

**Critical Gaps in the Marine Sanctuary  
Network proposed by the Federal  
Government for Australia's South-west.**

**Centre for Conservation Geography**

*Applied Strategic Tools and Conservation Innovation*

Report as at June 2011

## Executive Summary

On Thursday the 5<sup>th</sup> of May, 2011 the Australian Government proposed a number of marine sanctuaries for the Commonwealth waters of the South-west planning region. The south west of Australia is a globally important region for marine life with very high levels of unique species (for example the Australian south west contains higher levels of unique species than the Great Barrier Reef). This report uses a simple accounting approach to provide information on whether the proposed marine sanctuaries are likely to protect the South-west's unique marine life. We then use this information to identify 33 critical gaps in the network of marine sanctuaries proposed by The Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC).

## Key Findings

1. Almost 75% of the areas recommended for protection by scientists from the University of Queensland, remain unprotected.
2. Less than 5% of the proposed marine sanctuaries occur on the shelf and upper slope where scientists report marine life to be most threatened.
3. Inadequate or no protection has been provided for eight of the ten underwater icons of the South-west.
4. Inadequate or no protection has been provided for thirteen of the sixteen key ecological features of the South-west.
5. Inadequate or no protection has been provided to four of the flagship species of the South-west planning region including the endangered southern right whale and the threatened Australian sea lion, Australian lesser noddy and white shark.
6. Of the 165 biologically important areas mapped within the South-west planning region, 163 fail to meet minimum scientific benchmarks for protection. For example, no protection has been provided for the critical feeding grounds of the endangered blue whale.
7. The proposed marine sanctuaries are biased towards waters off Western Australia with less than 3% of the proposed marine sanctuaries occurring within the waters off South Australia.
8. The proposals do not establish the comprehensive, adequate and representative network of marine sanctuaries required to protect marine life. Specifically:
  - a. Of the ten bioregions contained within the South-west planning region all ten contain unprotected features that are critical for the protection of biodiversity. Three bioregions contain no proposed marine sanctuaries.
  - b. Overall, the median representation of features important for the conservation of biodiversity within the South-west planning region is 0%.
  - c. Six of the seven proposed marine sanctuaries located on the shelf and upper slope fail to meet world's best practice guidelines for minimum size.

- d. The marine sanctuaries proposed for the shelf and upper slope fail to form an interconnected network, with marine life protected within each proposed marine sanctuary likely to face major connectivity issues.
9. A number of areas critical to the protection of marine life are missing from the proposed marine sanctuary network. Thirty three of these critical gaps are identified in this report.

The marine sanctuaries proposed by DSEWPaC are not comprehensive, adequate, or representative of the South-west planning region. The complete lack of proposed marine sanctuaries for three entire bioregions and an overall median representation of 0% imply that the Commonwealth government is not making a genuine effort to meet the primary goal set by the Howard government in 1998 of establishing a national system of marine sanctuaries to protect Australia's unique marine life.

A 2009 study completed by scientists at the University of Queensland provided the Commonwealth Government with advice on how a comprehensive, adequate and representative network of marine sanctuaries could be established for a minimum cost. This advice appears to have predominantly been ignored.

In this report we document, for each key ecological feature mapped by the Commonwealth government, for biologically important areas mapped by the Commonwealth government and for the mapped biodiversity within each bioregion, the locations where particularly unique, rare, iconic, or significant habitats overlap with other important conservation features that require protection. These areas represent critical gaps in the proposed sanctuary network and their protection is a minimum requirement for the Commonwealth Government to demonstrate a genuine effort to protect the unique and unprotected biodiversity of the South-west (Figure 1).

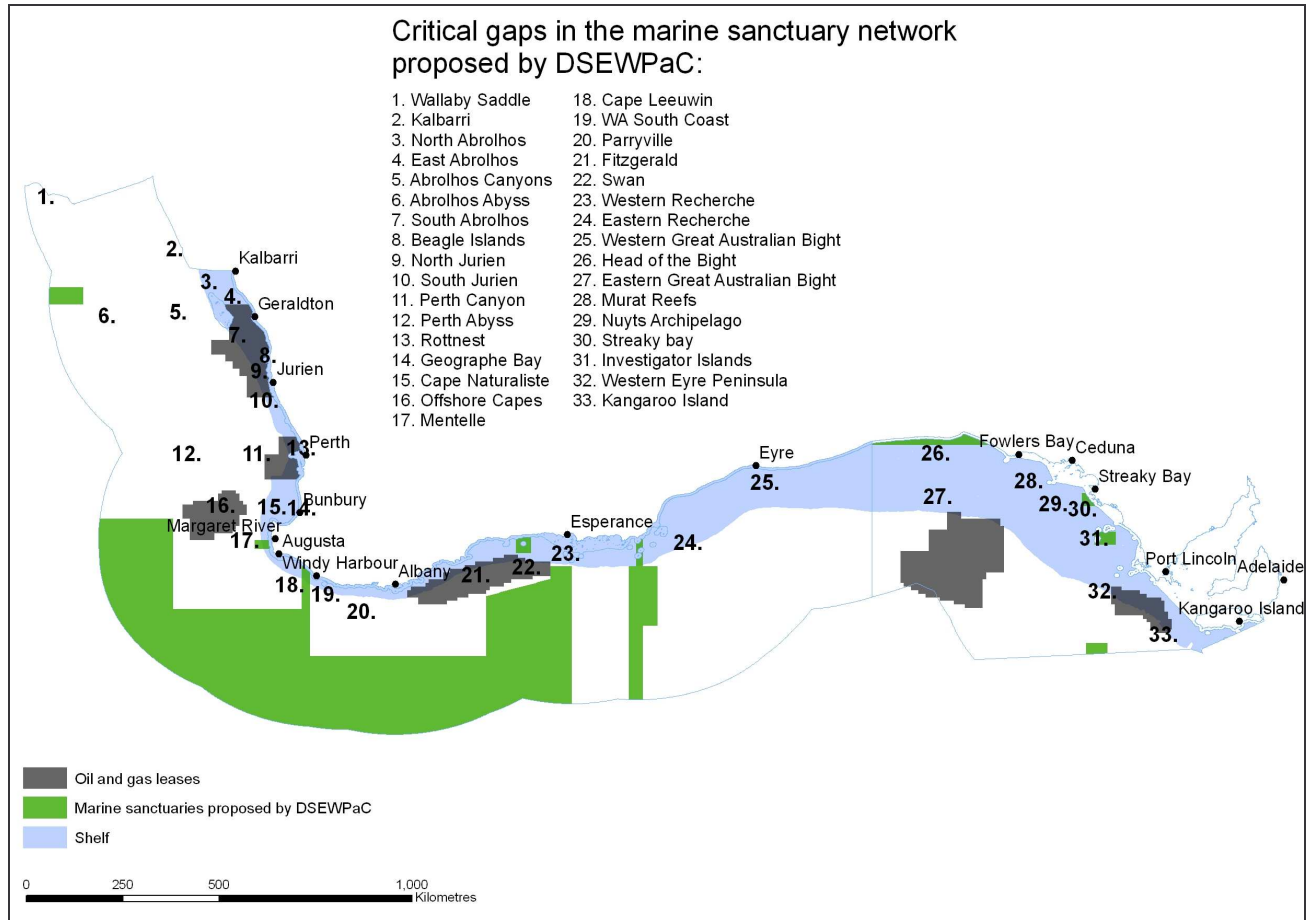


Figure 1 – Critical gaps in the marine sanctuary network proposed by DSEWPaC.

## Introduction

The Australian Government has proposed a network of marine sanctuaries to protect the marine life of the South-west planning region. The South-west planning region spans 1.3 million km<sup>2</sup> and contains a wide variety of species, up to 90% of which only occur in Australia's temperate waters. The proposed marine sanctuary network was released for public comment on the 5<sup>th</sup> of May 2011.

The stated primary goal of Australia's marine protected area (MPA) network is to “*establish and manage a comprehensive, adequate and representative system of MPAs to contribute to the long-term ecological viability of marine and estuarine systems, to maintain ecological processes and systems, and to protect Australia's biological diversity at all levels.*” (ANZECC TFMPA, 1998). This study assesses whether the proposed marine sanctuary network includes adequate coverage of areas critical to the protection of marine life within the region. We assess how the proposed network includes areas previously identified as important for protection including underwater icons, key ecological features and biologically important areas. We also compile and use a variety of biodiversity surrogates to help determine whether the proposed sanctuary network is comprehensive, adequate and representative of the marine biodiversity of the region. Biodiversity

surrogates aim to represent trends in the distribution of marine life and are a critical part of the process for identifying where marine sanctuaries should be located (Margules and Pressey, 2000; Possingham et al., 2009).

We show that the proposed sanctuary network inadequately incorporates areas vital for protecting the marine life of the South-west planning region. We identify 33 critical gaps in the proposed network. These 33 locations would meet multiple conservation objectives if they were included within the network. The following sections discuss our analysis and recommendations in relation to the nine key findings stated within the executive summary.

## Key Finding 1: Almost 75% of the areas recommended for protection by scientists from the University of Queensland, remain unprotected.

In 2009, scientists at the University of Queensland found that to adequately protect the unique marine life of the South-west around 54% of the planning region should be placed in marine sanctuaries (Possingham et al., 2009). Comparing the proposed marine sanctuaries to the University of Queensland candidate solution A shows that almost 75% of the areas proposed for protection by UQ remain unprotected (Figure 2).

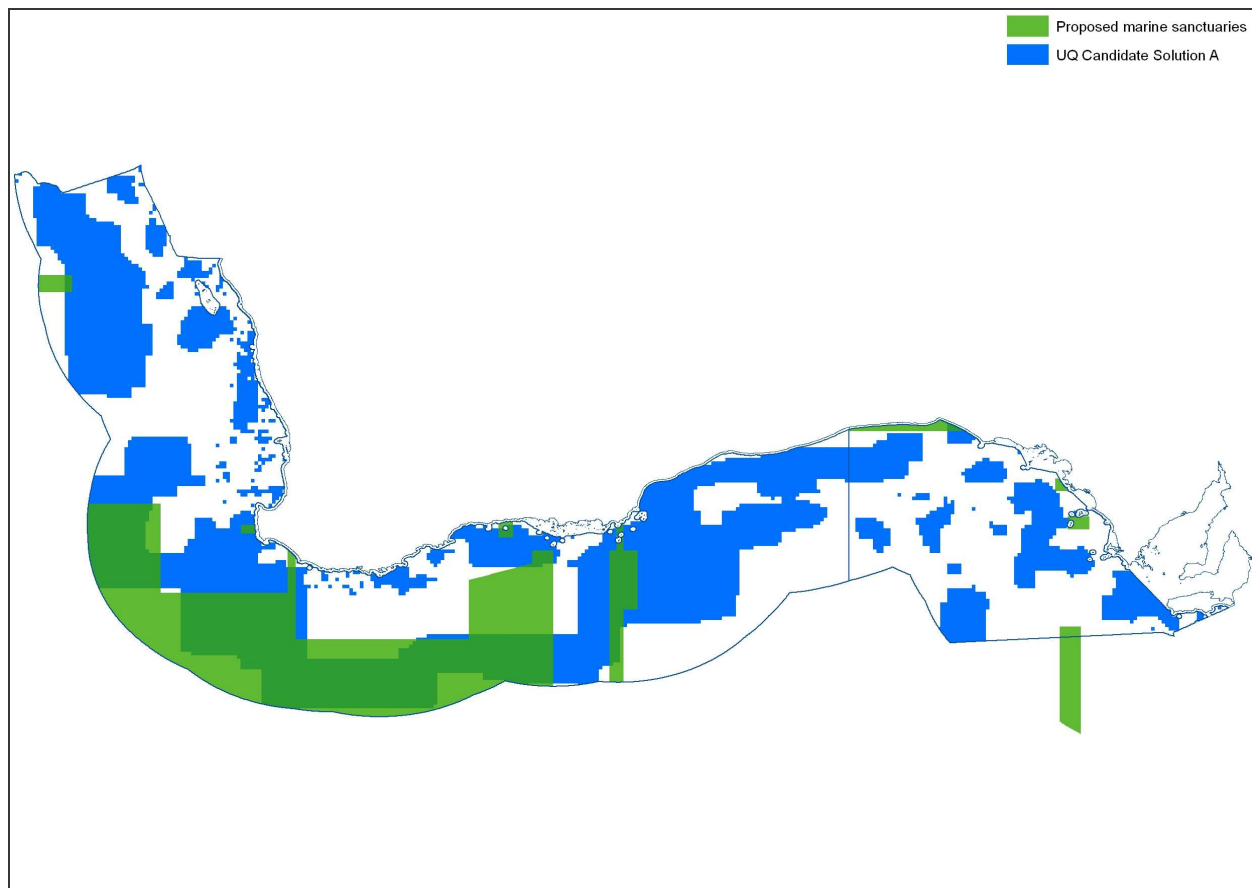


Figure 2 – Marine sanctuaries proposed by DSEWPaC overlaid with candidate solution A from Possingham et al. (2009).

**Key Finding 2: Less than 5% of the proposed marine sanctuaries occur on the shelf and upper slope where scientists report marine life to be most threatened.**

In the ocean the region of greatest biodiversity overlaps with the area of most heavy use by humanity. This area is broadly defined by the continental shelf and upper slope (less than 1500m) and has been called the zone of importance (Williams et al, 2009). Less than 5% of the proposed marine sanctuaries occur within the zone of importance showing that they are biased towards areas where fishing and mining do not currently occur (Figure 3).

**Key Finding 3: Inadequate or no protection has been provided for eight of the ten underwater icons of the South-west.**

Ten underwater icons have been identified within the South-west planning region (<http://www.saveourmarinelife.org.au/>). The proposed marine sanctuaries provide substantial protection for two of these icons, the Naturaliste Plateau and the Diamantina Fracture Zone. However, inadequate or no protection is provided for the other eight iconic areas (Figure 3).

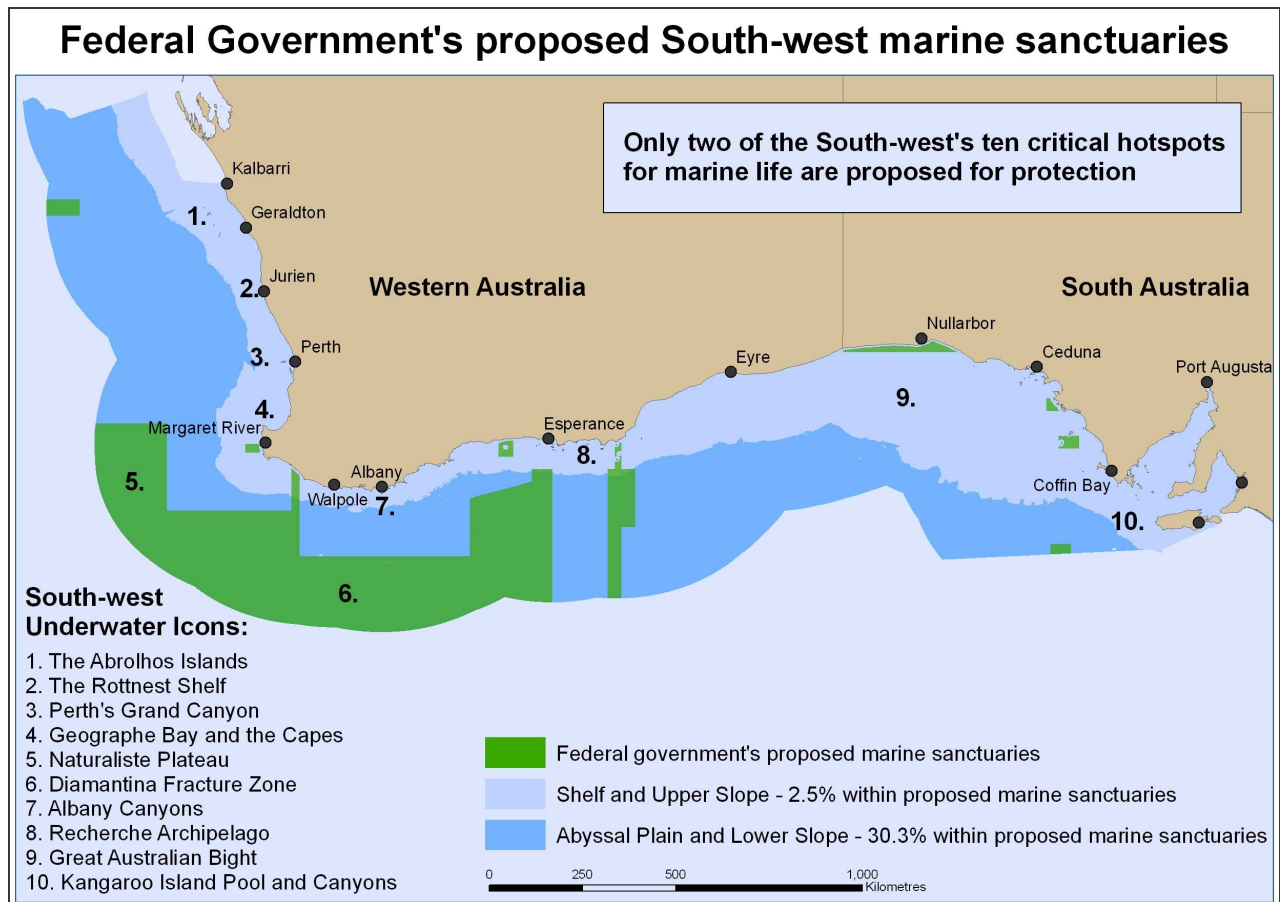


Figure 3 – Marine sanctuaries proposed by DSEWPaC overlaid with the zone of importance and underwater icons of Australia's unique South West.

## Key finding 4: Inadequate or no protection has been provided for thirteen of the sixteen key ecological features of the South-west.

DSEWPaC has defined 16 key ecological features across the South-west planning region (CoA, 2007). The proposed marine sanctuaries provide high levels of protection to three of the key ecological features, the Diamantina Fracture Zone, the Naturaliste Plateau and the Head of the Bight. However, inadequate or no protection is proposed for the other 13 key ecological features (Table 1). Within the following sections we recommend actions to improve the inclusion of these 13 features within the proposed sanctuary network.

**Table 1 – Level of inclusion of key ecological features as defined by DSEWPaC for the South-west planning region.**

DSEWPaC key ecological features	Marine sanctuaries proposed by DSEWPaC
Albany Canyons	8.6%
Cape Mentelle upwelling	12.7%
Demersal slope fish communities	0.0%
Diamantina Fracture Zone	99.9%
Eddy Generation Fields	3.6%
Geographe Bay	0.0%
Head of Bight	99.8%
Houtman Abrolhos Islands	0.0%
Kangaroo Island Canyons	0.0%
Kangaroo Island pool and Eyre Peninsula upwellings	5.1%
Naturaliste Plateau	81.1%
Perth Canyon	0.0%
Recherche Archipelago	7.9%
West Coast Canyons	0.0%
West Coast inshore lagoons	0.0%
Western Rock Lobster	1.7%

### 1. West Coast Canyons

*“The West Coast Canyons are believed to be associated with small periodic upwellings that locally enhance productivity and attract aggregations of marine life. The Perth Canyon is prominent among these canyons because of its magnitude and ecological importance. The Perth Canyon marks the southern boundary for numerous tropical species groups on the shelf, including sponges, corals, decapods and xanthid crabs. Deep ocean currents upwelling in the canyon create a nutrient-rich cold-water habitat attracting feeding aggregations of deep diving mammals, such as pygmy blue whales and large predatory fish that feed on aggregations of small fish, krill and squid.” (CoA, 2007)*

There are 53 canyons mapped within the west coast canyon system. Nine of the canyons occur within the Southwest Transition bioregion with the remaining 44 found within the Central Western Province bioregion. The two most distinctive of these canyons are the Perth Canyon and the Houtman Canyon, which are the two largest canyons and the only canyons to emerge onto the shallow mid slope. The Perth Canyon is the only west coast canyon to emerge onto the shelf and has been identified by CoA (2007) as ecologically important.

**Recommendations:** Protection for the west coast canyons should first be established via two sanctuaries: (i) Houtman and adjacent canyons. (ii) Perth and adjacent canyons (Figure 4).

## West Coast Inshore Lagoons

*“An extended chain of inshore lagoons, extending from south of Mandurah to Kalbarri, is considered to be important for benthic productivity and recruitment for a range of marine species. Although macro-algae and seagrass appear to be the primary source of production, scientists suggest that ground water enrichment may supplement the supply of nutrients to the inshore lagoon. The inshore lagoons are important areas for the recruitment of the commercially and recreationally important western rock lobster, dhufish, pink snapper, breaksea cod, baldchin and blue gropers, and many other reef species.” (CoA, 2007)*

No marine sanctuaries have been proposed for the west coast inshore lagoons. Within Commonwealth waters the majority of the lagoons are within existing or proposed petroleum leases. Inshore lagoons to both the north and south are free from petroleum activity. Other opportunities for protection exist where other important conservation features can also be captured including surrounding the Beagle Islands and north of Perth.

