A review of the south coast marine environment and proposed areas for state marine reservation between Albany and Eucla, Western Australia

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1. Executive summary

The primary aim of this report is to provide updated knowledge on the marine flora, fauna, habitats and geomorphology of the coastal waters between Albany and the Western Australia/South Australia (WA/SA) border. In particular, for the areas recommended for marine reservation in the 1994 Wilson Report: Cape Vancouver to Bald Island, Fitzgerald Biosphere Reserve, Stokes Inlet, Recherche Archipelago and Twilight Cove. A proposed strategic framework for marine waters of WA's south coast was developed following a south coast regional marine planning process carried out in the early 2000's (Oceans of Opportunity; SCRMPWG 2010). A key strategy under the Environment and Biodiversity section included 'reviewing recommendations of the 1994 Wilson report'. This review addresses that key strategy highlighted in the Oceans of Opportunity report by reviewing the areas recommended for marine reservation on the south coast (east of Albany).

The information, recommendations and knowledge gaps presented in this review are based on the most current scientific literature, however, it is acknowledged that the WA south coast is relatively understudied compared to other areas. In the absence of comprehensive biodiversity information across spatial and temporal scales, geomorphology and coastline orientation to wave exposure are likely still the most reliable predictors of habitat diversity. Nevertheless, species and location specific studies are summarised in this report for comprehensiveness, while the introduction includes some broader scale studies encompassing the south coast.

Most of the information sourced for this review related to the Recherche Archipelago, and it is evident that the Cape Vancouver to Bald Island, Fitzgerald Biosphere Reserve, Stokes Inlet, and Twilight Cove areas are relatively understudied. The identification of new species is common along the south coast and is reflective of the relatively limited research efforts.

The key ecological values of each of the five proposed areas for marine reservation include:

Cape Vancouver to Bald Island

- Diversity of benthic habitats and communities including extensive seagrass meadows, macroalgal beds, sand and sessile invertebrates
- The rare endemic labrid, Braun's wrasse (*Pictilabrus brauni*) is currently only known from Cheynes Beach (International Union for Conservation of Nature (IUCN) Red List Status: Data deficient)
- Juvenile southern bluefin tuna seasonally use inshore waters for foraging
- Identified as a Biologically Important Area for white sharks (*Carcharodon carcharias*)

- All state waters are included in the Geographe Bay to Eucla Important Marine Mammal Area
- Identified as a Biologically Important Area for Australian sea lions, and Coffin Island and Bald Island have been identified as important breeding and haul out islands for Australian sea lions (*Neophoca cinerea*) and long-nosed fur seals (*Arctocephalus forsteri*)
- Two Peoples Bay and the surrounding coastline is a Biologically Important Area for southern right whales

Fitzgerald Biosphere Reserve

- Diversity of benthic habitats and communities, including limestone and granite reefs, sand, seagrass meadows, sponges and macroalgae
- Identified as a Biologically Important Area for white sharks
- All state waters are included in the Geographe Bay to Eucla Important Marine Mammal Area
- Doubtful Island and Red Islet are known breeding site for Australian sea lions
- Doubtful Island Bay is a Biologically Important Area and Commonwealth recognised large aggregation area for southern right whales during calving season

Stokes Inlet

- Diversity of benthic habitats and communities, including limestone reef, seagrass meadows, macroalgae and sand
- Identified as a Biologically Important Area for white sharks (*Carcharodon carcharias*)
- All state waters are included in the Geographe Bay to Eucla Important Marine Mammal Area
- Identified as a Biologically Important Area for southern right whales during calving season

Recherche Archipelago

- Diversity of benthic habitats and communities, including rhodolith beds, low and high profile reef, seagrass meadows, sponges, macroalgae and sand
- Habitat for threatened (Environment Protection and Biodiversity Conservation (EPBC) Act listed) syngnathid species, including the first live records of the ruby seadragon (*Phyllopteryx dewysea*)
- Identified as a Biologically Important Area for white sharks (*Carcharodon carcharias*)
- All state waters are included in the Geographe Bay to Eucla Important Marine Mammal Area
- Identified as a Biologically Important Area for Australian sea lions and a number of islands are used for breeding by Australian sea lions and long-nosed fur seals

- Identified as a Biologically Important Area for southern right whales, and Israelite Bay and around Cape Arid are used by large aggregations during calving season
- Identified as a Key Biodiversity Area (previously termed Important Bird Area) for seabirds and resident waterbirds

Twilight Cove

- Some rhodolith habitat and extensive seagrass meadows
- Identified as a Biologically Important Area for white sharks (*Carcharodon carcharias*)
- All state waters are included in the Geographe Bay to Eucla Important Marine Mammal Area
- The Baxter Cliffs is noted as a haul out and breeding site for Australian sea lions
- Identified as a Biologically Important Area for southern right whales and is a Commonwealth recognised emerging aggregation area

Based on the six ecological criteria used in the framework for prioritising the implementation of marine reserves in WA, and combined with knowledge from this review and expert comments, we find the relative importance of each of the five areas at a regional level could be prioritised as follows:

1. Recherche Archipelago
2. Fitzgerald Biosphere Reserve
3. Cape Vancouver to Bald Island
4. Stokes Inlet
5. Twilight Cove

