna artemisioides x sturtii	Grey Cassia
	Senna artemisioides zygophylla	

Subcluster - Region/Project	Scientific name	Common name
	Templetonia retusa	Blunt-leaved Templetonia
	Tetragonia implexicoma	Bower Spinach
	Threlkeldia diffusa	Coast Bonefruit
	Zygophyllum apiculatum	Callweed
	Zygophyllum billardierei	Coast Twinleaf
SSWFE – Kangaroo Island	*Acacia acinacea*	
	Acacia cupularis	Coastal Umbrella Bush
	Acacia euthycarpa	
	Acacia farinosa	
	Acacia leiophylla	
	Acacia myrtifolia	Myrtle Wattle
	Acacia paradoxa	
	Acacia provincialis	
	Acacia pycnantha	
	Acacia spinescens	Hard-leaf Wattle
	Acacia triquetra	A wattle
	Acrotriche cordata	
	Acrotriche depressa	
	Acrotriche patula	Ridged Ground-berry
	Adenanthos macropodianus	Kangaroo Island Gland-flower
	Adenanthos terminalis	
	Allocasuarina muelleriana notocolpica	Kangaroo Island Oak-bush
	Allocasuarina striata	
	Allocasuarina verticillata	Drooping Sheoak
	Astroloma conostephioides	
	Astroloma humifusum	
	Atriplex cinerea	Grey salt bush
	Atriplex semibaccata	Australian Saltbush
	Austrostipa elegantissima	Elegant Spear-grass
	Austrostipa flavescens	
	Austrostipa hemipogon	
	Austrostipa macalpinei	
	Austrostipa mollis	
	Baeckea crassifolia	
	Banksia marginata	
	Bertya rotundifolia	Round-leaf Bertya
	Beyeria lechenaultii	Pale Turpentine Bush
	Billardiera cymosa	
	Billardiera uniflora	
	Billardiera versicolor	
	Boronia coerulescens coerulescens	
	Brachyloma ericoides bicolor	Kangaroo Island Brush Heath

Subcluster - Region/Project	Scientific name	Common name
	Callistemon rugulosus	Scarlet Bottle-brush
	Callitris gracilis	Slender Cypress-pine
	Callitris rhomboidea	
	Calytrix tetragona	Common Fringe-myrtle
	Carpobrotus rossii	
	Cassinia complanata	
	Cheiranthera alternifolia	
	Chorizandra enodis	
	Clematis microphylla	
	Comesperma volubile	
	Convolvulus remotus	
	Cyphanthera myosotidea	
	Dampiera lanceolata var. *insularis*	Kangaroo Island Dampiera
	Daviesia brevifolia	
	Daviesia genistifolia	
	Daviesia ulicifolia	
	Dianella brevicaulis	Blueberry Lily
	Dianella revoluta	Blueberry Lily
	Dianella revoluta var. *revoluta*	0
	Dillwynia hispida	
	Dillwynia sericea	
	Disphyma crassifolium clavellatum	
	Dodonaea baueri	
	Dodonaea hexandra	Horned Hop-bush
	Dodonaea viscosa	Broad leaf Hopbush
	Drosera macrantha	
	Drosera whittakeri	
	Eleocharis acuta	
	Enchylaena tomentosa var. *tomentosa*	Ruby Saltbush
	Epilobium sp.	
	Eremophila behriana	
	Eremophila glabra glabra	
	Eucalyptus albopurpurea	
	Eucalyptus camaldulensis camaldulensis	River Red Gum
	Eucalyptus cladocalyx	
	Eucalyptus cosmophylla	
	Eucalyptus diversifolia diversifolia	Soap mallee
	Eucalyptus fasciculosa	
	Eucalyptus leptophylla	March Mallee
	Eucalyptus leucoxylon	
	Eucalyptus odorata	
	Eucalyptus paludicola	Marsh Gum

Subcluster - Region/Project	Scientific name	Common name
	Eucalyptus phenax	
	Eucalyptus rugosa	Kingscote mallee
	Eucalyptus viminalis cygnetensis	Rough-barked manna Gum
	Euchiton sphaericus	
	Eutaxia diffusa	
	Eutaxia microphylla	Common Eutaxia
	Ficinia nodosa	Knotted Club Rush
	Glischrocaryon behrii	
	Gompholobium ecostatum	
	Gonocarpus mezianus	
	Goodenia blackiana	
	Goodenia geniculata	
	Goodenia ovata	
	Goodenia varia	Sticky Goodenia
	Goodia medicaginea	
	Grevillea ilicifolia ilicifolia	
	Grevillea linearifolia	
	Gyrostemon australasicus	
	Hakea mitchellii	
	Hakea rostrata	
	Hakea rugosa	
	Hakea vittata	
	Hibbertia crinita	
	Hibbertia devitata	
	Hibbertia paeninsularis	
	Hibbertia riparia	
	Hibbertia serrata	
	Isolepis multicaulis	
	Isopogon ceratophyllus	
	Juncus bufonius	
	Juncus kraussii	
	Juncus pallidus	
	Juncus subsecundus	
	Kennedia prostrata	Running Postman
	Lasiopetalum baueri	
	Lasiopetalum behrii	
	Lasiopetalum discolor	
	Lasiopetalum schulzenii	
	Lawrencia spicata	
	Laxmannia orientalis	
	Lepidosperma semiteres	
	Lepidosperma viscidum	