**Recommendations:** Protection for the west coast inshore lagoons should first be established via four sanctuaries: (i) the northernmost lagoons east of the Abrolhos Islands, (ii) the lagoons around the Beagle Islands, (iii) the lagoons north of Perth and Rottnest Island, and (iv) the southernmost lagoons (Figure 4).



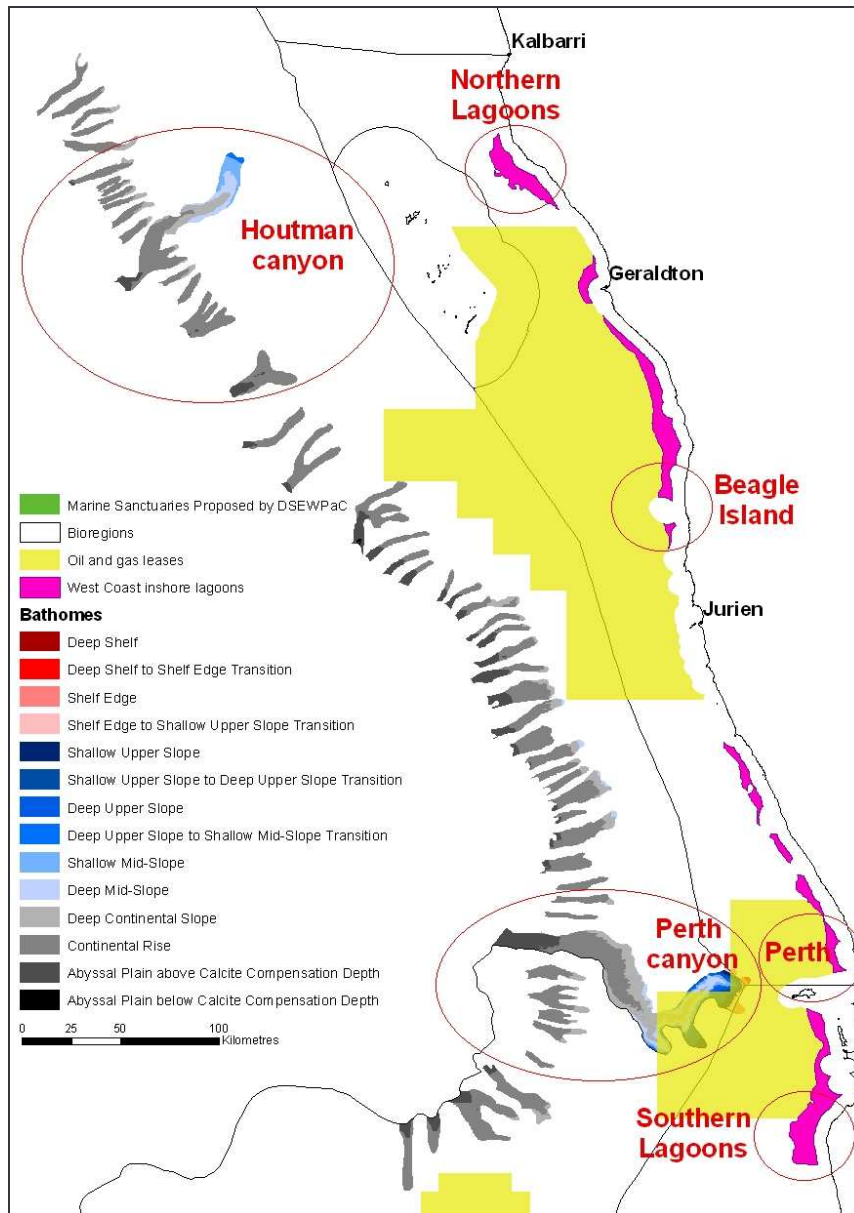


Figure 4 – Marine sanctuaries proposed by DSEWPaC overlaid by the West Coast Canyons and West Coast Inshore Lagoons showing canyon bathomes (depth classes) and bioregions.

## Albany Canyons

*“The Albany Canyons, including 32 canyons along 700km of continental slope, are believed to be associated with small periodic upwellings that enhance productivity and attract aggregations of marine life. Anecdotal evidence indicates that this area supports fish aggregations that attract large predatory fish, sharks and toothed, deep-diving whales such as the sperm whale.” (CoA, 2007)*

There are 39 canyons mapped within the Albany canyons system. All but one of these canyons is within the Southern Province. Of the 39 canyons the most distinctive are Malcolm Canyon, the only shelf breaking canyon, the two largest canyons, Bremer and Gardener, Esperance Canyon,

the only canyon with an along slope orientation, the six canyons to emerge onto the upper slope (Malcolme, Bremer, Vancouver, Mentelle, Pallinup and Swan canyons) and the canyons associated with the three ridges of the Albany canyons system, the Walpole, Parryville and Albany Spurs.

The proposed South West Corner marine sanctuary includes part of the D'Entrecasteaux Canyon and all of the Esperance Canyon. This is around 9% of the canyons by area and 5% by number which is a low level of representation for a system identified as a key ecological feature. The canyons for which protection has been proposed are more than 500km apart, making the likelihood of connectivity between the proposed sanctuaries very low (Halpern et al, 2006). The proposed sanctuary over part of the D'Entrecasteaux canyon is narrow and does not include the whole canyon making within sanctuary larval dispersal less likely for canyon dwelling species.

**Recommendations:** Priorities for additional marine sanctuaries should be Malcolme Canyon, Bremer and Pallinup Canyons, Swan Canyon, the Parryville Spur system (including Wilson and/or Denmark Canyons), Gardener Canyon and the rest of D'Entrecasteaux Canyon. Protection for the Albany Canyons should be increased by: (i) expanding the proposed Eastern Recherche marine sanctuary to include Malcolme canyon, (ii) expanding the proposed marine sanctuary at Red Island to include Swan Canyon, (iii) establishing a marine sanctuary for Bremer and Pallinup Canyons, (iv) establishing a marine sanctuary for the Parryville Spur system including the Wilson and/or Denmark Canyons, and (v) expanding the proposed South West Corner marine sanctuary to include Gardener Canyon and the rest of D'Entrecasteaux Canyon (Figure 5).

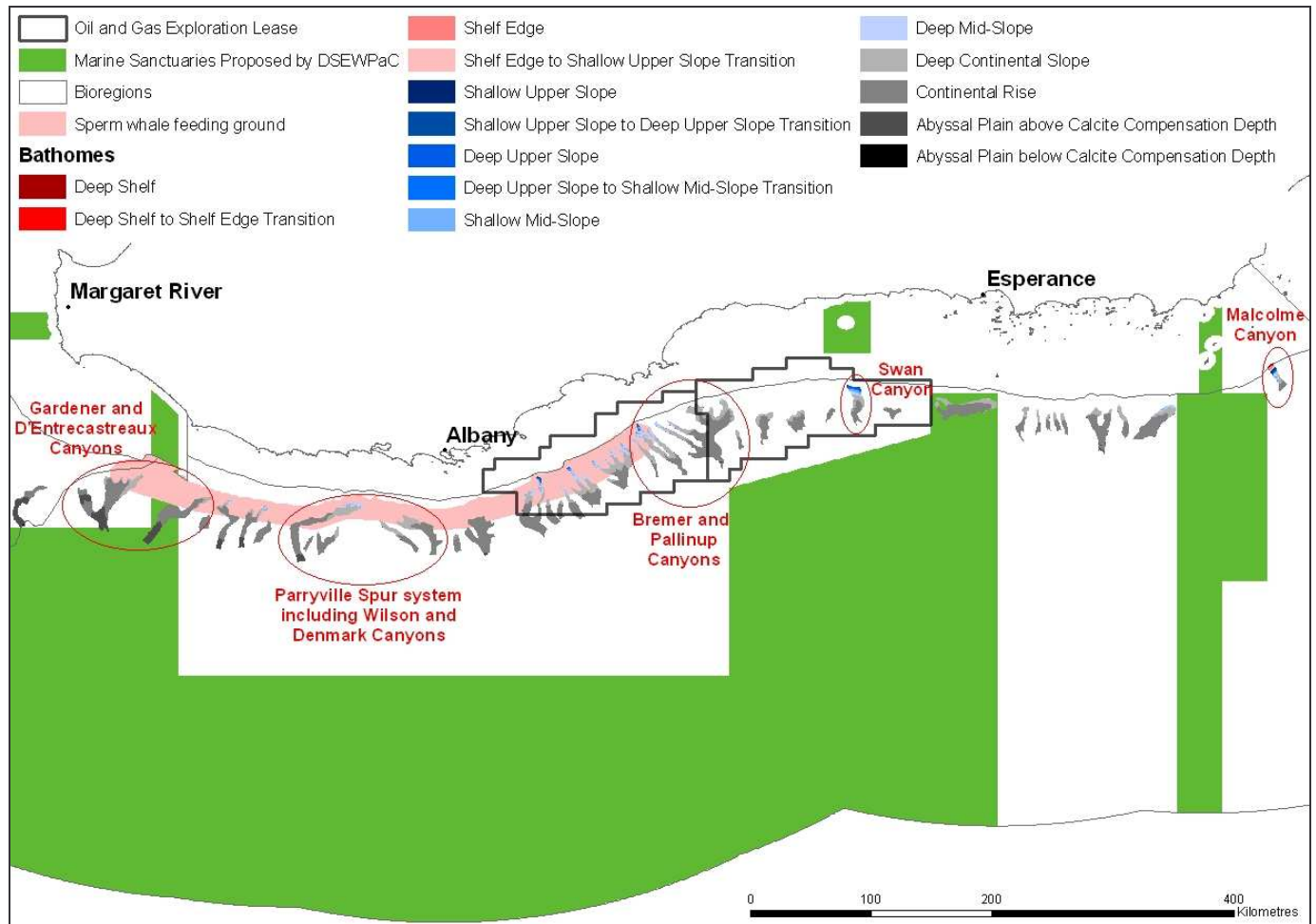


Figure 5 – Marine sanctuaries proposed by DSEWPaC overlaid by the Albany canyons showing bathomes (depth ranges) and bioregions.

## Kangaroo Island Canyons

*“The Kangaroo Island canyons – a small group of steep-sided, narrow canyons – are associated with enhanced productivity that attracts aggregations of marine life. Seasonal upwellings are believed to be an important factor enhancing production. These upwellings support aggregations of krill, small pelagic fish and squid that in turn attract marine mammals (e.g. pygmy blue whales, fin whales, sperm whales, dolphins and New Zealand fur seals), sharks, large predatory fish and seabirds. Anecdotal evidence indicates that orange roughy, blue grenadier and western gemfish aggregate and are thought to spawn in this area. Empirical evidence shows that orange roughy eggs occur in high densities. The canyons are also thought to be an important pupping area for school shark and the adjacent shelf break is known for high yields of giant crab and southern rock lobster.”*  
(CoA, 2007)

There are 30 canyons mapped within the Kangaroo Island Canyons system (CoA, 2007). All of these canyons are within the Southern Province. The most distinctive canyons are the five shelf commencing canyons including Murray Canyon, De Couedic Canyon and Lincoln Canyon.

No marine sanctuaries have been proposed for the Kangaroo Island Canyons. The seven easternmost canyons are outside the South-west planning region. The marine sanctuary network for the adjacent South-east planning region also failed to provide any protection for this key ecological feature. **Recommendations:** Priorities for sanctuaries are the shelf commencing canyons, three of which occur within the South-west planning region. Protection for the Kangaroo Island Canyons should be established via a marine sanctuary from Lincoln to De Couedic Canyon (Figure 6).

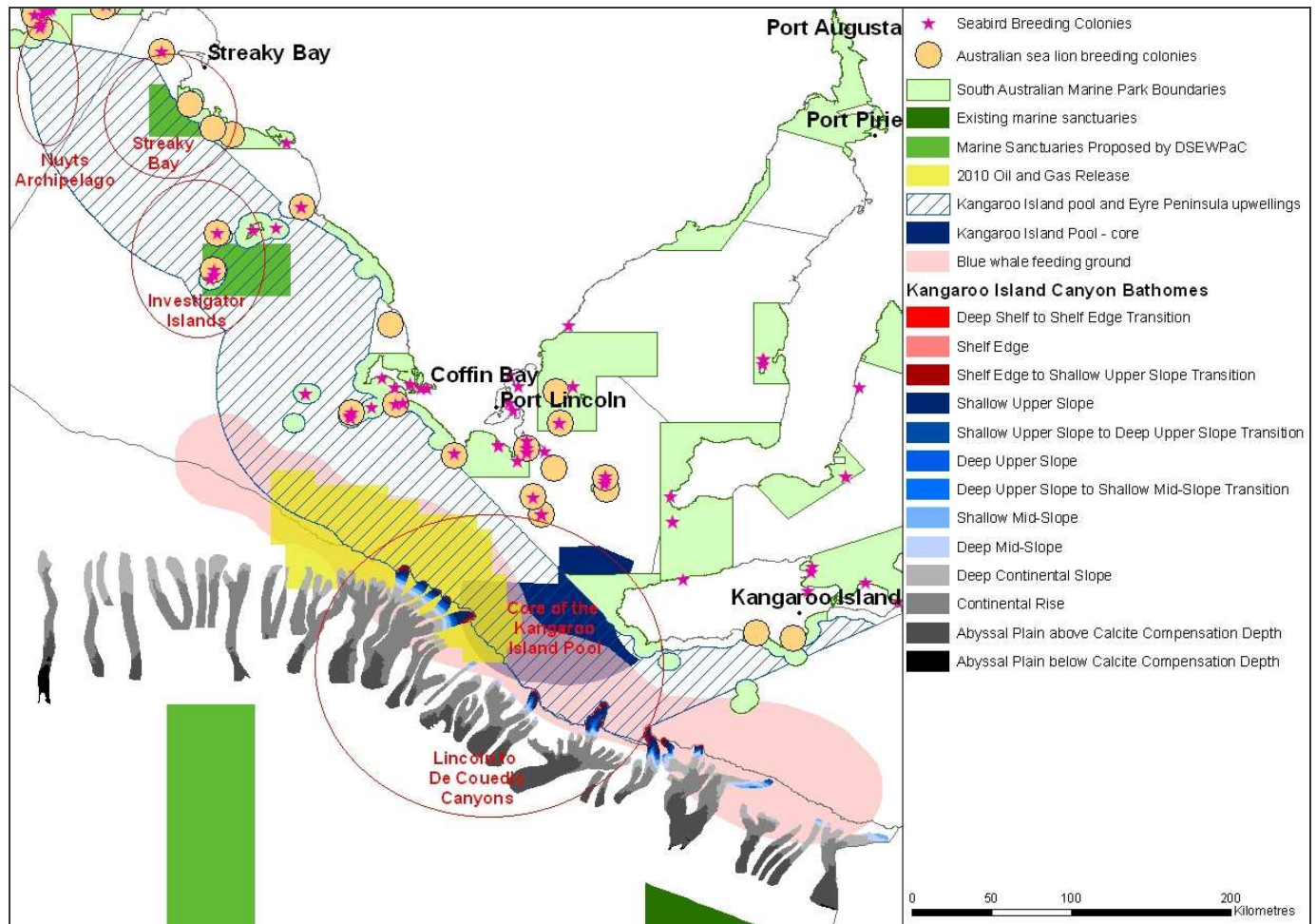


Figure 6 – Marine sanctuaries proposed by DSEWPaC overlaid with the Kangaroo Island Canyons and Pool showing bathomes (depth classes) within the canyons.

### Kangaroo Island Pool and Eyre Peninsula Upwellings

*“The Kangaroo Island Pool and Eyre Peninsula upwellings are known to be associated with seasonal aggregations of marine life. The nutrient-rich upwellings enhance the production of plankton communities supporting seasonal aggregations of krill, small pelagic fish and squid which in turn attract marine*

*mammals (e.g. toothed whales, dolphins and New Zealand fur seals), sharks, large predatory fish and seabirds.*" (CoA, 2007)

The two proposed Western Eyre marine sanctuaries together contain 5% of the Kangaroo Island Pool and Eyre Peninsula upwellings (Figure 6). This is a very low level of protection for an area of high ecological significance (CoA, 2007). None of the core area of the Kangaroo Island Pool is included within the proposed marine sanctuaries. The core of the Kangaroo Island Pool is a priority area for protection. Three opportunities exist that would maximize conservation outcomes by choosing locations that overlap with where other important conservation features require protection. Opportunities include expanding the proposed sanctuary network near the Investigator Islands and Streaky Bay and also to incorporate the waters surrounding the Nuyts Archipelago. Each of the existing proposed sanctuaries at the Investigator Islands and Streaky Bay is small making within sanctuary larval dispersal unlikely for many species.

**Recommendations:** Protection for the Kangaroo Island Pool and Eyre Peninsula upwellings should be increased by (i) establishing a new sanctuary to provide protection for the core area of the Kangaroo Island Pool upwelling, (ii) by expanding the proposed marine sanctuary at the Investigator Islands, (iii) by expanding the proposed marine sanctuary at Streaky Bay, and (iv) by establishing a new sanctuary around the Nuyts Archipelago (Figure 6).

## Abrolhos Islands

*"The Houtman Abrolhos Islands and surrounding reefs have been relatively well studied and are noted for their high species diversity. The reefs are composed of 184 known species of corals that support about 400 known species of demersal fish, 492 known species of molluscs, 110 known species of sponges, 172 known species of echinoderms and 234 known species of benthic algae. The high biodiversity of the islands is attributed to the mix of temperate and tropical species resulting from the southward transport of species by the Leeuwin Current over thousands of years."* (CoA, 2007)

No marine sanctuaries have been proposed for the Abrolhos Islands. Adequate protection of the complex system of reef, pinnacle, reef apron/fan, bank, shoal, canyon and channel habitats, seascapes and fish and invertebrate assemblages can only be achieved by a network of marine sanctuaries across the Abrolhos system.

**Recommendations:** Incorporate the following locations within the proposed sanctuary network: (i) the unique pinnacle, channel, reef and bank systems of the northern Abrolhos, (ii) the reef systems of the eastern Abrolhos, (iii) the unique bank and channel systems of the southern Abrolhos, (iv) the unique canyon systems of the western Abrolhos (Figure 7).

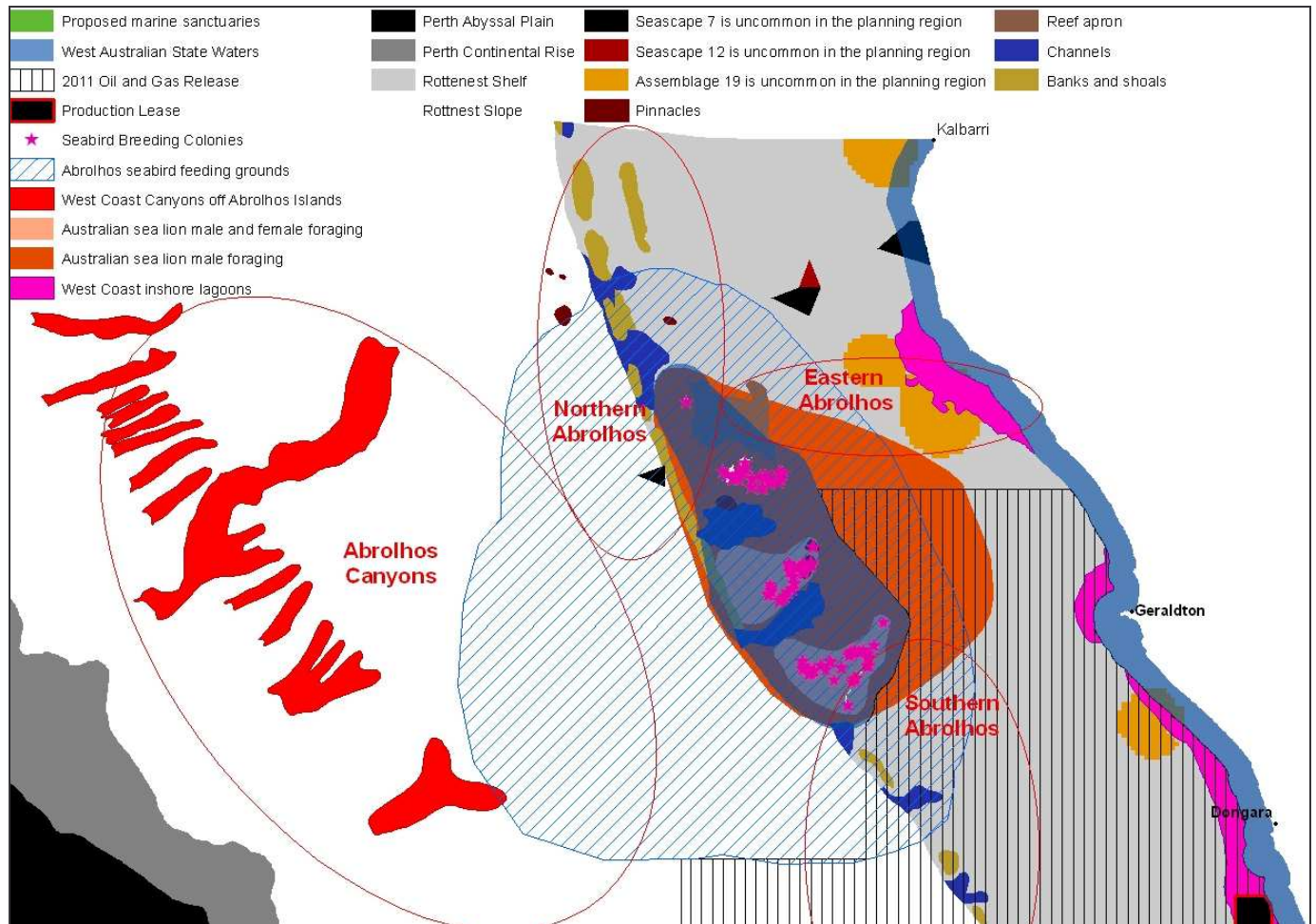


Figure 7 – Marine sanctuaries proposed by DSEWPaC overlaid by some of the conservation features of the Abrolhos Islands key ecological feature.