Subcluster - Region/Project	Scientific name	Common name
	Leptospermum continentale	
	Leptospermum myrsinoides	
	Leucopogon concurvus	
	Leucopogon parviflorus	Coast Beard Heath
	Leucopogon rufus	
	Lobelia anceps	
	Logania linifolia	
	Logania ovata	
	Lomandra micrantha	
	Melaleuca acuminata acuminata	Mallee Honey-myrtle
	Melaleuca brevifolia	
	Melaleuca cuticularis	Salt Paperbark
	Melaleuca gibbosa	Slender Honey-myrtle
	Melaleuca lanceolata	Moonah
	Melaleuca uncinata	Broom Bush
	Micrantheum demissum	
	Microtis sp.	
	Millotia tenuifolia var. *tenuifolia*	
	Muehlenbeckia adpressa	
	Myoporum insulare	Blueberry Tree
	Nitraria billardierei	Dillon Bush
	Olearia axillaris	Coastal Daisybush
	Olearia ramulosa	
	Olearia teretifolia	
	Opercularia varia	
	Ozothamnus retusus	
	Pelargonium australe	
	Phyllanthus australis	
	Phyllanthus striaticaulis	
	Phyllota pleurandroides	
	Pimelea glauca	
	Pimelea octophylla	
	Pimelea phylicoides	
	Pimelea stricta	
	Pittosporum angustifolium	Weeping Pittosporum
	Pittosporum phillyreoides	Weeping Pittosporum
	Platysace heterophylla var. *heterophylla*	
	Pomaderris halmaturina halmaturina	Kangaroo Island Pomaderris
	Pomaderris obcordata	
	Prostanthera chlorantha	
	Pultenaea acerosa	
	Pultenaea daphnoides	

Subcluster - Region/Project	Scientific name	Common name
	Pultenaea pedunculata	
	Rhagodia candolleana candolleana	Seaberry Saltbush
	Rytidosperma caespitosum	
	Rytidosperma geniculatum	
	Sarcocornia quinqueflora	
	Scaevola aemula	
	Scaevola linearis confertifolia	
	Schoenus breviculmis	
	Senecio hispidulus	
	Senecio odoratus	
	Senecio picridioides	
	Senecio quadridentatus	
	Solanum simile	
	Spyridium eriocephalum var. *glabrisepalum*	Macgillivray Spyridium
	Spyridium nitidum	
	Spyridium spathulatum	
	Stackhousia aspericocca	
	Thomasia petalocalyx	
	Threlkeldia diffusa	Coast Bonefruit
	Thysanotus patersonii	
	Triglochin striata	
	Vittadinia australasica	
	Vittadinia gracilis	
	Wahlenbergia sp.	
	Xanthorrhoea semiplana tateana	
	Xanthosia dissecta	
	Xanthosia leiophylla	
	Xanthosia tasmanica	

Table A 8: **Coastal vegetation species occurring in south-western Australia that were modelled.**

Scientific name	Common name
Acacia cochlearis	Rigid Wattle
Acacia cyclops	Coastal Wattle
Acacia lasiocarpa	Panjang
Acacia littorea	Wattle 1
Acacia rostellifera	Summer-Scented Wattle
Acacia spathulifolia	Wattle 2
Acacia xanthina	White-stemmed Wattle
Actites megalocarpus	Dune Thistle
Adenanthos cygnorum	Common Woollybush
Adenanthos sericeus	Woollybush
Agonis flexuosa	Peppermint
Allocasuarina humilis	Dwarf Sheoak
Allocasuarina trichodon	Sheoak 1
Alyogyne huegelii	Lilac Hibiscus
Ammophila arenaria	Marram Grass
Angianthus cunninghamii	Coast Angianthus
Atriplex isatidea	Coast Saltbush
Banksia armata	Prickly Dryandra
Banksia grandis	Bull Banksia
Banksia heliantha	Oak-leaved Dryandra
Banksia media	Southern Plains Banksia
Banksia menziesii	Firewood Banksia
Banksia sessilis	Parrot Bush
Calothamnus pinifolius	Dense Clawflower
Calothamnus quadrifidus	One-sided Bottlebrush
Carpobrotus virescens	Coastal Pigface
Clematis linearifolia	Slender Clematis
Dodonaea aptera	Coast Hop-bush
Eucalyptus angulosa	Ridge-fruited Mallee
Eucalyptus conferruminata	Bald Island Marlock
Eucalyptus conglobata	Port Lincoln Mallee
Eucalyptus utilis	Coastal Moort
Exocarpos sparteus	Broom Ballart
Ficinia nodosa	Knotted Club Rush
Hakea oleifolia	Dungyn
Hardenbergia comptoniana	Native Wisteria
Hibbertia cuneiformis	Cutleaf Hibbertia
Jacksonia cupulifera	A pea
Lepidosperma gladiatum	Coast Sword-sedge
Leucophyta brownii	Cushion Bush