## Geographe Bay

*“Geographe Bay is a large sheltered embayment with extensive beds of tropical and temperate seagrass that account for about 80 per cent of benthic primary production in the area. The seagrass beds are noted for their high species biodiversity and endemism. Similar to the lagoons to the north, Geographe Bay provides important nursery habitat for many shelf species (e.g. dusky whaler sharks use the shallow seagrass habitat as nursery grounds for several years before ranging out over the shelf to adult feeding grounds along the shelf break). Geographe Bay is also an important resting area for migrating humpback whales.” (CoA, 2007)*

No marine sanctuaries have been proposed for Geographe Bay. Opportunities for protection that overlap with the location of other important conservation features that require protection include areas to the east of Bunbury and around Cape Naturaliste.

**Recommendations:** That protection for Geographe Bay be established through marine sanctuaries at (i) east of Bunbury, and (ii) around Cape Naturaliste (Figure 8).

## Cape Mentelle Upwelling

*“The Cape Mentelle upwelling draws relatively nutrient-rich water from the base of the Leeuwin Current, where nutrient levels are higher, up the continental slope and on to the continental shelf, where it results in blooms of phytoplankton at the surface. Higher densities of phytoplankton provide the basis of an extended food chain characterised by aggregations of small pelagic fish, larger predatory fish, seabirds, dolphins and sharks.” (CoA, 2007)*

The proposed marine sanctuary south west of Margaret River includes 13% of the area influenced by the Cape Mentelle Upwelling. This is a low level of protection for an area which is highly significant for the ecology of the region. Expanding the proposed marine sanctuary to the north and west would increase the level of protection for the Cape Mentelle upwelling as well as achieving other conservation objectives.

**Recommendations:** Increase protection for the Cape Mentelle Upwelling by expanding the proposed marine sanctuary to the south west of Margaret River (Figure 8).

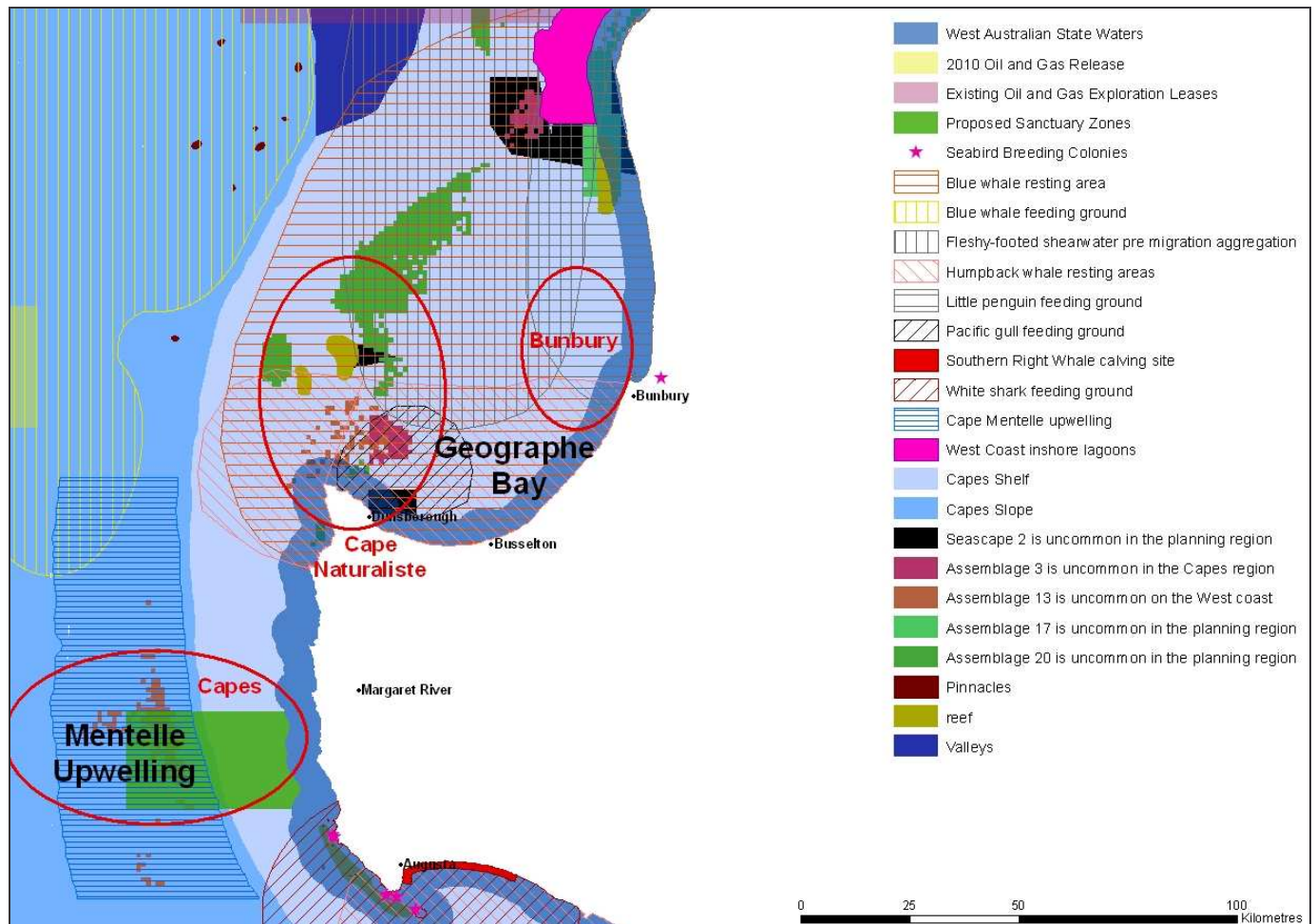


Figure 8 – Marine sanctuaries proposed by DSEWPaC overlaid by some of the conservation features in and around the key ecological features of Geographe Bay and the Mentelle Upwelling.

## Western Rock Lobster

*“This species is the dominant large benthic invertebrate in this bioregion. Western rock lobsters are an important part of the food web on the inner shelf, particularly when they are juveniles as they are preyed upon by octopus, cuttlefish, baldchin groper, blue groper, dhufish, pink snapper wirrah cod and breaksea cod. Western rock lobster are also particularly vulnerable to predation during seasonal moults in November-December and to a lesser extent during April-May. The high biomass of western rock lobsters and their vulnerability to predation suggest that they are an important trophic pathway for a range of inshore species that prey upon juvenile lobsters” (CoA, 2007).*

Western rock lobsters are a key ecological feature of the shelf ecosystems of the Central West Coast, Abrolhos and Leeuwin-Naturaliste bioregions. This area only contains a single proposed marine sanctuary (the proposed Mentelle sanctuary) at the southern end of the range and covering less than 2% of their habitat. Significant western rock lobster habitats remain unprotected, for example there are no sanctuaries in the Abrolhos Islands system which provides an estimated 50% of the broodstock of the species (DoF, 2007). Recent evidence has shown that mature western rock lobsters close to the shelf break in the northern Abrolhos system are the most critical broodstock for the western rock lobster species (Caputi et al., 2010). Sanctuaries in the northern, southern and eastern Abrolhos would protect the western rock lobster broodstock, while also increasing protection for the unique habitats of the Abrolhos Islands. Sanctuaries at the Beagle Islands and west of the Jurien Bay Marine Park would provide protection for the western rock lobster habitats of the Central West Coast bioregion, while also providing critical protection for the habitats of WA's largest sea lion population. A marine sanctuary north of Perth and Rottnest Island would provide an important scientific reference site while increasing connectivity between sanctuaries in the Central West Coast and Leeuwin-Naturaliste bioregion. Sanctuaries at Geographe Bay, Cape Naturaliste, Mentelle and Cape Leeuwin would protect important parts of the southern end of the range while also providing protection for the unique habitats of Geographe Bay and the Capes.

**Recommendations:** Protection for western rock lobsters should be increased through the establishment or expansion of marine sanctuaries at (i) northern Abrolhos, (ii) eastern Abrolhos, (iii) southern Abrolhos, (iv) Australian sea lion feeding grounds adjacent to the Beagle Islands and the Jurien Bay marine park, (v) area north of Perth and Rottnest Island, (vi) Geographe Bay, (vii) Cape Naturaliste, (viii) expanding the Mentelle sanctuary, (ix) Cape Leeuwin (Figure 9).

## Central Western Province Demersal Slope Fish Communities

*“Demersal slope fish assemblages in this bioregion are characterised by high species diversity. Scientists have described 480 species of demersal fish that inhabit the slope of this bioregion and 31 of these are considered endemic to the bioregion. Demersal fish on the slope in this bioregion in particular have high species diversity compared with other more intensively sampled oceanic regions of the world. Below 400 m water depth demersal fish communities are characterised by a diverse assemblage where relatively small, benthic species (grenadiers, dogfish and cucumber fish) dominate.” (CoA, 2007)*



No marine sanctuaries have been proposed that would protect the diverse species of the Central Western Province slope. The most important habitats are those surrounding the Houtman and Perth Canyons, the deeper slope habitats south of the Wallaby Saddle, the eddy influenced regions west of the Abrolhos and Jurien and the pinnacle habitats to the west of Kalbarri on the Carnarvon terrace and slope.

**Recommendations:** Protection for the demersal slope fish communities of the Central Western Province should be established via sanctuaries at (i) Perth Canyon, (ii) west of the Abrolhos Islands including Houtman Canyon, (iii) west of the Jurien Bay marine park, (iv) west of Kalbarri, and (v) south of the Wallaby Saddle (Figure 9).

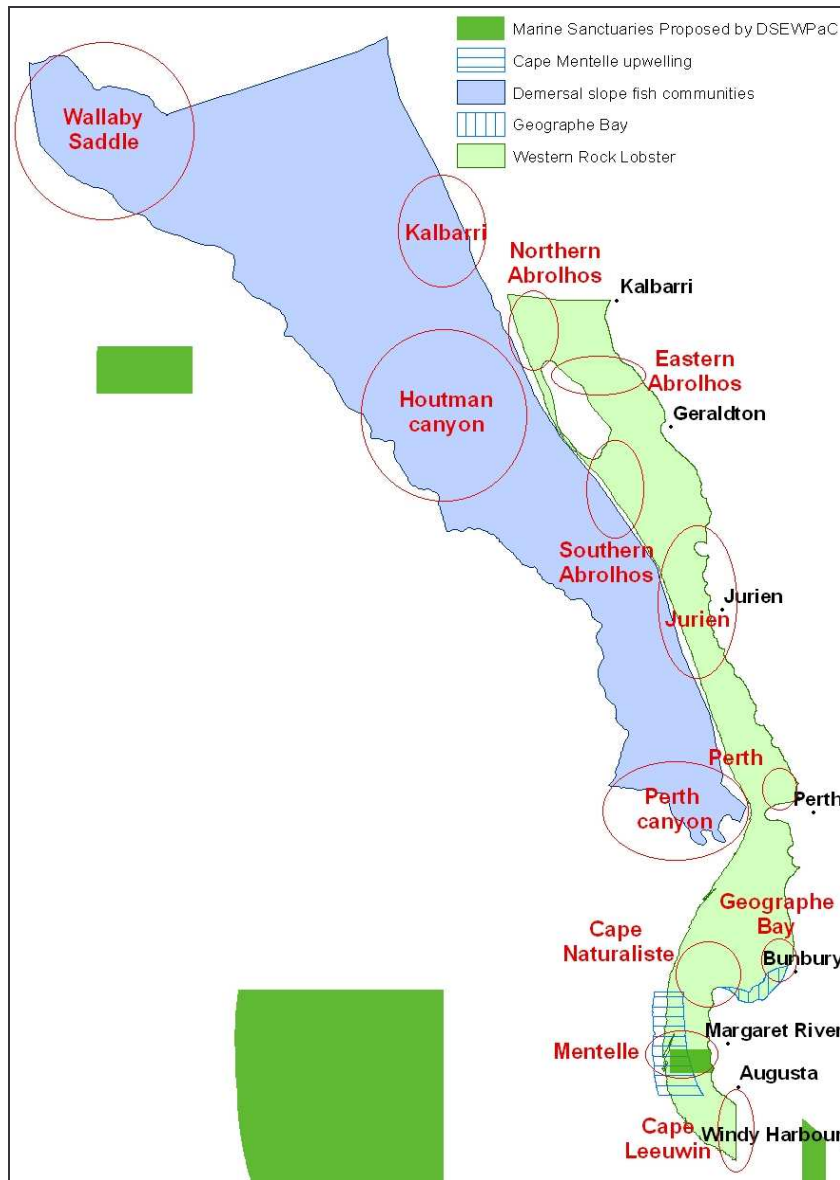


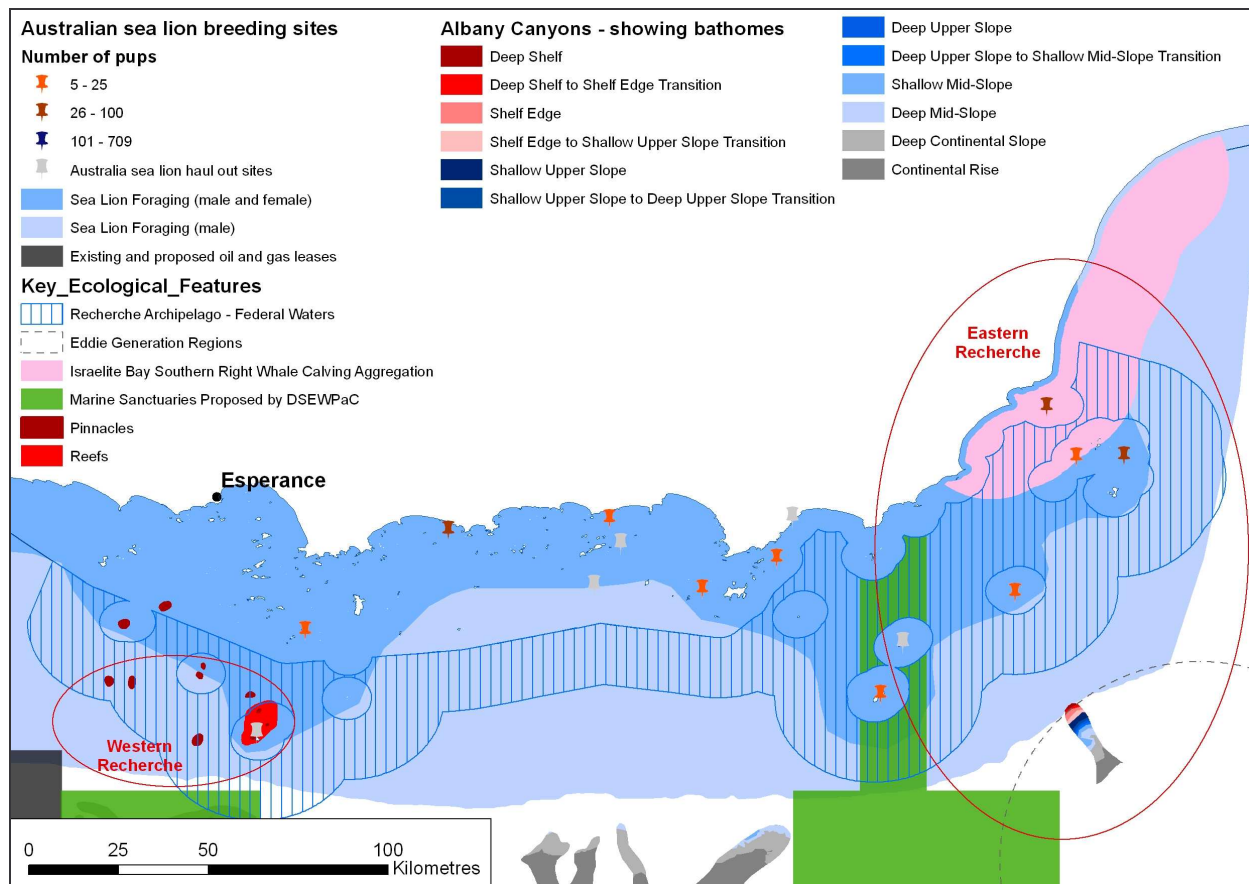
Figure 9 – Marine sanctuaries proposed by DSEWPac overlaid with two key ecological features; the western rock lobster and demersal slope fish communities.

## Recherche Archipelago

*“The Recherche Archipelago is the most extensive area of reef in the South-west Marine Region (35 203 km<sup>2</sup> of reef habitat). Its reef and seagrass habitat supports a high species diversity of warm temperate species including 263 known species of fish, 347 known species of molluscs, 300 known species of sponges, and 242 known species of macro-algae. The islands also provide haul-out (resting areas) and breeding sites for Australian sea lions and New Zealand fur seals.” (CoA, 2007)*

The proposed marine sanctuaries in the eastern and western Recherche Archipelago include 8% of the federal waters of the Recherche Archipelago which is a low level of protection for a biodiverse and ecologically significant area. Opportunities for protection that overlap with other important conservation features that require protection include to the north of the proposed marine sanctuary in the western Recherche Archipelago and to the east of the proposed marine sanctuary in the eastern Recherche Archipelago.

**Recommendations:** That protection for the Recherche Archipelago be increased by expanding the proposed marine sanctuaries in the eastern and western Recherche Archipelago (Figure 10)



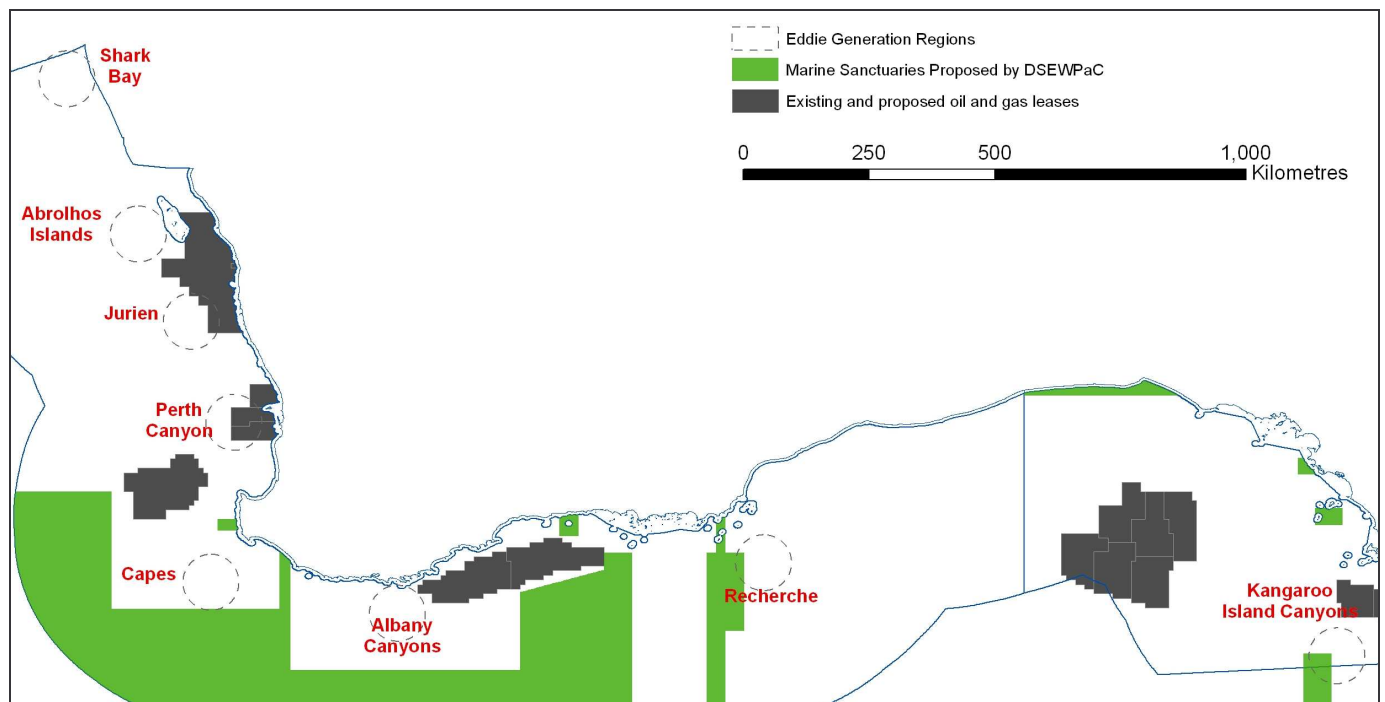
**Figure 10 - Marine sanctuaries proposed by DSEWPAC overlaid by some important conservation features including the two recommended locations for increased protection in the western and eastern Recherche Archipelago.**

## Eddy Generation Regions

*“Eddies and eddy fields form at predictable locations off the western and south-western shelf break (south-west of Shark Bay, offshore of the Houtman Abrolhos Islands, south-west of Jurien Bay, Perth canyon, south-west of Cape Leeuwin and south of Albany, Esperance and the Eyre Peninsula). The meso-scale eddies of this Region are important transporters of nutrients and plankton communities, taking them far offshore into the Indian Ocean where they are consumed by oceanic communities. Clockwise eddies are considered to play an important role in lifting deep water, which can be relatively cooler and richer in nutrients, toward the surface where it can enhance production of plankton communities that attract aggregations of marine life.” (CoA, 2007)*

Of the eight predictable locations where eddies and eddy fields form in the South-west planning region, three partially overlap with the marine sanctuaries proposed by DSEWPaC. Overall the proposed marine sanctuaries protect less than 4% of the eddy generation regions of the South-west planning region. This is a low level of protection for a key ecological process of the region. Opportunities to increase protection that overlap with the location of other important conservation features that require protection include the Abrolhos Islands, Perth Canyon, Capes and Recherche eddy generation regions.

**Recommendations:** That protection for the eddy generation regions of the South-west planning region be increased by establishing sanctuaries at (i) the Abrolhos Islands, (ii) Perth Canyon, (iii) south of Cape Leeuwin and (iv) by expanding the proposed marine sanctuary at the western Recherche Archipelago (Figure 11).



**Figure 11 – Marine sanctuaries proposed by DSEWPaC overlaid by the location of predicable locations of eddy formation in the South-west planning region.**

## Eastern Great Australian Bight

*“Soft-sediment benthic invertebrate communities of the eastern Great Australian Bight shelf form some of the world’s most diverse soft sediment ecosystems. A 2002 survey of benthic marine life sampled 798 species, including 360 species of sponge, 138 ascidians and 93 bryozoans, many of which were new to science. The shelf in this area of the Region is part of the world’s largest cool-water carbonate province. Invertebrate skeletons and shells make up over 80 per cent of the shelf sediments.” (CoA, 2007)*

The Eastern Great Australian Bight (Eastern GAB) contains the shelf habitats of the Murat bioregion and the eastern section of the Eucla bioregion. This ecologically significant area is afforded a very low level of protection by the proposed sanctuary network with less than 5% of the eastern GAB included within a single sanctuary. This proposed sanctuary at the head of the bight is, in places, very narrow.

Protection for the shallower habitats of the Eastern GAB should be increased by expanding the proposed sanctuary to be a minimum of 20km wide at all points and to include the only reef system mapped within the Commonwealth waters of the Eucla bioregion. Protection of shallower eastern GAB habitats should also be enhanced via sanctuaries for the important sea lion feeding grounds of the Nuyts Archipelago and the Murat bioregion reef system. Protection for the deeper shelf waters of the Eastern GAB should be established around the existing Great Australian Bight marine park and within the deep shelf waters of the Murat bioregion.

**Recommendations:** Increase the level of protection for the Eastern Great Australian Bight shelf by (i) expanding the proposed sanctuary at the head of the bight, (ii) establishing a sanctuary in the deeper waters of the Eucla bioregion in and around the existing Great Australian Bight marine park, (iii) establishing a sanctuary in the Commonwealth waters adjacent to the Nuyts Archipelago, (iv) establishing a sanctuary around the Murat Reefs, (v) establishing a sanctuary for the deeper waters of the Murat bioregion south of the Nuyts Archipelago (Figure 12).

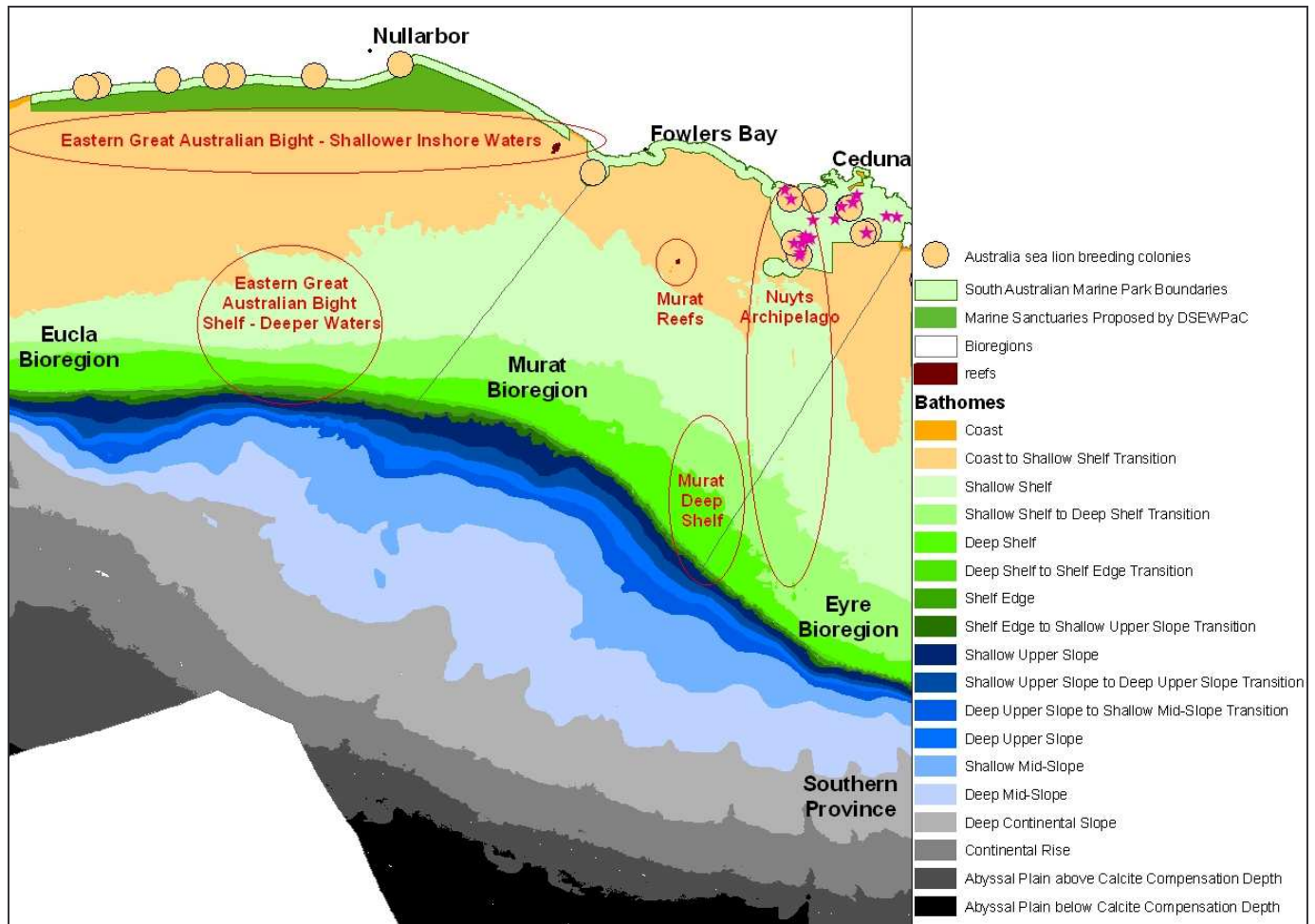


Figure 12 – Marine sanctuary proposed by DSEWPaC overlaid by the bathomes, bioregions and reefs within the key ecological feature of the Eastern Great Australian Bight Shelf.

**Key finding 5: Inadequate or no protection has been provided to four of the flagship species of the South-west planning region including the endangered southern right whale and the threatened Australian sea lion, Australian lesser noddy and white shark.**

The proposed marine sanctuaries provide inadequate or no protection for the biologically important areas of the Australian sea lion, white shark, Australian lesser noddy and Southern right whale, which were identified by DSEWPaC as flagship species for the South-west.

### **Australian Sea Lion *Neophoca cinerea***

Conservation status: Listed as threatened in the vulnerable category (EPBC Act 1999).

The Australian sea lion is one of the flagship species of the South-west (CoA, 2007). Australian sea lion breeding colonies are significant since they are an endemic threatened species that have not recovered from overhunting (CoA, 2007). With the exception of the Page Islands all Australian sea lion breeding colonies are within or adjacent to the South-west planning region. Populations of Australian sea lions located near the Abrolhos Islands, the west coast of WA, the south coast of WA and off the coast of South Australia are distant from each other and are therefore likely to be isolated populations (Figure 13).

The proposed sanctuary network provides a low level of protection to the Sea lion population off the coast of South Australia. Only 4% of the feeding area of the sea lions is located within sanctuaries and 12 of the 39 breeding colonies are located near proposed sanctuaries. This is a low level of protection for the important breeding and feeding habitat of an endemic threatened species and could be improved by expanding the proposed sanctuaries at the head of the bight, Streaky Bay and the Investigator Islands and by establishing a marine sanctuary for the Nuyts Archipelago.

The sea lion population off the southern coast of Western Australia has 2 of its 15 breeding colonies near a proposed marine sanctuary and 7% of its feeding area included within marine sanctuaries. This level of protection is low for an important breeding and feeding habitat of an endemic threatened species. Protection could be improved by expanding the proposed network at Red Island and in the Eastern and Western Recherche Archipelago and to include the Fitzgerald River National Park.

The sea lion populations on the west coast of Western Australia and at the Abrolhos Islands have no proposed marine sanctuaries. The key feeding grounds of these two populations are substantially covered by a proposed oil and gas lease. Key areas of the Abrolhos Islands and the west coast of WA should be excised from the proposed lease to enable protection for critical sea lion feeding grounds. The most important areas are those adjacent to breeding colonies in the southern Abrolhos, the Beagle Islands, the Fisherman Islands and Buller Island.

**Recommendations:** Additional protection should be provided to the populations of Australian sea lions within:

- The South Australian Coast by (i) expanding the proposed marine sanctuary at the head of the bight, (ii) establishing a marine sanctuary around the Nuyts Archipelago, (iii) expanding the proposed marine sanctuary at the Investigator Islands, (iv) expanding the proposed marine sanctuary at Streaky Bay;
- The south coast of Western Australia by (v) expanding the proposed marine sanctuary in the eastern Recherche Archipelago, (vi) expanding the proposed marine sanctuary in the western Recherche Archipelago, (vii) expanding the proposed marine sanctuary at Red Island, (viii) establishing a marine sanctuary off the Fitzgerald River National Park and;
- The west coast of Western Australian and Abrolhos Islands by (ix) establishing a marine sanctuary in the Southern Abrolhos, (x) establishing a marine sanctuary off Beagle Island, (xi) establishing a marine sanctuary off the Fisherman Islands, and (xii) establishing a marine sanctuary off Buller Island (Figure 13).

Table 2 – Level of inclusion of important habitats for Australian sea lions within the proposed marine sanctuaries.

Region	Number of Breeding Colonies	Number of breeding colonies within 10 nautical miles of proposed marine sanctuaries	Proportion of foraging grounds within the South-west planning region within proposed marine sanctuaries
South Australia	39	12	3.8%
WA South Coast	15	2	6.5%
WA West Coast	3	0	0%
Abrolhos Islands	1	0	0%
Total	58	14	4.0%

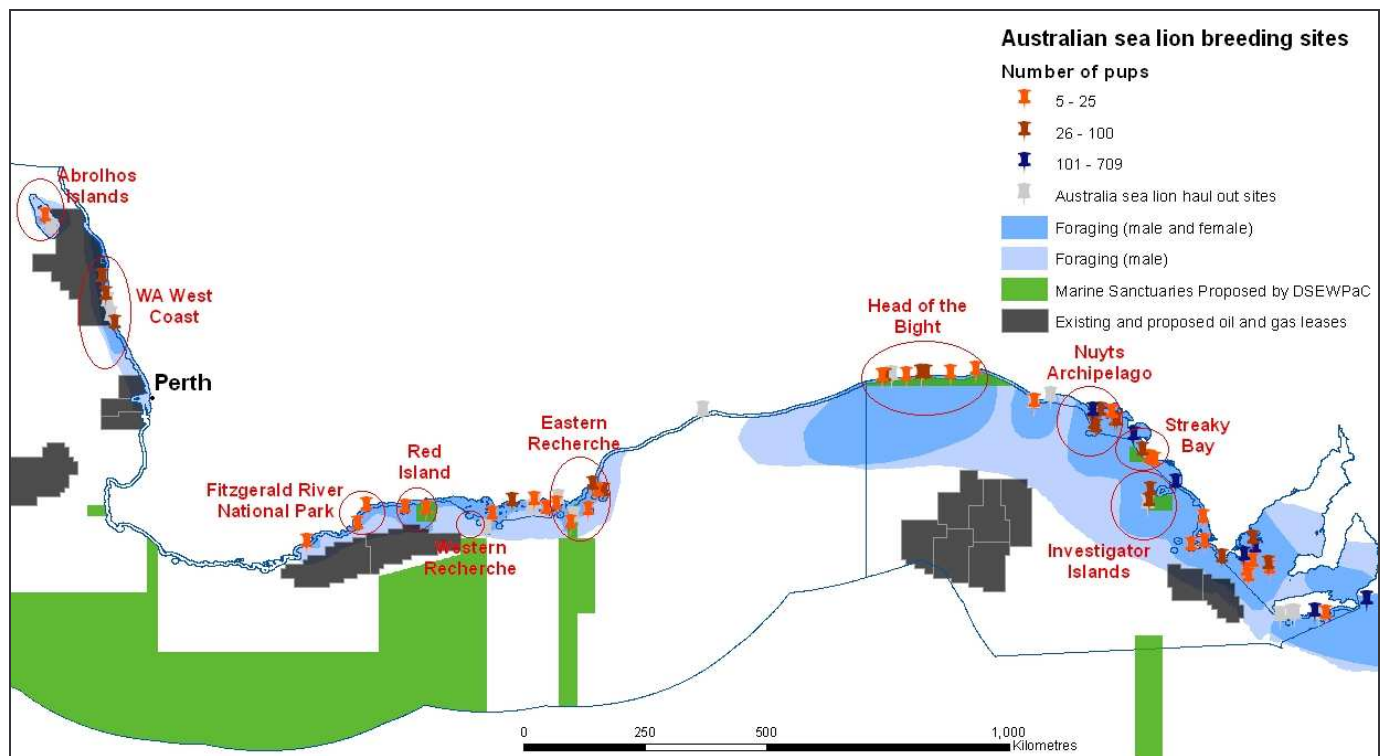


Figure 13 – Marine sanctuaries proposed by DSEWPaC overlaid with feeding and breeding locations for Australian sea lions in the South-west planning region.

### White Shark *Carcharodon carcharias*

Conservation status: Listed as threatened in the vulnerable category of the EPBC Act (1999)

The white shark is one of the flagship species of the South-west planning region (CoA, 2007). The South-west planning region contains globally significant breeding and feeding grounds for white sharks. Within Commonwealth waters the key areas for white sharks are the known feeding grounds around the Neptune Islands, Investigator Islands, Nuyts Archipelago and off Bremer Bay. Locations likely to be important feeding grounds for white sharks are near the colonies of

pinniped species (i.e. fin-footed mammals including seals). The inshore waters of the Great Australian Bight and the Eyre Peninsula contain particularly high densities of white sharks with the mix of very large and small sharks indicating it is likely to be a pupping ground for the species (CoA, 2007).

Of the four known feeding grounds of white sharks, only one has any area included within the proposed marine sanctuaries. Advice from the scientific community is that “*threatened and highly range-restricted species and habitats should be targeted for full reservation*” (Possingham et al., 2009). These four known feeding grounds represent a highly spatially restricted habitat for a threatened species and therefore their total geographic extent should be protected.

The proposed sanctuaries at Red Island, the Western and Eastern Recherche Archipelago, the Head of the Bight, and Streaky Bay together cover 7% of the likely feeding grounds of the white shark. This level of protection is low given that these are globally significant habitats of a threatened species. Protection could be increased by expanding existing sanctuary proposals and establishing new sanctuary proposals at the Abrolhos Islands, WA West Coast, Cape Leeuwin and Twilight Cove where other important conservation features also require protection.

The proposed sanctuaries at the Head of the Bight, Streaky Bay and the Investigator Islands together cover 2% of the high density and potential pupping ground for white sharks. For a globally significant habitat of a threatened species this is very low. Protection could be increased by expanding the proposed Eastern Recherche, Head of the Bight and Streaky Bay sanctuaries and by proposing a new sanctuary at Twilight Cove where other important conservation features also require protection.

**Recommendations:** Protection for white sharks should be increased by expanding the existing proposed sanctuaries at (i) Investigator Islands, (ii) Red Island, (iii) Western Recherche, (iv) Eastern Recherche, (v) Head of the Bight, (vi) Streaky Bay, and by proposing new sanctuaries at (vii) Abrolhos Islands, (viii) WA west coast, (ix) Cape Leeuwin, (x) Fitzgerald River National Park, (xi) Twilight Cove, (xii) Nuyts Archipelago, (xiii) Neptune Islands (Figure 14).

**Table 3 – The proportion of white shark biologically important areas covered by the marine sanctuaries proposed by DSEWPAC.**

Type	White Shark Biologically Important Areas	Proposed Marine Sanctuaries
High density	Inshore waters of the Great Australian Bight and Eyre Peninsula	2.3%
	Investigator Islands	21.4%
Known feeding ground	Neptune Islands	0.0%
	Nuyts Archipelago	0.0%
	Waters off Bremer Bay	0.0%
Likely feeding ground	Waters off pinniped colonies throughout the South-west Marine Region	7.4%



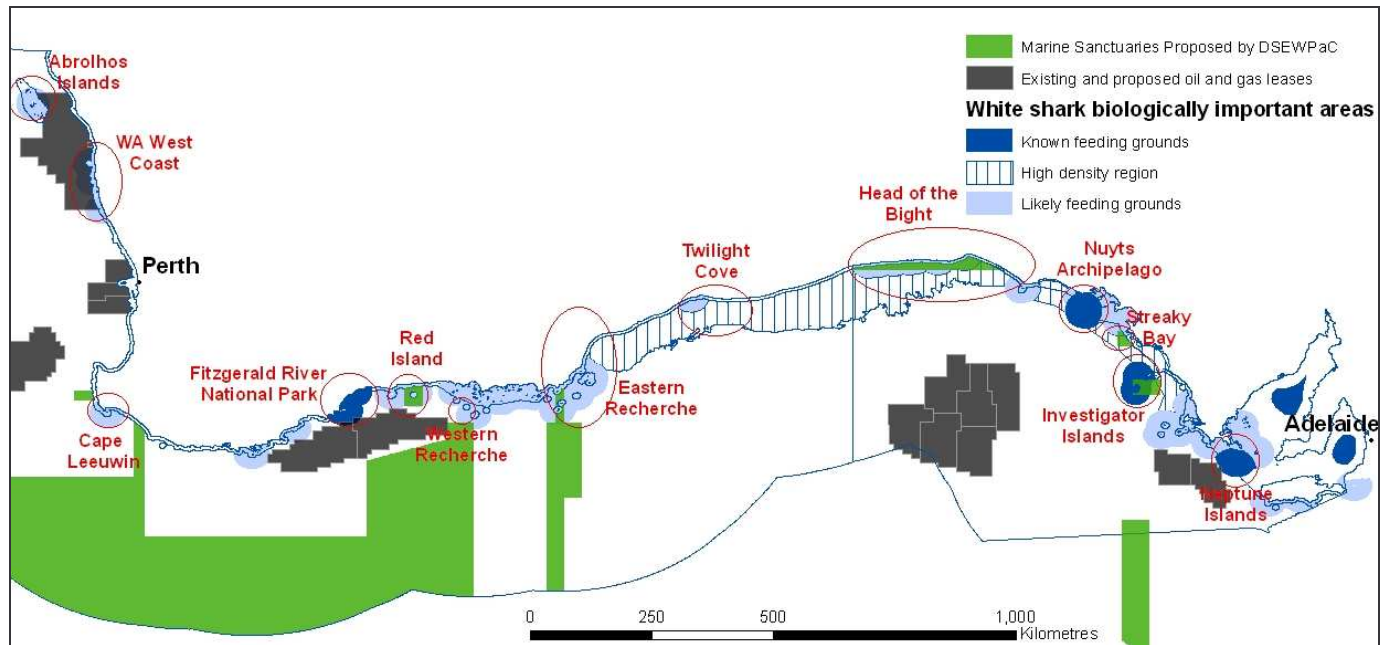


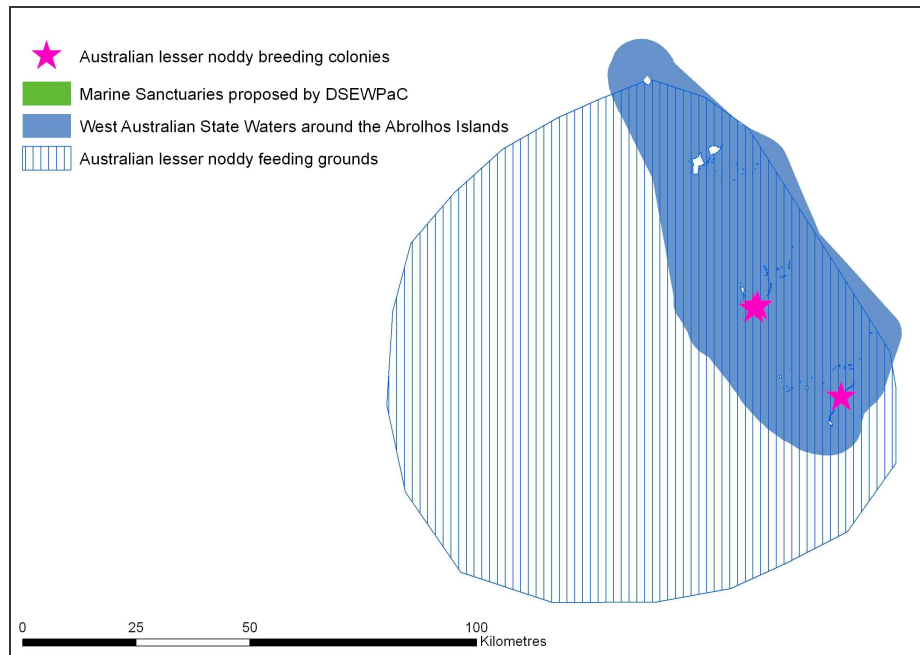
Figure 14 – Marine sanctuaries proposed by DSEWPaC overlaid with biologically important areas for white sharks.