Scientific name	Common name
Melaleuca cardiophylla	Tangling Melaleuca
Melaleuca cuticularis	Salt Paperbark
Melaleuca huegelii	Chenille Honeymyrtle
Melaleuca pentagona	A Melaleuca
Melaleuca rhaphiophylla	Swamp Paperbark
Melaleuca systena	A Melaleuca
Myoporum insulare	Blueberry Tree
Nuytsia floribunda	Christmas Tree
Olax phyllanthi	A shrub
Olearia axillaris	Coastal Daisybush
Pelargonium capitatum	Rose Pelargonium
Pimelea clavata	A shrub
Pimelea ferruginea	A shrub
Scaevola crassifolia	Thick-leaved Fan-flower
Scaevola nitida	Shining Fanflower
Senecio pinnatifolius	Coast Groundsel
Spinifex hirsutus	Hairy Spinifex
Spinifex longifolius	Beach Spinifex
Spyridium globulosum	Basket Bush
Tetragonia decumbens	Sea Spinach
Trachyandra divaricata	Dune Onion Weed

Table A 9: **Sandalwood host species modelled.**

Scientific name	Common name
Acacia acuminata	Jam
Acacia aneura	Mulga
Acacia burkittii	Sandhill Wattle
Acacia coolgardiensis	Spinifex Wattle
Acacia hemiteles	Tan Wattle
Acacia merrallii	Merrall's Wattle
Acacia neurophylla	
Acacia saligna	Orange Wattle
Allocasuarina acutivalvis	
Allocasuarina corniculata	
Allocasuarina huegeliana	Rock Sheoak
Casuarina obesa	Swamp Sheoak

Table A 10: **Potential carbon planting species modelled.**

Scientific name	Common name
Acacia acuminata	Jam
Acacia hemiteles	
Acacia merrallii	Merrall's Wattle
Acacia rostellifera	Summer-Scented Wattle
Acacia saligna	Orange Wattle
Acacia tetragonophylla	Kurara
Atriplex amnicola	Swamp Saltbush
Atriplex nummularia	Old Man Saltbush
Casuarina obesa	Swamp Sheoak
Eucalyptus arachnaea	Black-stemmed Mallee
Eucalyptus capillosa	
Eucalyptus eremophila	Eastern Goldfields Horned Mallee
Eucalyptus kondininensis	
Eucalyptus loxophleba	York Gum
Eucalyptus platypus	Moort
Eucalyptus salicola	Salt Gum
Eucalyptus salmonophloia	Salmon Gum
Eucalyptus sargentii	
Eucalyptus spatulata	
Eucalyptus wandoo	Wandoo
Melaleuca acuminata	A Melaleuca
Melaleuca adnata	
Melaleuca eleuterostachya	
Melaleuca thyoides	
Melaleuca uncinata	Broom Bush

Table A 11: **Potential salt tolerant species modelled.**

Scientific name	**Common name**
Allocasuarina acutivalvis	
Allocasuarina corniculata	
Allocasuarina huegeliana	Rock Sheoak
Atriplex amnicola	Swamp Saltbush
Atriplex cinerea	Grey salt bush
Atriplex isatidea	Coast Saltbush
Atriplex nummularia	Old Man Saltbush
Atriplex semibaccata	Australian Saltbush
Casuarina obesa	Swamp Sheoak
Eucalyptus salmonophloia	Salmon Gum
Maireana brevifolia	Small Leaf Bluebush
Rhagodia drummondii	
Rhagodia preissii	

Table A 12: **Potential fodder species modelled.**

Scientific name	Common name
Acacia acuminata	Jam
Acacia aneura	Mulga
Acacia burkittii	Sandhill Wattle
Acacia cochlocarpa velutinosa	Velvety Spiral Pod Wattle
Acacia coolgardiensis	Spinifex Wattle
Acacia cyclops	Coastal Wattle
Acacia forrestiana	
Acacia hemiteles	
Acacia merrallii	Merrall's Wattle
Acacia neurophylla	
Acacia rostellifera	Summer-Scented Wattle
Acacia saligna	Orange Wattle
Acacia tetragonophylla	Kurara
Atriplex amnicola	Swamp Saltbush
Atriplex nummularia	Old Man Saltbush
Atriplex semibaccata	Australian Saltbush
Maireana brevifolia	Small Leaf Bluebush
Rhagodia drummondii	
Rhagodia preissii	

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