### Australian Lesser Noddy *Anous tenuirostris melanops*

Conservation status: Listed as threatened in the vulnerable category (EPBC Act)

The Australian lesser noddy is a flagship species of the South-west (CoA, 2007). Globally, the only known breeding colonies of the Australian lesser noddy are in the Abrolhos Islands. These breeding colonies and the important feeding grounds associated with them are very important locations for this species. There are no proposed marine sanctuaries to protect these locations. Advice from the scientific community is that “*threatened and highly range-restricted species and habitats should be targeted for full reservation*” (Possingham et al., 2009). These breeding colonies and the feeding grounds associated with them represent a highly spatially restricted habitat for a threatened species and should be targeted for protection.

**Recommendations:** Establish marine sanctuaries to the west and south of the Abrolhos Islands to include the feeding grounds of the Australian lesser noddy.



**Figure 15 – Marine sanctuaries proposed by DSEWPaC overlaid with biologically important areas for the threatened Australian lesser noddy.**

### **Southern Right Whale *Eubalaena australis***

Conservation status: Listed as threatened in the endangered category (EPBC Act)

The Southern right whale is a flagship species for the South-west (CoA, 2007) and is recovering from high levels of past exploitation. The Australian Southern right whale population migrates each year northwards from the sub-Antarctic waters to their breeding grounds on the Australian coastline. Large aggregations of calving whales occur at the Head of the Bight and within the Israelite Bay and Doubtful Island Bay areas. The proposed sanctuary at the Head of the Bight provides high level protection for one of the three calving aggregations. There are no proposed sanctuaries for either of the other two calving aggregations. Advice from the scientific community is that “*threatened and highly range-restricted species and habitats should be targeted for full reservation*” (Possingham et al., 2009). These three sites have been documented to support a substantial proportion of the Southern Right Whale calving population over a number of decades. The calving sites represent a highly spatially restricted habitat for an endangered species and should be targeted for protection.

**Recommendations:** Improve protection of the biologically important areas for the endangered Southern right whales by (i) establishing a marine sanctuary at Israelite Bay and (ii) establishing a marine sanctuary at Doubtful Island Bay (Figure 16).

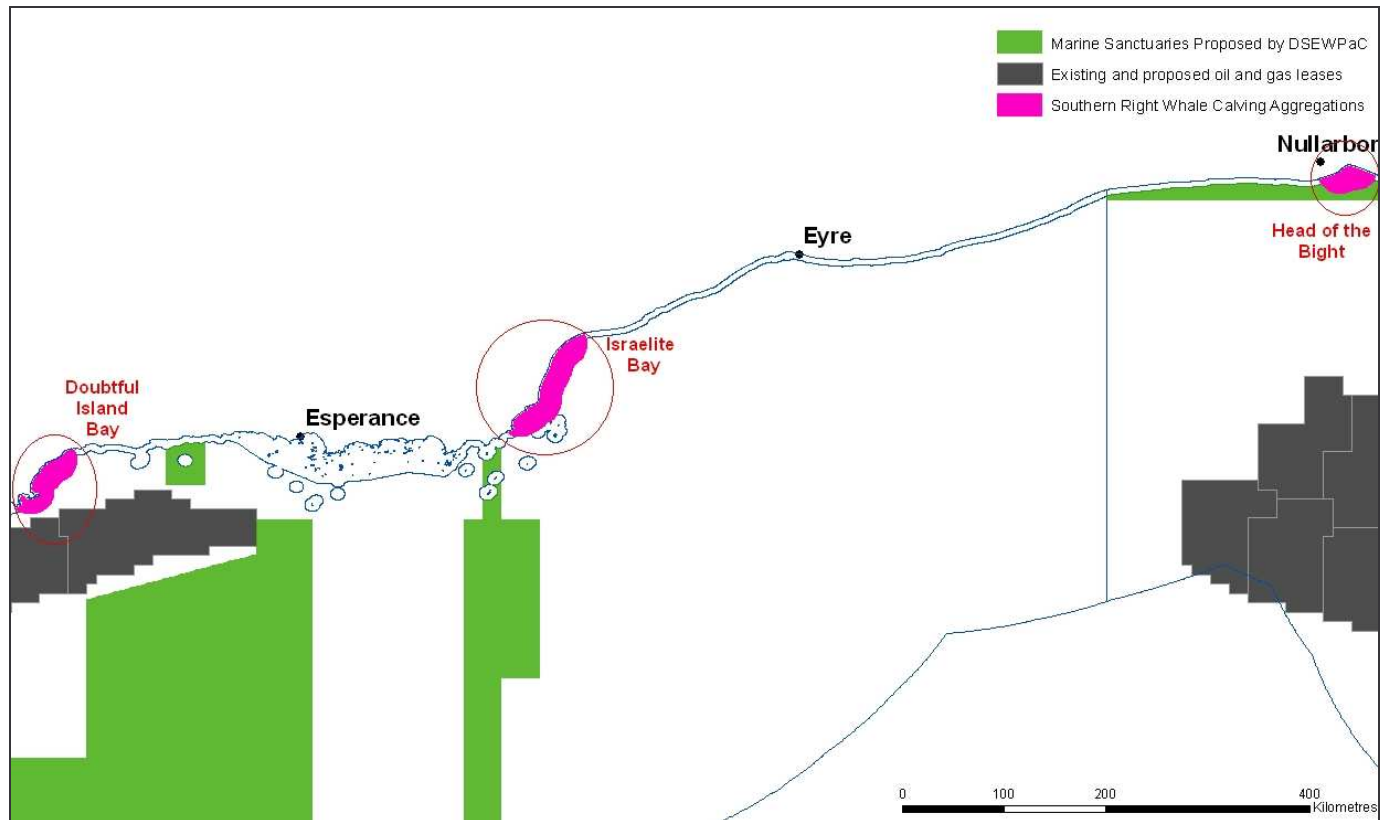


Figure 16 – Marine sanctuaries proposed by DSEWPaC overlaid with the three calving aggregations of the endangered Southern Right Whale.

**Key finding 6: Of the 165 biologically important areas mapped within the South-west planning region, 163 fail to meet minimum scientific benchmarks for protection. For example, no protection has been provided for the critical feeding grounds of the endangered blue whale.**

DSEWPaC has compiled published and unpublished data on the extent of 165 biologically important habitats for 24 ecologically significant species within the South-west planning region. Only 2 of these 165 biologically important areas have more than 30% of their extent within the proposed marine sanctuaries. These two are the feeding grounds of the great winged petrel and the feeding grounds of the short tailed shearwater population that nests on the islands of the Recherche Archipelago. The other 163 biologically important areas have no or little of their extent within proposed marine sanctuaries. A brief summary of the biologically important areas for blue whales, humpback whales and seabirds is provided below.

## Blue Whales

Conservation status: Listed as threatened in the endangered category (EPBC Act)

Two of the three known feeding aggregations of blue whales in Australian waters occur within the South-west planning region at the Perth Canyon and the Kangaroo Island Canyons. No marine sanctuaries have been proposed for these important habitats. The third blue whale feeding aggregation at the Bonney Upwelling in the adjacent South-east planning region is also unprotected. Advice from the scientific community is that “*threatened and highly range-restricted species and habitats should be targeted for full reservation*” (Possingham et al., 2009). The feeding aggregations at the Perth Canyon and the Kangaroo Island canyons are spatially restricted habitats for an endangered species that should be targeted for protection.

The South-west planning region also contains a likely feeding ground for blue whales along the shelf break of the eastern Great Australian Bight, feeding grounds to the north and south of the Perth Canyon where blue whales are known to feed while migrating, as well as the region between Perth and Geographe Bay which is used by blue whales as resting habitats. No marine sanctuaries have been proposed for any of these important habitats. Options for protection of these areas that would overlap with where other important conservation features require protection include near Perth Canyon, Cape Naturaliste, Geographe Bay, south of the Head of the Bight and south of Nuyts Archipelago.

**Recommendations:** Incorporate important breeding and resting locations of the endangered blue whale by establishing five marine sanctuaries at (i) the Perth Canyon, (ii) the Kangaroo Island Canyons, (iii) Cape Naturaliste, (iv) Geographe Bay near Bunbury, (v) south of the Head of the Bight, and (vi) south of Nuyts Archipelago (Figure 17).

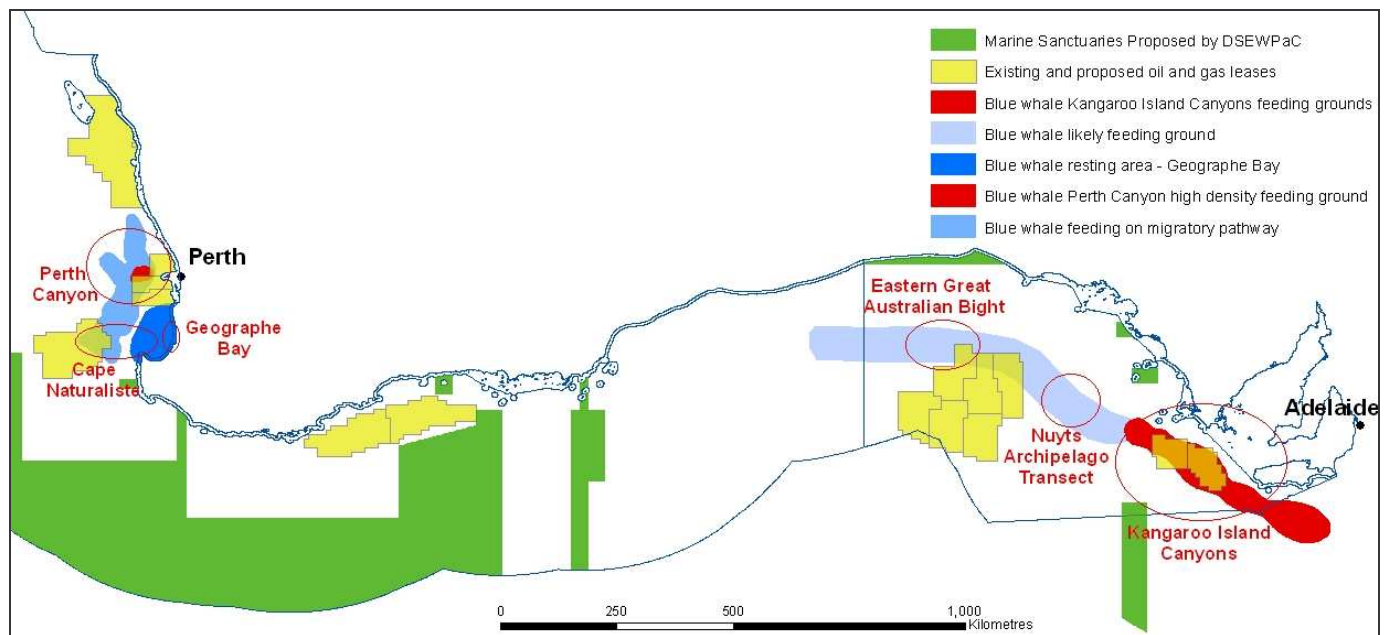


Figure 17 – Marine sanctuaries proposed by DSEWPAC overlaid by biologically important areas for the endangered blue whale and the five recommended sanctuary locations.

## Humpback Whales

Conservation status: Listed as threatened in the vulnerable category (EPBC Act)

Each year humpback whales migrate through the South-west region on the way to and from their calving grounds in the Kimberley and their feeding grounds in the Antarctic. During migration the Abrolhos Islands, Geographe Bay, Cape Naturaliste and Flinders Bay act as important resting habitats. Of these four locations only one, Flinders Bay is represented within the proposed marine sanctuaries. In total, 16% of Flinders Bay is within the proposed Windy Harbour sanctuary which is a low level of representation for an important habitat of a threatened species. Increasing protection of Flinders Bay by expanding the proposed Windy Harbour sanctuary eastwards and by establishing a sanctuary at Cape Leeuwin would also protect other important conservation features. Options for establishing protection for the other humpback whale resting habitats that would also protect other important conservation features include east and south of the Abrolhos Islands and at Cape Naturaliste.

**Recommendations:** Improve protection of the important resting habitats for humpback whales by (i) establishing a marine sanctuary to the east of the Abrolhos Islands, (ii) establishing a marine sanctuary to the south of the Abrolhos Islands, (iii) establishing a marine sanctuary at Cape Naturaliste, (iv) establishing a marine sanctuary at Cape Leeuwin and (v) expanding the proposed Windy Harbour marine sanctuary westwards.

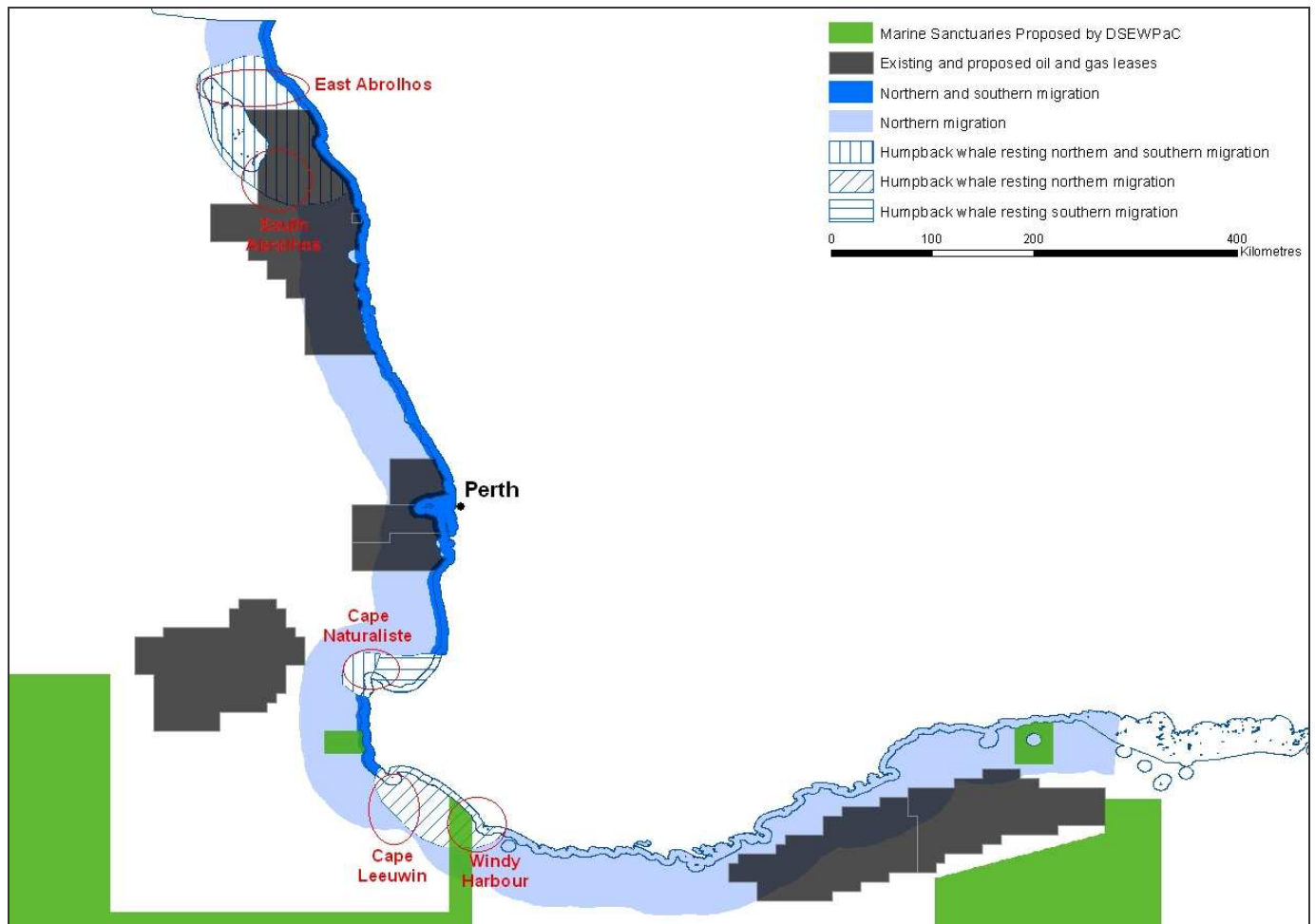


Figure 18 – Marine sanctuaries proposed by DSEWPAC overlaid with biologically important habitats for the threatened humpback whales and the five recommended locations for improved protection of resting habitats important to migrating whales.

## Sperm Whale *Physeter macrocephalus*

Conservation status: Listed as migratory (EPBC Act).

There are two known feeding grounds for sperm whales in the South-west planning region in the Perth Canyon and in the Albany Canyons between Gardener Canyon and Pallinup Canyon (figure 19). No marine sanctuaries have been proposed for the Perth Canyon feeding ground. The proposed marine sanctuary off Windy Harbour covers 7% of the Albany Canyons feeding ground which is a low level of protection for the biologically important habitats of a top order predator like the sperm whale. Options for increasing protection that coincide with the location of other important conservation features include in the Perth Canyon, around Gardener and D'Entrecasteaux canyons, at Parryville Spur and around Pallinup Canyon.

The South-west region also contains areas likely to be important feeding grounds for sperm whales including the Kangaroo Island Canyons and the shelf break of the eastern Great Australian Bight. No marine sanctuaries have been proposed for these areas. Options for protecting these potentially important feeding grounds that coincide with the location of other important conservation features include the shelf break south of the Head of the Bight, south of Nuyts Archipelago, south of the Eyre Peninsula and at the Kangaroo Island Canyons.

**Recommendations:** Protection for biologically important areas for sperm whales within the South-west planning region should be increased by (i) establishing a marine sanctuary at the Perth Canyon, (ii) expanding the proposed Windy Harbour sanctuary to include the entire area of the Gardener and D'Entrecasteaux canyons, (iii) establishing a marine sanctuary at the Parryville Spur including Wilson and/or Denmark Canyons, (iv) establishing a marine sanctuary at Pallinup Canyon, (v) establishing a marine sanctuary on the shelf break south of the Head of the Bight, (vi) establishing a marine sanctuary on the shelf break to the south of Nuyts Archipelago, (vii) establishing a marine sanctuary to the south of the Eyre Peninsula, (viii) establishing a marine sanctuary over the Kangaroo Island Canyons (Figure 19).

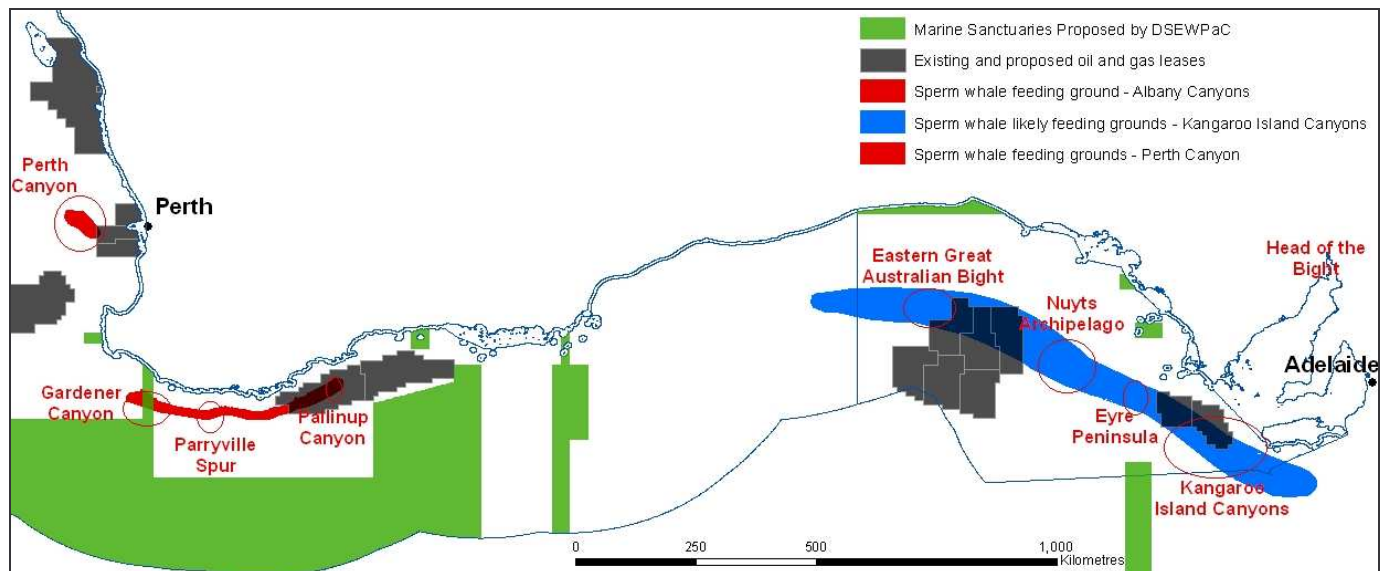


Figure 19 – Marine sanctuaries proposed by DSEWPAC overlaid with important feeding locations for sperm whales.

## Seabirds

Other than the Australian lesser noddy, biologically important areas have been identified by DSEWPaC for 17 species of seabirds. No marine sanctuaries have been proposed over the biologically important areas of three species the common noddy, the roseate tern and the wedge tailed shearwater. The other 14 species all have at least some of their biologically important areas covered by marine sanctuaries. However this coverage is generally low with eight species having 10% or less of their biologically important areas within proposed marine sanctuaries and only two species with more than 20% of their biologically important areas within proposed marine sanctuaries (Table 4).

**Table 4 – Proportion of biologically important areas within the South-west region covered by the marine sanctuaries proposed by DSEWPaC for 17 seabird species.**

Common Name	Scientific name	Proportion within marine sanctuaries proposed by DSEWPaC
Common noddy	<i>Anous stolidus</i>	0.0%
Roseate Tern	<i>Sterna dougallii</i>	0.0%
Wedge-tailed shearwater	<i>Puffinus pacificus</i>	0.0%
Bridled tern	<i>Onychoprion anaethetus</i>	3.5%
Fleshy-footed shearwater	<i>Puffinus carneipes</i>	5.2%
Fairy tern	<i>Sterna nereis</i>	5.5%
Sooty tern	<i>Onychoprion fuscata</i>	5.8%
Caspian tern	<i>Sterna caspia</i>	5.8%
Indian Yellow-nosed albatross	<i>Thalassarche carteri</i>	6.6%
Pacific gull	<i>Larus pacificus</i>	8.2%
Little penguin	<i>Eudyptula minor</i>	8.4%
Black-faced cormorant	<i>Phalacrocorax fuscescens</i>	10.9%
White-faced storm petrel	<i>Pelagodroma marina</i>	10.9%
Soft-plumaged petrel	<i>Pterodroma mollis</i>	12.7%
Little shearwater	<i>Puffinus assimilis tunneyi</i>	13.9%
Short-tailed shearwater	<i>Puffinus tenuirostris</i>	21.0%
Great-winged petrel (macroptera race)	<i>Pterodroma macroptera macroptera</i>	42.2%

### **Key finding 7: The proposed marine sanctuaries are biased towards waters off Western Australia with less than 3% of the proposed marine sanctuaries occurring within the waters off South Australia**

The South-west planning region spans parts of the states of both Western and South Australia. The proposed marine sanctuaries are biased towards the waters off Western Australia with less than 3% of the proposed marine sanctuaries occurring in the waters of South Australia (Figure 3).

## **Key finding 8: The proposals do not establish the comprehensive, adequate and representative network of marine sanctuaries required to protect marine life.**

An analysis of the comprehensiveness, adequacy and representativeness of the network of marine sanctuaries is critical to determining whether or not the proposed marine sanctuaries are capable of protecting the marine life of the South-west planning region. In addition to the data already examined it is customary for biodiversity surrogates to form a key role in the process for identifying where marine sanctuaries should be located (Margules and Pressey, 2000; Possingham et al., 2009). Biodiversity surrogates aim to represent the trends in marine life. The assumption is that if enough of each biodiversity surrogate is protected within marine sanctuaries then the marine life which that surrogate represents will also be protected. The corollary is that where there is inadequate or no inclusion of a biodiversity surrogate within a marine sanctuary then the suite of species these surrogates represent are inadequate.

During the planning process information was collected on the biodiversity of the South-west and the region was divided into a number of provinces and bioregions within which different environments and habitats were mapped (IMCRA, 2006). Provinces are large scale regions with a shared evolutionary history. Bioregions are meso scale regions that have a shared ecology (Last et al, 2010).

Within each bioregion bathomes, geomorphology, marine ecosystems, species assemblages, community compositions and seascapes have been mapped.

Many marine species can only live within specific depth ranges. This depth partitioning of habitats gives rise to different species living at different depths. Bathomes describe the depth ranges at which different groups of depth restricted species tend to occur (Last et al, 2010). Bathomes of the South-west region have been defined for Australian marine planning processes by the Marine Biodiversity Research Hub (Last et al., 2005; Lyne et al., 2009; CoA, unpublished).

The shape and composition of the seabed has a large impact on marine habitats. Geomorphic features are indicative of different seabed conditions, e.g. hard rock, or soft sediments. They also identify critical vertical features like canyons and seamounts that can shape ecological processes like upwelling through their interaction with ocean currents. Geoscience Australia has mapped the geomorphology of the South-west region (Harris et al, 2005).

Geomorphic features and bathomes on their own are insufficient to describe where species assemblages differ (insert ref). However, bathomes, geomorphic features and bioregions can be used in synergy to understand the distribution of different environmental types and the species for which they support (Williams et al., 2009; Last et al., 2010). This combination of bioregions, bathomes and geomorphic features is referred to here as marine ecosystem mapping.

Seascapes are a Geoscience Australia classification that aims to identify different environments within the South-west planning region based on biophysical conditions like depth, productivity and seafloor sediments which are known to influence the distribution of marine life (Whiteway et al., 2007).

The Marine Biodiversity Research Hub have created two datasets that predict both the distribution of species assemblages and community compositions to assist the MPA planning



process. These datasets use the relationship between species records and biophysical datasets like depth and productivity to predict where different species assemblages and community compositions occur (Ellis and Pitcher, 2009; Dunstan and Foster, 2009).

## Bioregions of the South-west Planning Region

The South-west planning region contains ten bioregions. Of the ten bioregions two contain significantly higher levels of protection than the other seven bioregions. The proposed marine sanctuaries provide minimal or no protection for the other seven bioregions.

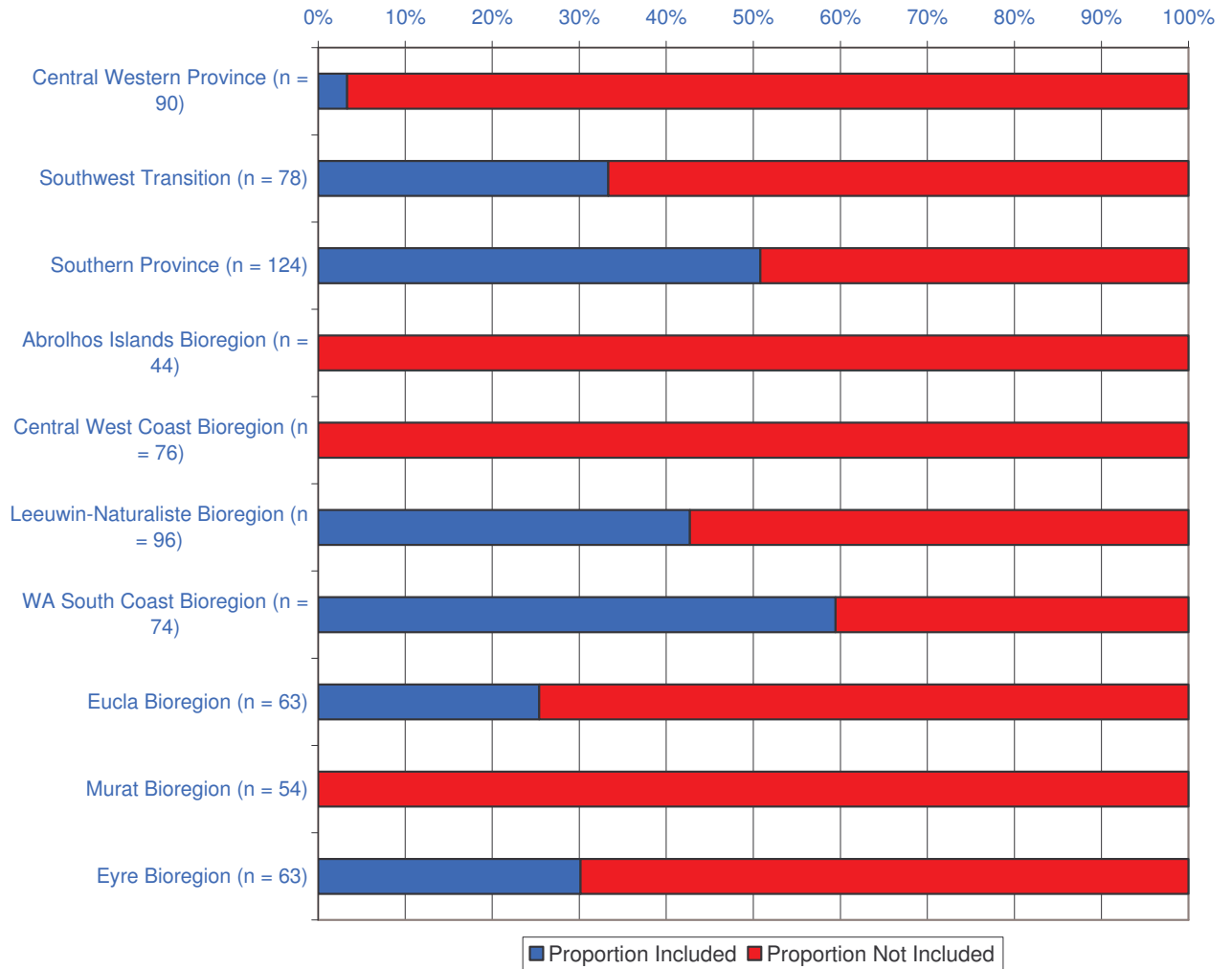
**Table 5 – Proportion of Commonwealth waters in each bioregion included in proposed marine sanctuaries within the South-west planning region.**

Realm	Bioregion	Proposed Marine Sanctuaries	Median representation for the marine ecosystems dataset
Off-shelf	Central Western Province	1.3%	0%
	Southern Province	35.7%	0.03%
	Southwest Transition	28.6%	0%
	<b>Total</b>	<b>26.0%</b>	<b>0%</b>
Shelf	Eucla	3.7%	0%
	Murat	0.0%	0%
	Leeuwin-Naturaliste	6.9%	0%
	WA South Coast	5.9%	4.0%
	Abrolhos Islands	0.0%	0%
	Central West Coast	0.0%	0%
	Eyre	3.7%	0%
<b>Total</b>	<b>3.5%</b>	<b>0%</b>	
<b>South-west Region</b>		<b>21.3%</b>	<b>0%</b>

## Comprehensiveness

The Australian government has defined comprehensiveness as the inclusion of “*the full range of ecosystems recognised at an appropriate scale within and across each bioregion*” (ANZECC TFMPA, 1998). The proposed marine sanctuaries are not comprehensive for any of the ten bioregions of the South-west planning region. That is, for no bioregion, do the proposed marine sanctuaries include each of the marine ecosystems, seascapes, fish and invertebrate assemblages and community structures mapped within the bioregion (

Figure 20).



**Figure 20 – Percentage of total number of conservation features with more than 0% of their total extent included within the marine sanctuaries proposed by DSEWPaC. Data used is marine ecosystems, seascapes, fish and invertebrate assemblages and community structures.**

## Adequacy

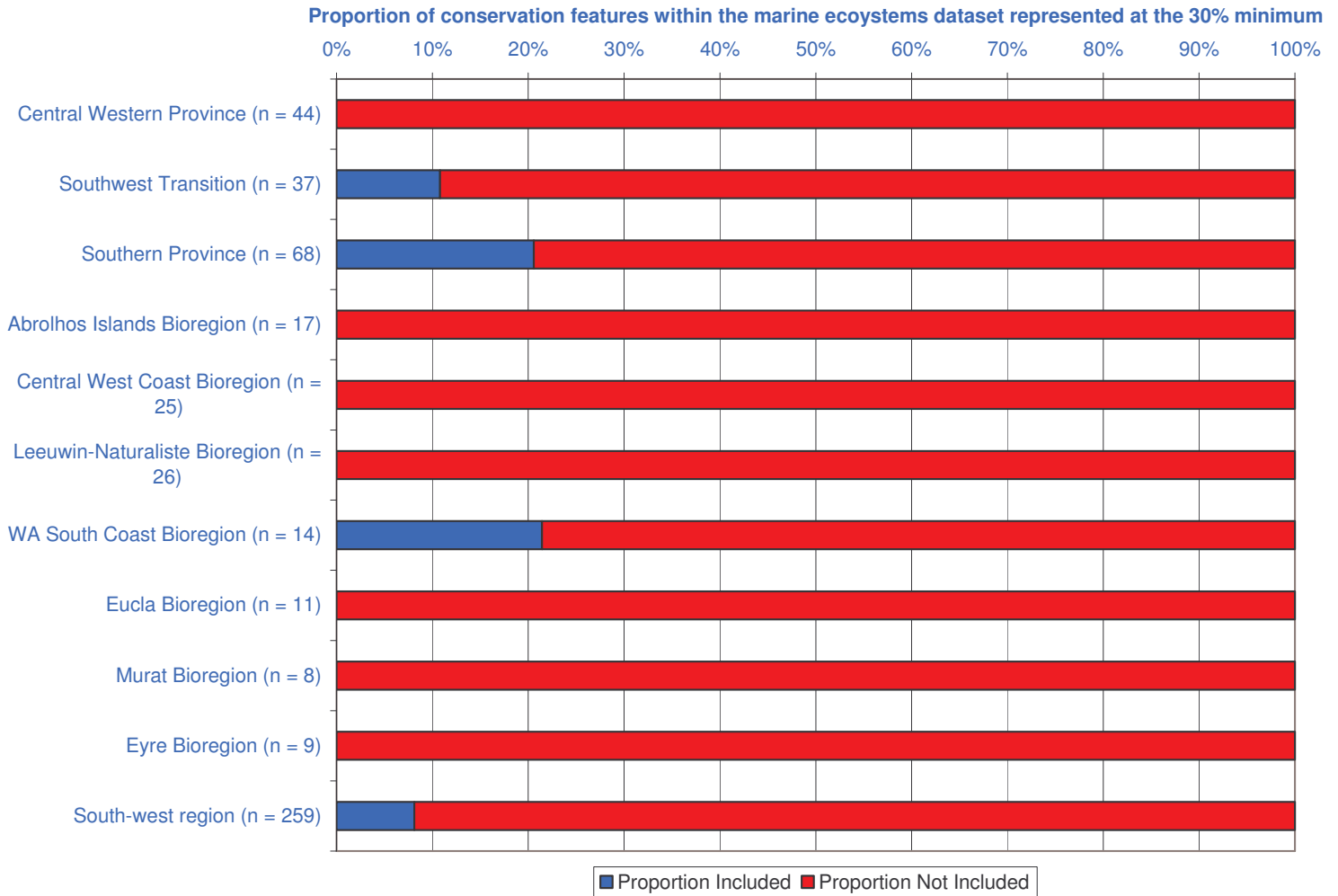
The Australian government has defined adequacy as “*the required level of reservation to ensure the ecological viability and integrity of populations, species and communities*” (ANZECC TFMPA, 1998). Consideration of whether a marine sanctuary or network of marine sanctuaries will be adequate involves an assessment of at least levels of protection, sanctuary size, sanctuary integrity and sanctuary connectivity (Possingham et al., 2009).

## Levels of protection

In interpreting adequacy the Task Force on Marine Protected Areas (a forum for marine protected areas policy - each Australian government is represented on the task force) determined in 1999

that for adequacy it is essential to determine how much of each ecosystem is included within marine protected areas (TFMPA, 1999). Recent advice from the scientific community is that *“Individual conservation features should all be represented in high protection zones at a minimum of 30% as a proportion of their distribution within each bioregion, although greater proportional representation within high protection zones will be required if only high level or indirect surrogates for biodiversity are used (original emphasis)”* (Possingham et al., 2009).

Of the ten bioregions in the South-west planning region, none have each of their conservation features represented at the minimum threshold of 30%. Only three bioregions, the Southwest Transition, Southern Province and WA South Coast bioregions have any conservation features that meet the minimum threshold for the marine ecosystems dataset (Figure 21). Within the two bioregions; the Southwest Transition and the Southern Province, none of the features within the marine ecosystems dataset represented at the 30% minimum are from the shelf and upper slope (dubbed by scientists as the zone of importance) (Williams et al, 2009). The marine ecosystems dataset maps 197 different environmental types on the shelf and upper slope of the South-west planning region. Just three of these environmental types are represented within the proposed marine sanctuaries at the 30% minimum.



**Figure 21 – Proportion of marine ecosystems represented within the marine sanctuaries proposed by DSEWPaC at the 30% minimum threshold recommended by the scientific community (UQ, 2009).**

### Sanctuary Size

Six of the seven marine sanctuaries proposed for the shelf and upper slope fail to meet recommended size requirements (Figure 22). To have integrity a marine sanctuary needs to be large enough to enable species with smaller home ranges, and/or larval dispersal distances the ability to disperse within the boundaries of the marine sanctuary. The Great Barrier Reef Marine Park rezoning process is a current example of world's best practice marine sanctuary design and advises that sanctuaries have a minimum width of 20km (GBRMPA, 2001). The marine sanctuaries proposed by DSEWPaC are less than 20km in width at Windy Harbour, Red Island, the Eastern Recherche, the Head of the Bight, Streaky Bay and the Investigator Islands.

## Sanctuary Integrity

Some ecological systems are based around particular physical structures of the sea floor for example seamounts, reefs and pinnacles. To ensure the integrity of the ecological system associated with these structures advice from the scientific community is that “*Where a physical structure/feature is incorporated into the MPA, the whole feature should be included*” (Possingham et al., 2009). Locations where only part of a physical structure is included within the proposed marine sanctuary include: (i) pinnacle at 112.7°E, 35.3°S, (ii) abyssal hill at 114.0°E, - 35.6°S, (iii) Gardener Canyon, (iv) D’Entrecasteaux Canyon, (v) ridge at 115.9°E, 36.6°S, (vi) ridge at 117.3°E, 36.7°S, and (vii) pinnacle at 120.0°E, 35.7°S. If the intention is to protect the ecological systems associated with these structures then they should be fully included within the proposed marine sanctuaries.

## Sanctuary Connectivity

The proposed sanctuary network fails to meet recommended guidelines for internal network connectivity. Marine species differ in the distance over which they can disperse and most marine species cannot disperse more than 200km (Halpern et al., 2006). Sanctuaries should therefore be placed at a range of distances no further than 200km from each other (Possingham et al., 2009). There are five gaps in the marine sanctuary network on the shelf and upper slope and two gaps in the marine sanctuary network on the lower slope and deep ocean where the distance between the proposed sanctuaries is greater than 200km (Figure 22).

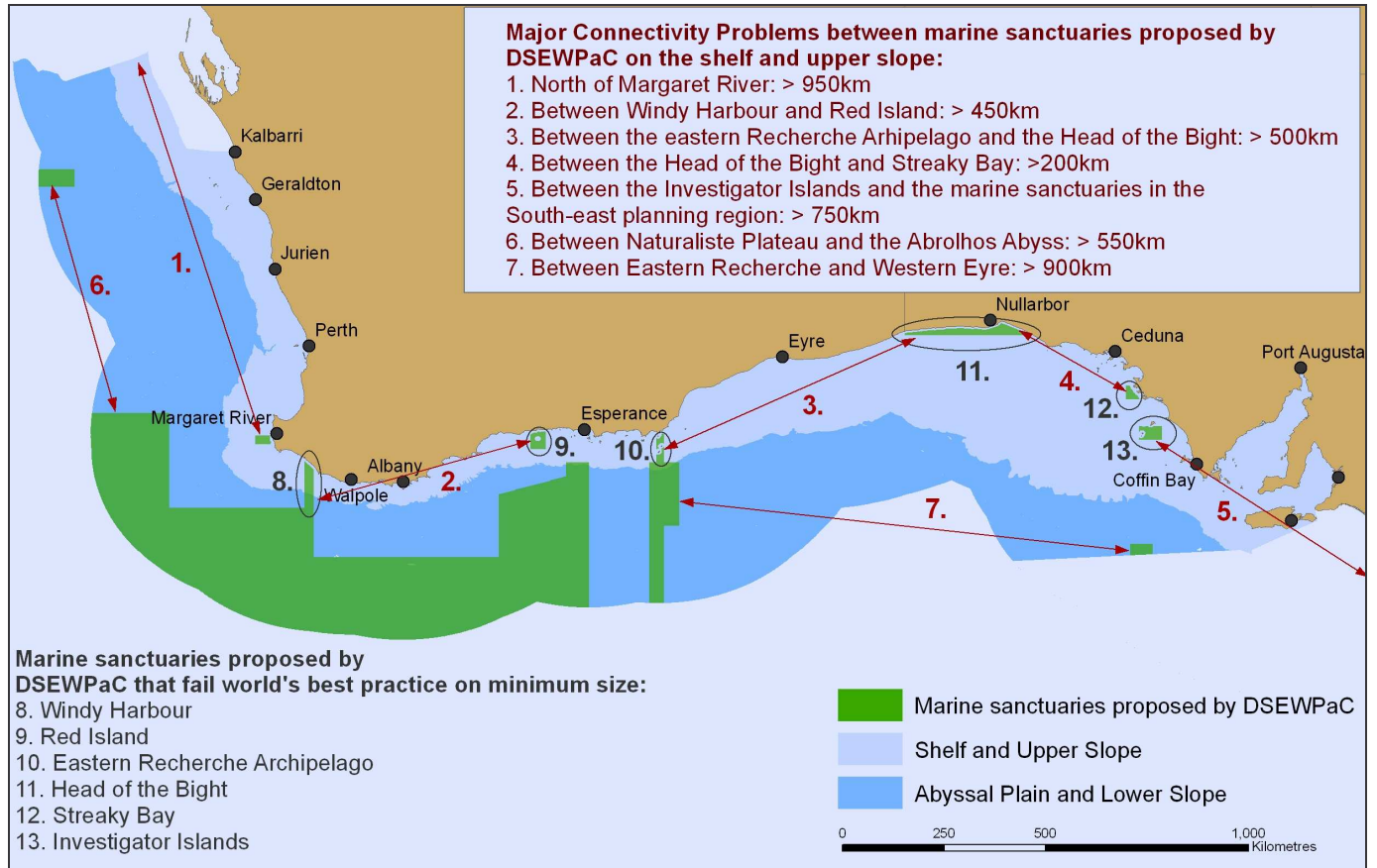


Figure 22 – Major connectivity and size problems for the marine sanctuaries proposed by DSEWPaC on the shelf and upper slope of the South-west planning region.

## Representativeness

The proposed marine sanctuaries are not representative of any of the ten bioregions of the South-west planning region (Table 5). The Australian government has defined representativeness as “those marine areas that are selected for inclusion in MPAs should reasonably reflect the biotic diversity of the marine ecosystems from which they derive” (ANZECC TFMPA, 1998).

Assessing representativeness requires an understanding of the distribution of marine life within the conservation features mapped. However this distribution of marine life is often unknown. Unknown heterogeneity and patchiness in species distributions is more likely to be captured by the sanctuary network when higher proportions of conservation features are included. Therefore, a simple accounting measure with utility to explore representativeness is the median representation. The median representation of features within the marine ecosystems dataset was calculated for each bioregion. Initially, we divided the area of each feature by the total area of all features. We then ordered the resulting values by size and chose the median or middle value. Only two bioregions have a median representation above 0%; the Southern Province at 0.03% and the WA South Coast at 4.0%. The median representation across the entire South-west planning region is 0%. These low values of median representation indicate the failure of the proposed sanctuary network to represent the range of marine ecosystems mapped within the South-west planning region (Table 5).

## **Key finding 9: A number of areas critical to the protection of marine life are missing from the proposed marine sanctuary network. Thirty three of these critical gaps are identified in this report.**

To determine the priority locations for additional protection to conserve the marine life of the South-west planning region we further explore each bioregion in relation to the important conservation features it contains.

### **Central Western Province**

The marine sanctuaries proposed by DSEWPaC cover 1% of the Central Western Province, including just 1 of the 44 environmental types identified in the marine ecosystems dataset and 0% of the shelf and upper slope (dubbed by scientists as the zone of importance) (Williams et al, 2009). The Central Western Province is home to the iconic Perth canyon, key ecological features associated with the west coast canyons, demersal slope fish communities, eddy generation fields of the Leeuwin current and the western section of the Abrolhos Islands system. Important feeding grounds for the endangered blue whale, the threatened Australian lesser noddy, and sperm whales as well as biologically important areas for other species all occur within the Central Western Province. The marine sanctuaries proposed by DSEWPaC cover none of these features. Regionally significant environments that remain unprotected include the only escarpment habitats mapped within the South-west planning region and the only pinnacle habitats mapped on the continental rise in Australia. The three most critical locations for the conservation of marine life in the Central Western Province are (i) the Perth Canyon, (ii) the Abrolhos Canyons and (iii) the slope habitats west of Kalbarri (Figure 1). Other important locations include Wallaby Saddle, Abrolhos Abyss and Perth Abyss (Figure 1).

### **Abrolhos Islands Bioregion**

Abrolhos Islands bioregion contains no proposed marine sanctuaries. The Abrolhos islands are an iconic marine environment. The influence of the Leeuwin current supports a highly diverse mix of tropical and temperate species. The islands themselves are the largest seabird nesting site in the eastern Indian Ocean, including the only nesting sites of the endemic Australian lesser noddy. The Abrolhos Islands host the most northern population of the threatened endemic Australian sea lion. This population is genetically isolated from all other Australian sea lion populations. Humpback whales use the calmer water inshore from the Abrolhos Islands as a resting site on their migration to and from their breeding grounds in the Kimberley and their feeding grounds in the Southern Ocean. The Abrolhos Islands contain up to 50% of the broodstock for western rock lobsters and are likely to be an important feeding ground for the threatened white shark. The marine sanctuaries proposed by DSEWPaC provide no protection for any of these conservation features. The three most critical locations for the conservation of marine life within the Abrolhos Islands are (i) the North Abrolhos, (ii) South Abrolhos and (iii) East Abrolhos (Figure 1).

## Central West Coast Bioregion

The Central West Coast bioregion contains no proposed marine sanctuaries. The Central West Coast bioregion is dominated by the iconic Rottneest Shelf. Key ecological features include the central range of the western rock lobster, west coast inshore lagoons and Western Australia's largest population of Australian sea lions. The interaction of the Leeuwin current with important topographic features like the Beagle Islands causes eddy formation, particularly west of the Jurien Bay Marine Park. The calmer waters inshore from the Abrolhos Islands are an important resting site for humpback whales on their migration to and from their breeding grounds in the Kimberley and their feeding grounds in the Southern Ocean. The head of the Perth Canyon and the waters to the north represent important feeding grounds for endangered blue whales. Regionally significant environments that remain unprotected include the bank/shoal, pinnacle and channel habitats of the Rottneest shelf and slope. The three most critical locations for the protection of the Central West Coast Bioregion are (i) east of the Abrolhos Islands, (ii) west of the Jurien Bay Marine Park and Beagle Islands, and (iii) north of Rottneest Island (Figure 1). Other important locations include north of the Abrolhos Islands and north of the Perth Canyon (Figure 1).

## Leeuwin-Naturaliste Bioregion

The marine sanctuaries proposed by DSEWPaC cover 7% of the Leeuwin-Naturaliste bioregion, with a median representation of conservation features of 0%. The Leeuwin-Naturaliste bioregion contains the southern range of the western rock lobster and west coast inshore lagoons ecological system. The head of the perth canyon and the waters to the south are important feeding grounds for endangered blue whales. Geographe Bay and Cape Naturaliste are important resting habitats for migrating blue and humpback whales. Cape Leeuwin contains important seabird nesting habitats, is an important resting habitat for humpback whales on their northern migration to breeding grounds in the Kimberley, is the most westerly breeding ground regularly used by endangered Southern Right Whales and is also likely to be an important feeding ground for threatened white sharks. The key ecological features of Geographe Bay and the Mentelle Upwelling off Margaret River all occur within the Leeuwin-Naturaliste bioregion. Regionally significant habitats that remain unprotected include reef, pinnacle, bank/shoal and valley habitats. The three most critical locations for increasing protection of the Leeuwin-Naturaliste bioregion are (i) Geographe Bay, (ii) Cape Naturaliste, and (iii) Cape Leeuwin (Figure 1). Other important locations include south of the Perth Canyon, west of Margaret River, and south of Windy Harbour (Figure 1).

## South-west Transition

The marine sanctuaries proposed by DSEWPaC cover 29% of the South-west Transition bioregion, but just 0.1% of the biologically diverse and threatened shelf and upper slope (dubbed by scientists as the zone of importance) (Williams et al, 2009). Overall the median representation for the bioregion is 0%. The proposed marine sanctuaries provide high level protection to the ecologically important habitats of the Naturaliste Plateau but provide little or no protection to other locations within the bioregion which are important for marine life. The South-west



Transition contains the southernmost extent of the west coast canyons, important habitats related to the eddy's formed by the interaction of the Leeuwin current with Perth Canyon and the Capes. It also includes the western sections of the Mentelle Upwelling one of the most biologically productive areas of the South-west planning region. The South-west Transition contains important feeding grounds for endangered blue whales as well as biologically important feeding grounds for a number of seabirds. Regionally important habitats that are currently unprotected include various canyon, pinnacle, slope, terrace and trench habitats. The three most critical locations for increasing protection of the Leeuwin-Naturaliste bioregion are (i) south and west of the Perth Canyon, (ii) west of Cape Naturaliste, and (iii) west of Margaret River (Figure 1). Other important locations include south of Cape Leeuwin (Figure 1).

## **WA South Coast**

The WA South Coast bioregion contains two proposed marine sanctuaries at Red Island and in the Eastern Recherche Archipelago. These two proposed marine sanctuaries combined cover 6% of the WA South Coast bioregion. These two small sanctuaries are not likely to be large enough to independently sustain populations of marine life. They are also both more than 200km from the nearest marine sanctuaries on the shelf in any direction (Figure 22). This is beyond the likely dispersal distance for most marine life. The WA South Coast bioregion contains the iconic Recherche Archipelago. West of the Recherche Archipelago at Doubtful Island Bay, the WA South Coast bioregion is home to one of the three large calving aggregations of endangered Southern Right Whales. Doubtful Island Bay is also a known feeding ground for the threatened white shark. WA South Coast bioregion also contains a population of Australian sea lions which is genetically isolated from all other Australian sea lion populations. These Australian sea lion breeding colonies, as well as other seal colonies, are also likely feeding grounds for threatened white sharks. All of these important features currently have little or no protection under the marine sanctuaries proposed by DSEWPaC. Other regionally important conservation habitats that remain unprotected include deeper reef and shelf habitats. The three most critical locations for increasing protection of the WA South Coast bioregion are (i) Doubtful Island Bay, south of the Fitzgerald River National Park, (ii) the Eastern Recherche Archipelago, and (iii) east of Windy Harbour in the easternmost section of the bioregion (Figure 1). Other important locations include the western Recherche Archipelago and south of Red Island (Figure 1).

## **Eucla**

The Eucla bioregion contains a single proposed marine sanctuary at the head of the bight which covers 4% of the bioregion. The median representation for the Eucla bioregion is 0%. The proposed marine sanctuary at the Head of the Bight is very narrow and is unlikely to be large enough to independently sustain populations of marine life. The proposed marine sanctuary is also more than 200km from the nearest marine sanctuaries on the shelf in any direction. This is beyond the likely dispersal distance for most marine life. The Eucla bioregion is part of the iconic Great Australian Bight ecological system and is home to two of the three large calving aggregations of the endangered Southern Right Whale at the Head of the Bight and Israelite Bay. The proposed marine sanctuary provides high level protection of the head of the bight calving aggregation but no protection for the calving aggregation at Israelite Bay. The inshore waters of the Eucla bioregion are a high density area for threatened white sharks. The mix of very large and

young sharks in this area indicates that it is likely to be a pupping ground for the species. The Eucla bioregion is also home to part of the South Australian population of Australian sea lions. While the shelf break in the east of the bioregion is a likely feeding ground for sperm whales and the endangered blue whale. With the exception of the conservation features associated with the Head of the Bight, the marine sanctuaries proposed by DSEWPaC provide little or no protection for these important conservation features. Regionally significant habitats that remain unprotected include reef habitats (south-west of Cape Nuyts) and deeper shelf habitats. The three most critical locations for increasing protection of the Eucla bioregion are (i) Israelite Bay, (ii) the Head of the Bight and (iii) the eastern shelf break of the Great Australian Bight (Figure 1). Other important locations include the western Great Australian Bight south of Eyre (Figure 1).

## **Murat**

The Murat bioregion contains no proposed marine sanctuaries. The Murat bioregion is part of the eastern section of the iconic Great Australian Bight ecological system. The Eyre Peninsula Upwelling, one of the most biologically productive systems in the South-west planning region extends into the bioregion to the Nuyts Archipelago. The Nuyts Archipelago is home to an important part of the South Australian population of Australian sea lions and is an important feeding ground for the threatened white shark. The inshore waters of the Murat bioregion are a high density area for threatened white sharks. The mix of very large and young sharks in this area indicates that it is likely to be a pupping ground for the species. The shelf break of the Eucla bioregion is a likely feeding ground for sperm whales and the endangered blue whale. The marine sanctuaries proposed by DSEWPaC provide no protection for any of these important conservation features. Other regionally important conservation features which are currently unprotected include reef and shelf habitats. The three most critical locations for increasing protection of the Murat bioregion are (i) Nuyts Archipelago, (ii) the Murat Reefs, and (iii) the Murat shelf break (Figure 1)

## **Eyre**

The Eyre bioregion contains two proposed marine sanctuaries at Streaky Bay and the Investigator Islands. These two proposed marine sanctuaries together cover 4% of the bioregion. These two small sanctuaries are not likely to be large enough to independently sustain populations of marine life. They are also more than 200km from the nearest marine sanctuaries on the shelf to both the east and west (Figure 22). This is beyond the likely dispersal distance for most marine life. The median representation for conservation features in the Eyre bioregion is 0%. The Eyre bioregion contains the iconic Kangaroo Island Pool upwelling system, one of the most biologically productive systems within the South-west planning region. This upwelling system supports an important feeding ground for the endangered blue whale and likely feeding grounds for sperm whales. The Eyre bioregion also contains the Eyre peninsula upwelling system, high density habitats for the threatened white shark, including the known feeding ground at the Investigator Islands and important feeding and breeding habitats for the South Australian population of Australian sea lions. The marine sanctuaries proposed by DSEWPaC provide little or no protection for all of these important conservation features. Other regionally significant habitats that remain unprotected include deeper shelf habitats. The three most critical locations for increasing protection for the Eyre bioregion are (i) Kangaroo Island, (ii) the Investigator Islands,

and (iii) Streaky Bay (Figure 1). Other important locations include the shelf break south of Nuyts Archipelago and the shelf break south of the Investigator Islands (Figure 1).

## **Southern Province**

The marine sanctuaries proposed by DSEWPaC cover 36% of the Southern Province bioregion but just 2% of the biologically diverse and threatened upper slope and shelf (referred to by scientists as the zone of importance) (Williams et al, 2009). Overall, the median representation for the bioregion is less than 0.1%. The proposed marine sanctuaries provide high level protection for the ecologically important habitats of the Diamantina Fracture Zone but provide inadequate or no protection for other habitats within the bioregion that are important for marine life. The Southern Province contains the iconic Albany and Kangaroo Island canyons systems. Important eddy related habitats occur south of the Kangaroo Island canyons, the eastern Recherche Archipelago and south of Albany. The Southern Province contains known feeding grounds for the endangered blue whale at the Kangaroo Island Canyons and likely feeding grounds along the shelf break of the eastern Great Australian Bight. These areas are also likely feeding grounds for sperm whales, with known feeding grounds for sperm whales occurring within the western sections of the Albany canyons. Other regionally important conservation features that remain unprotected include various canyon, bank/shoal, pinnacle, terrace, ridge and knoll habitats. The three most critical locations for increasing protection within the Southern Province are (i) the Kangaroo island Canyons, (ii) east of the Recherche Archipelago and (iii) Bremer and Pallinup canyons south of the Fitzgerald River National Park (Figure 1). Other important locations include Swan Canyon south of Red Island, Parryville Ridge south of Albany, in and around the Great Australian Bight Marine Park, the shelf break south of the Investigator Islands and Gardener Canyon (Figure 1).

## **Critical Gaps**

In total we have identified 33 locations that are priorities for increased protection within the proposed marine sanctuary network (Figure 1). For each location we describe below the conservation objectives that would be achieved by their inclusion within the network.

### **1. Wallaby Saddle**

Conservation Objectives:

1. Protection of deeper demersal slope fish communities.
2. Protection of the only escarpment habitats mapped within the South-west planning region.

### **2. Kalbarri**

Conservation Objectives:

1. Protection of demersal slope fish communities. In particular:
  - a. The only shallow upper slope pinnacle habitats in the Central Western Province.
  - b. The only shelf edge pinnacle habitats in the Central Western Province.

- c. Important samples of the upper slope and shelf edge habitats of the Central Western Province.
- d. Important samples of the deep upper slope, shallow mid slope, and shallow upper slope habitats on the Carnarvon Terrace.
- e. Important samples of the seascapes of the Central Western Province.
- f. Important samples of fish and invertebrate community structures in the Central Western Province.

### **3. Northern Abrolhos**

#### Conservation Objectives:

1. Protection of the Western Rock Lobster broodstock.
2. Protection of biologically important areas for seabirds including:
  - a. Australian lesser noddy feeding grounds.
  - b. Common noddy feeding grounds.
  - c. Fairy tern feeding grounds.
  - d. Pacific gull feeding grounds.
  - e. Roseate tern feeding grounds.
  - f. Caspian tern feeding grounds.
  - g. Bridled tern feeding grounds.
3. Protection of the iconic Abrolhos Islands system particularly:
  - a. Protection of bank/shoal habitats within the Abrolhos Islands and Central West Coast bioregions
  - b. Protection of slope habitats within the Abrolhos Islands bioregion.
  - c. Protection of reef habitats within the Abrolhos Islands bioregion.
  - d. Protection of pinnacle habitats within the Abrolhos Islands bioregion.
  - e. Protection of shallower channel habitats within the Abrolhos Islands and Central West Coast bioregions.
  - f. Protection of the seascapes of the Abrolhos Islands, Central West Coast and Central Western Province bioregions.
  - g. Protection of fish and invertebrate assemblages of the Abrolhos Islands and Central West Coast bioregions.
  - h. Protection of fish and invertebrate community structures in the Abrolhos Islands and Central West Coast bioregions.
4. Protection of the pinnacle habitats of the northern Rottnest slope.
5. Protection of the shallow shelf bathome and deeper bank/shoal habitats on the iconic Rottnest shelf.

6. Protection of demersal slope fish communities within the Central Western Province, Abrolhos Islands and Central West Coast bioregions.

#### **4. Eastern Abrolhos**

Conservation Objectives:

1. Protection of the iconic Abrolhos Islands system particularly:
  - a. Protection of reef apron habitats in the Abrolhos Islands bioregion.
  - b. Protection of reef habitats in the Abrolhos Islands bioregion.
  - c. Protection of the seascapes of the Abrolhos Islands and Central West Coast bioregions.
  - d. Protection of the fish and invertebrate assemblages of the Abrolhos Islands and Central West Coast bioregions.
2. Protection of west coast inshore lagoons.
3. Protection and replication of western rock lobster habitats at the northern end of their range within the planning region.
4. Protection of biologically important areas for seabirds including:
  - a. Caspian tern feeding grounds.
  - b. Fairy tern feeding grounds.
  - c. Pacific gull feeding grounds.
5. Protection of humpback whale resting habitats.
6. Protection of the iconic Rottnest shelf.
7. Protection of feeding grounds for male Australian sea lions.

#### **5. Abrolhos Canyons**

Conservation Objectives:

1. Protection of Houtman Canyon.
2. Protection of the West Coast Canyons.
3. Protection of demersal slope fish communities.
4. Protection of eddy related habitats.
5. Protection biologically important areas for seabirds including:
  - a. Australian lesser noddy feeding grounds.
  - b. Common noddy feeding grounds.
  - c. Pacific gull feeding grounds.
  - d. Roseate tern feeding grounds.
  - e. Wedge-tailed shearwater feeding grounds.
  - f. Fairy tern feeding grounds.

- g. Sooty tern feeding grounds.
- 6. Protection of the fish and invertebrate community structures and seascapes of the Central Western Province bioregion.

## **6. Abrolhos Abyssal**

Conservation Objectives:

- 1. Protection of the Perth abyssal plain and continental rise.
- 2. Protection of sooty tern feeding grounds.
- 3. Protection of the seascapes of the Central Western Province bioregion

## **7. Southern Abrolhos**

Conservation Objectives:

- 1. Protection of the iconic Abrolhos Islands system including:
  - a. Protection of deeper channel habitats within the Abrolhos Islands and Central West Coast bioregions.
  - b. Protection of deeper shelf habitats within the Abrolhos Islands bioregion.
  - c. Protection of shallower bank/shoal habitats within the Central West Coast bioregion.
  - d. Protection of the only pinnacles mapped on the Rottnest shelf.
  - e. Protection of the seascapes of the Abrolhos Islands and Central West Coast bioregions.
  - f. Protection of the fish and invertebrate assemblages of the Abrolhos Islands and Central West Coast bioregions.
  - g. Protection of the invertebrate assemblages of the Abrolhos Islands and Central West Coast bioregions.
- 2. Protection of the Western Rock Lobster broodstock.
- 3. Protection of demersal slope fish communities in Central Western Province and Central West Coast bioregions.
- 4. Protection of biologically important areas seabird including:
  - a. Australian lesser noddy feeding grounds.
  - b. Bridled tern feeding grounds.
  - c. Caspian tern feeding grounds.
  - d. Common noddy feeding grounds.
  - e. Fairy tern feeding grounds.
  - f. Pacific gull feeding grounds.
- 5. Protection of humpback whale resting areas.

## 8. Beagle Island

### Conservation Objectives:

1. Protection of the WA west coast population of the threatened Australian sea lion.
2. Protection of west coast inshore lagoons.
3. Protection of the iconic Rottneest shelf.
4. Protection and replication of western rock lobster habitats from the middle of its range.
5. Protection of biologically important areas for seabirds including:
  - a. Caspian tern feeding grounds.
  - b. Fairy tern feeding grounds.
  - c. Pacific gull feeding grounds.
  - d. Roseate tern feeding grounds.
6. Protection of the fish and invertebrate assemblages and seascapes of the Central West Coast bioregion.

## 9. North Jurien

### Conservation Objectives:

1. Protection of the WA west coast population of the threatened Australian sea lion.
2. Protection of the iconic Rottneest shelf.
3. Protection and replication of western rock lobster habitats from the middle of its range.
4. Protection of biologically important areas for seabirds including:
  - a. Caspian tern feeding grounds.
  - b. Common noddy feeding grounds.
  - c. Fairy tern feeding grounds.
  - d. Pacific gull feeding grounds.
  - e. Roseate tern feeding grounds.
5. Protection of the fish and invertebrate assemblages and seascapes of the Central West Coast bioregion.

## 10. South Jurien

### Conservation Objectives:

1. Protection of the WA west coast population of the threatened Australian sea lion.
2. Protection of the iconic Rottneest shelf.
3. Protection of slope habitats within the Central West Coast bioregion.
4. Protection and replication of western rock lobster habitats from the middle of its range.
5. Protection of biologically important areas for seabirds including:

- a. Caspian tern feeding grounds.
  - b. Common noddy feeding grounds.
  - c. Fairy tern feeding grounds.
  - d. Pacific gull feeding grounds.
  - e. Roseate tern feeding grounds.
6. Protection of the fish and invertebrate assemblages and seascapes of the Central West Coast bioregion.

## **11. Perth Canyon**

### Conservation Objectives:

1. Protection of the iconic Perth Canyon.
2. Protection of endangered blue whale feeding grounds.
3. Protection of sperm whale feeding grounds.
4. Protection of the west coast canyons.
5. Protection of eddy related habitats.
6. Protection of biologically important areas for seabirds including:
  - a. Wedge-tailed shearwater feeding grounds.
  - b. Soft-plumaged petrel feeding grounds.
  - c. Pre-migration aggregation area for fleshy-footed shearwaters.
  - d. Fairy tern feeding grounds.
  - e. Common noddy feeding grounds.
7. Protection of demersal slope fish communities in the Central Western Province and Central West Coast bioregions.
8. Protection of the only pinnacle habitats on the mid slope of the Central Western Province.
9. Protection of the only Australian pinnacle habitats to be mapped on the continental rise.
10. Protection of the pinnacle habitats of the southern Rottnest slope.
11. Protection of the bank/shoal habitats and shelf edge pinnacle habitats of the Leeuwin-Naturaliste bioregion.
12. Protection of fish and invertebrate community structures and assemblages, and seascapes of the Central West Coast, Leeuwin-Naturaliste, Central Western Province and Southwest Transition bioregions.

## **12. Perth Abyss**

### Conservation Objectives:

1. Protection of the Perth abyssal plain and continental rise.
2. Protection of feeding grounds for the sooty tern.



3. Protection of the seascapes of the Central Western Province bioregion.

### **13. Rottnest**

#### Conservation Objectives:

1. Protection of west coast inshore lagoons.
2. Ensure connectivity between proposed marine sanctuaries on the shelf.
3. Protection of feeding grounds for male Australian sea lions.
4. Protection of the iconic Rottnest Shelf.
5. Protection of biologically important areas for seabirds including:
  - a. Caspian tern feeding grounds.
  - b. Fairy tern feeding grounds.
  - c. Roseate tern feeding grounds.
6. Protection of the fish and invertebrate assemblages and seascapes of the Central West Coast bioregion.

### **14. Geographe Bay**

#### Conservation Objectives:

1. Protection of the seagrass beds, biodiversity and nursery habitats of the iconic Geographe Bay.
2. Protection of endangered blue whale resting habitats.
3. Protection and replication of western rock lobster habitats in the south of its range.
4. Protection of biologically important areas for seabirds including:
  - a. Little penguin feeding grounds.
  - b. Fairy tern feeding grounds.
  - c. Fleshy-footed shearwater pre-migration aggregation sites.
5. Protection of the fish and invertebrate assemblages and seascapes of the Leeuwin-Naturaliste bioregion.

### **15. Cape Naturaliste**

#### Conservation Objectives:

1. Protection of the seagrass beds, biodiversity and nursery habitats of the iconic Geographe Bay.
2. Protection of blue and humpback whale resting habitats.
3. Protection of western rock lobster habitats in the south of its range.
4. Protection of biologically important areas for seabirds including:
  - a. Bridled tern feeding grounds.
  - b. Fleshy-footed shearwater pre-migration aggregation sites.

- c. Pacific gull former feeding grounds.
5. Protection of the Leeuwin-Naturaliste bioregion including important samples of:
  - a. Reef habitats.
  - b. Deeper shelf habitats.
  - c. Deep shelf pinnacle habitats.
  - d. Seascapes.
  - e. Fish and invertebrate assemblages.
  - f. Fish and invertebrate community structures.
6. Protection of the seascapes of the Southwest Transition bioregion.

## **16. Offshore Capes**

### Conservation Objectives:

1. Protection of feeding grounds and migratory pathways for endangered blue whales.
2. Protection of the Southwest Transition bioregion including important samples of:
  - a. Deeper pinnacle habitats.
  - b. Deeper canyon habitats.
  - c. Slope habitats.
  - d. Terrace habitats.
  - e. Trench and trough habitats.
  - f. Seascapes.
  - g. Fish and invertebrate community structures.
3. Protection of biologically important areas for seabirds including:
  - a. Soft-plumaged petrel feeding grounds.
  - b. Sooty tern feeding grounds.

## **17. Mentelle**

### Conservation Objectives:

1. Protection of the Cape Mentelle upwelling.
2. Protection of fish and invertebrate community structures and assemblages, seascapes, slope and terrace habitats within the Leeuwin-Naturaliste bioregion.
3. Protection and replication of western rock lobster habitats in the south of its range.
4. Protection of fish and invertebrate community structures and seascapes within the Southwest Transition bioregion.

## **18. Cape Leeuwin**

### Conservation Objectives:

1. Protection of humpback whale resting habitats.
2. Protection of sperm whale feeding grounds.
3. Protection of Gardener Canyon, one of the iconic Albany canyons.
4. Protection of biologically important areas for seabirds including:
  - a. Bridled tern feeding grounds.
  - b. Caspian tern feeding grounds.
  - c. Fairy tern feeding grounds.
  - d. Fleshy-footed shearwater feeding grounds.
  - e. Little penguin feeding grounds.
  - f. Pacific gull feeding grounds.
  - g. Indian yellow-nosed albatross feeding grounds.
5. Protection of fish and invertebrate community structures and assemblages, seascapes, and slope and terrace habitats within the Leeuwin-Naturaliste bioregion.
6. Protection of fish and invertebrate community structures, seascapes, canyon and slope habitats within the South-west Transition bioregion.
7. Protection of predictable eddy generation regions.

## **19. WA South Coast**

### Conservation Objectives:

1. Protection of sperm whale feeding grounds.
2. Protection of D'Entrecasteaux canyon, one of the iconic Albany canyons.
3. Protection of resting habitats for humpback whales.
4. Protection of the Southern Province, Leeuwin-Naturaliste and WA South Coast bioregions including important samples of:
  - a. Shallower pinnacle habitats.
  - b. Reef habitats.
  - c. Shallower shelf habitats.
  - d. Shallower slope habitats.
  - e. Seascapes.
  - f. Fish and invertebrate assemblages.
  - g. Fish and invertebrate community structures.
5. Protection of biologically important areas for seabirds including:
  - a. Indian yellow-nosed albatross feeding grounds.
  - b. Pacific gull feeding grounds.

- c. Fairy tern feeding grounds.
- d. Fleshy-footed shearwater feeding grounds.
- e. Little penguin feeding grounds.
- f. Caspian tern feeding grounds.
- g. Bridled tern feeding grounds.

## **20. Parryville**

Conservation Objectives:

1. Protection of sperm whale feeding grounds.
2. Protection of Wilson Canyon, one of the iconic Albany canyons.
3. Protection of Parryville Spur.
4. Protection of Indian yellow-nosed albatross feeding grounds.
5. Protection of invertebrate community structures in the Southern Province.

## **21. Fitzgerald**

Conservation Objectives:

1. Protection of southern right whale breeding habitat.
2. Protection of feeding grounds for the threatened white shark.
3. Protection of the WA south coast population of the threatened Australian sea lion.
4. Protection of Sperm whale feeding grounds.
5. Protection of Bremer and Pallinup canyons, two of the iconic Albany canyons.
6. Maintaining connectivity between marine sanctuaries on the shelf.
7. Protection of fish and invertebrate community structures and assemblages, seascapes, and shelf habitats within the WA South Coast bioregion.
8. Protection of important seabird habitats including:
  - a. Bridled tern feeding grounds.
  - b. Caspian tern feeding grounds.
  - c. Fairy tern feeding grounds.
  - d. Fleshy-footed shearwater feeding grounds.
  - e. Little penguin feeding grounds.
  - f. Pacific gull feeding grounds.
  - g. Indian yellow-nosed albatross feeding grounds.

## **22. Swan**

Conservation Objectives:

1. Protection of Swan Canyon, one of the iconic Albany canyons.

2. Protection of male and female feeding grounds for the WA south coast Australian sea lion population.
3. Protection of fleshy-footed shearwater feeding grounds.
4. Protection of fish and invertebrate community structures and assemblages, and seascapes within the WA South Coast bioregion.

### **23. Western Recherche**

#### Conservation Objectives:

1. Protection of the WA south coast population of the threatened Australian sea lion.
2. Protection of the iconic Recherche Archipelago.
3. Protection of likely feeding habitats for the threatened white shark.
4. Protection of biologically important areas for seabirds including:
  - a. Bridled tern feeding grounds.
  - b. Fairy tern feeding grounds.
  - c. Fleshy-footed shearwater feeding grounds.
5. Protection of the WA South Coast bioregion including important samples of:
  - a. Reef habitats.
  - b. Pinnacle habitats.
  - c. The shallow shelf to deep shelf transition bathome.
  - d. Seascapes.
  - e. Fish and invertebrate assemblages.
  - f. Fish and invertebrate community structures.

### **24. Eastern Recherche**

#### Conservation Objectives:

1. Protection of southern right whale breeding grounds.
2. Protection of Malcolme Canyon, one of the iconic Albany canyons.
3. Protection of the WA south coast population of the threatened Australian sea lion.
4. Protection of the iconic Recherche Archipelago.
5. Protection of eddy related habitats.
6. Protection of biologically important areas for seabirds including:
  - a. Black-faced cormorant feeding grounds.
  - b. Caspian tern feeding grounds.
  - c. Fairy tern feeding grounds.
  - d. Fleshy-footed shearwater feeding grounds.

- e. Little penguin feeding grounds.
  - f. Pacific gull feeding grounds.
  - g. Short-tailed shearwater feeding grounds.
  - h. Little shearwater feeding grounds.
  - i. White-faced storm petrel feeding grounds.
7. Protection of likely feeding, pupping and high density habitats for the threatened white shark.
  8. Protection of the Southern Province, WA South Coast, and Eucla bioregions including important samples of:
    - a. Shelf habitats.
    - b. Terrace habitats.
    - c. Shelf commencing canyons.
    - d. Slope hills.
    - e. Seascapes.
    - f. Fish and invertebrate assemblages.
    - g. Fish and invertebrate community structures.

## **25. Western Great Australian Bight**

### Conservation Objectives:

1. Protection of the iconic Great Australian Bight.
2. Protection of likely feeding, pupping and high density habitats for the threatened white shark.
3. Protection of the Eucla bioregion including important samples of:
  - a. Shelf habitats.
  - b. Terrace habitats.
  - c. Seascapes.
  - d. Fish and invertebrate assemblages.
  - e. Invertebrate community structures.
4. Maintenance of connectivity between marine sanctuaries on the shelf.
5. Protection of feeding grounds for little penguins.

## **26. Head of the Bight**

### Conservation Objectives:

1. Protection of southern right whale breeding habitat.
2. Protection of the South Australian population of the threatened Australian sea lion.

3. Protection of likely feeding, pupping and high density habitats for the threatened white shark.
4. Protection of the iconic Eastern Great Australian Bight.
5. Protection of the Eucla bioregion including important samples of:
  - a. Reef habitats.
  - b. Shelf habitats.
  - c. Terrace habitats.
  - d. Fish and invertebrate assemblages.
  - e. Invertebrate community structures.

## **27. Eastern Great Australian Bight**

Conservation Objectives:

1. Protection of the iconic Eastern Great Australian Bight.
2. Protection of the Southern Province and deeper shelf habitats within the Eucla bioregion including important samples of:
  - a. Deeper shelf habitats.
  - b. Terrace habitats.
  - c. Seascapes.
  - d. Fish and invertebrate assemblages.
  - e. Fish and invertebrate community structures.
3. Protection of feeding grounds for the South Australian population of the threatened Australian sea lion.
4. Protection of likely blue and sperm whale feeding grounds.

## **28. Murat**

Conservation Objectives:

1. Protection of reef, shallower shelf habitats, invertebrate community structures, fish and invertebrate assemblages, and seascapes in the Murat bioregion.

## **29. Nuyts**

Conservation Objectives:

1. Protection of the South Australian population of the threatened Australian sea lion.
2. Protection of known feeding grounds for the threatened white shark.
3. Protection of the Eyre Peninsula upwelling system.
4. Protection of the iconic Eastern Great Australian Bight.
5. Protection of likely feeding grounds for blue whales.
6. Protection of the Murat and Eyre bioregions.

7. Maintenance of connectivity between marine sanctuaries on the shelf.
8. Protection of biologically important seabird habitats including:
  - a. Caspian tern feeding grounds.
  - b. White-faced storm petrel feeding grounds.

### **30. Streaky Bay**

Conservation Objectives:

1. Protection of the South Australian population of the threatened Australian sea lion.
2. Protection of likely feeding, pupping and high density habitats for the threatened white shark.
3. Protection of the Eyre Peninsula upwelling system.
4. Protection of shallower shelf habitats, invertebrate community structures, and fish and invertebrate assemblages within the Eyre bioregion.
5. Protection of biologically important seabird habitats including:
  - a. Caspian tern feeding grounds.
  - b. Fairy tern feeding grounds and migration route.
  - c. Little penguin feeding grounds.

### **31. Investigator**

Conservation Objectives:

1. Protection of the South Australian population of the threatened Australian sea lion.
2. Protection of known feeding grounds for the threatened white shark.
3. Protection of the Eyre Peninsula upwelling system.
4. Protection of biologically important seabird habitats including:
  - a. Caspian tern feeding grounds.
  - b. Fairy tern feeding grounds and migration route.
  - c. Little penguin feeding grounds.
  - d. White-faced storm petrel feeding grounds
5. Protection of shallower shelf habitats, invertebrate community assemblages, fish and invertebrate assemblages, and seascapes within the Eyre bioregion.

### **32. Western Eyre Peninsula**

Conservation Objectives:

1. Protection of known feeding grounds for the endangered blue whale.
2. Protection of likely feeding grounds for sperm whales.
3. Protection of white-faced storm petrel feeding grounds.



4. Protection of fish and invertebrate community structures and terrace habitats within the Southern Province.
5. Protection of fish and invertebrate community structures and seascapes within the Eyre bioregion.

### 33. Kangaroo Island

#### Conservation Objectives:

1. Protection of known feeding grounds for the endangered blue whale.
2. Protection of likely feeding grounds for sperm whales.
3. Protection of the iconic Kangaroo Island Canyons.
4. Protection of the iconic Kangaroo Island Pool upwelling system.
5. Protection of biologically important seabird habitats including:
  - a. Caspian tern feeding grounds.
  - b. Fairy tern feeding grounds and migration route.
  - c. White-faced storm petrel feeding grounds.
  - d. Short-tailed shearwater feeding grounds.
6. Protection of the Southern Province and Eyre bioregions including important samples of:
  - a. Shelf commencing canyons.
  - b. Shelf habitats.
  - c. Seascapes.
  - d. Fish and invertebrate assemblages.
  - e. Fish and invertebrate community structures.

### References

- ANZECC TFMPA (Australian and New Zealand Environment and Conservation Council Task Force on Marine Protected Areas) 1998. *Guidelines for Establishing the National Representative System of Marine Protected Areas*. Australian and New Zealand Environment and Conservation Council, Task Force on Marine Protected Areas. Environment Australia, Canberra.
- Caputi, N., Feng, M., Penn, J., Slawinski, D., de Lestang, S., Weller, E. and Pearce, A. 2010. *Evaluating source-sink relationships of the western rock lobster fishery using oceanographic modelling*. Final report, Fisheries Research and Development Corporation Project No. 2008/087. Fisheries Research Report No. 209. Department of Fisheries, Western Australia. 68p.
- CoA, 2007. *The South-west marine bioregional plan: Bioregional profile*, National Oceans Office Branch, Department of the Environment and Water Resources, Commonwealth of Australia, Kingston, Tasmania.
- CoA, Unpublished. *Depth Biomes for IMCRA v4.0 Provincial Bioregions*, Department of Sustainability, Environment, Water, Population and Communities, Canberra, Australia.

DoF, 2007. *Management of the Houtman Abrolhos System, a draft review 2007-2017: Fisheries management paper no. 220*, Department of Fisheries, Perth, Western Australia.

Dunstan, P., and Foster, S., 2009. *Predicted patterns of seabed biodiversity in the South-west marine region*, CSIRO, Melbourne, Victoria.

Ellis, N., and Pitcher, C., 2009. *Predicted seabed assemblage patterns of marine fauna in the South-west marine region*, CSIRO, Melbourne, Victoria.

GBRMMPA, 2001, *Biophysical Operational Principles as recommended by the Scientific Steering Committee*, Great Barrier Reef Marine Park Authority, Townsville.

Halpern, B S, Regan, H M, Possingham, H P and M A McCarthy. 2006. Accounting for uncertainty in marine reserve design. *Ecology Letters* 9: 2-11

Harris, P, Heap, A, Passlow, V, Sbaffi, L, Fellows, M, Porter-Smith, R, Buchanan, C, & J Daniell. 2005. *Geomorphic Features of the Continental Margin of Australia*. Geoscience Australia, Record 2003/30, 142pp.

IMCRA, 2006. A Guide to the Integrated Marine and Coastal Regionalisation of Australia Version 4.0. Department of the Environment and Heritage, Commonwealth of Australia, Canberra, Australia.

Last, P., Lyne, V., Williams, A., Davies, C., Butler, A., and Yearsley, G., 2010. A hierarchical framework for classifying seabed biodiversity with application to planning and managing Australia's marine biological resources, *Biological Conservation*. 143: 1675-1686.

Last, P., Lyne, V., Yearsley, G., Gledhill, D., Gomon, M., Rees, T., and White, W., 2005. *Validation of national demersal fish datasets for the regionalization of the Australian continental slope and outer shelf (> 40m depth)*, National Oceans Office, Department of Environment and Heritage, Hobart, Tasmania.

Lyne, V., White, W., Gledhill, D., Last, P., Rees, T., and Porter-Smith, R., 2009. *Analysis of Australian continental shelf provinces and biomes based on fish data*. CSIRO Marine and Atmospheric Research, Hobart, Tasmania.

Margules CR, Pressey RL (2000) *Systematic conservation planning*. *Nature* 405: 243-253.

Possingham, H., Ward, T., Stewart, R., Segan, D., and Kircher, L. 2009. *South West Australia Science Project*, The Ecology Centre, University of Queensland, Brisbane, Queensland.  
<<http://www.uq.edu.au/ecology/index.html?page=146340>>

TFMPA (1999). *Understanding and applying the principles of comprehensiveness, adequacy and representativeness for the NRSMPA, Version 3.1*. Report prepared by the Action Team for the ANZECC Task Force on Marine Protected Areas. Marine Group, Environment Australia, Canberra.

Whiteway, T, Heap, A D, Lucieer, V, Hinde, A, Ruddick, R. and P T Harris. 2007. *Seascapes of the Australia Margin and Adjacent Sea Floor: Methodology and Results*. Geoscience Australia, Record 2007/11, 133pp.

Williams, A., Bax, N. J., Kloser, R. J., Althaus, F., Barker, B., and Keith G. 2009. Australia's deep-water reserve network: implications of false homogeneity for classifying abiotic surrogates of biodiversity. – *ICES Journal of Marine Science*, 66: 214–224.