Based on the literature and engagement with experts, recommendations are made for boundary extensions for all five proposed areas included in this review. Extending the boundaries of Cape Vancouver to Bald Island eastwards to Haul Off Rock would include an emerging aggregation area for southern right whales, an additional breeding site for Australian sea lions and long-nosed fur seals, extensive perennial seagrass meadows, foraging habitat for juvenile southern blue fin tuna, habitat for the rare endemic labrid, Braun's wrasse (*Pictilabrus brauni*), and bays and rocky headlands with different exposure angles to high energy wave action. By extending the boundaries of Fitzgerald Biosphere Reserve west to Groper Bluff and east to West Island, a greater diversity and extent of benthic habitats and associated species are included, as well as an emerging aggregation area for southern right whales, important breeding and haul out areas for sea lions, important habitat for seadragons, seabirds, juvenile southern bluefin tuna, and bays and rocky headlands with different exposure angles to high energy wave action. Extending the boundaries of Stokes Inlet to align with the boundaries of the South-West Corner Commonwealth Marine Park boundary, inclusive of Investigator Island and Lake Gore RAMSAR wetland

boundaries, would allow for continuous protection from the high intertidal mark through to deep open ocean, inclusive of a range of depths and habitats, as well as, including important habitat for seabirds and sea lions. Though Recherche Archipelago is the largest of the five proposed areas, extending the eastern boundary to Point Culver and including Esperance Bay would incorporate a diverse array of habitats, including rhodolith beds, that would help support the biodiversity of the archipelago, and also include an established recognised large aggregation area for southern right whales. Finally, adjusting the boundaries of Twilight Cove eastwards would encompass extensive seagrass meadows and rhodolith beds (likely), include more area for aggregating southern right whales, and improve connectivity with the South Australian Marine Park sanctuary zone that begins at Wilson Bluff on the WA/SA border.

2. Glossary and acronyms

Glossary	
Anthropogenic	Caused or influenced by human activities.
Arcuate	Curve shape.
Ascidian	Filter feeders that start life as a free swimmers before permanently attaching to the bottom.
Bathymetry	Mapping of the seafloor by measuring depth. Results reveal seafloor shape and elevation.
Benthic	The ocean floor or the bottom of any water body.
Bioclasts	Fossil fragments of both marine and terrestrial origin that are found in sedimentary rocks.
Biota	Plants and animals.
Cetaceans	A group of mammals including the whales, dolphins and porpoises.
Coelenterates (or Cnidarians)	A phylum (or group) of invertebrates that include jellyfish, anemones, corals and hydras.
Crustacean	A large group of organisms that includes crabs, crayfish, shrimp, prawns, krill, woodlice and barnacles.
Elasmobranchs	A group of marine species that includes the sharks and rays.
Endemism	A species native to a location and not found elsewhere.
Endofaunal	Fauna that lives on the outside surfaces or spaces of other organisms.
Eocene	The second of five epochs lasting from ~56 to ~34 million years ago.
Epiphytic	Plants or algae that grow on other plants for support.
Foraminifera	Single-celled organisms with shells or tests that are either planktonic or benthic living.
Fucoids	An order within the brown algae. Includes some of the common seaweeds.
Gastropod	Animals that include limpits, whelks, periwinkles, abalones, cone shells, sea slugs and sea hares.
Geomorphology	A branch of geology that studies the origin, structure and development of the earth's landforms.
Intraclast	Sediment of irregular grain shape.
Invertebrates	Animals that lack a backbone or skeleton.
K-selected species	Typically long-lived, late to mature, and/or invests more energy into offspring

Labrid	From the wrasse family of fishes (Labridae).
Laminariales	Large, brown seaweeds also known as kelps.
Macroalgae	Seaweeds and other benthic marine algae.
Metasediments	Rock that has been subjected to heat, pressure and chemical fluids (metamorphism).
Molluscs	A group of organisms that typically have soft bodies, a foot and a head. The bodies of some species are often covered by a hard shell. The group includes snails, clams, scallops, octopuses and squid for example.
Neritic	The stretch of water from the low tide mark out to the continental shelf (~200 m depth)
Otoliths	Ear bones in fishes that help maintain balance and orientation.
Perturbation	Internal or external mechanisms that induce a change in function of a biological system.
Pinnipeds	A group of mammals that are fin-footed and include seals, fur seals, sea lions and walrus.
Planar	Level or flat.
Pleistocene	A time between ~1.8 million and 11,000 years ago.
Propagules	Reproductive structures released by organisms that give rise to a new individual.
Quartzose	Made from quartz.
Quaternary	Fourth in rank order.
RAMSAR	The RAMSAR Convention aims to halt the global loss of wetlands. RAMSAR sites that can be classified as wetlands include swamps, marshes, billabongs, lakes, salt marshes, mudflats, mangroves, coral reefs, fens, peat bogs, or bodies of water.
Rhodolith	Unattached calcareous rock like nodules made of red algae.
Siphonophores	Colonial, carnivorous animals that are members of the Coelenterates (or Cnidarians).
Spatial	Position and area of a place.
Sponges	Filter feeders that live out their life attached to the bottom.
Terrigenous	Terrigenous sediments are derived from the erosion of terrestrial rocks.
Zooplankton	Small animals that float or swim in the water column. They may be microscopic animals such as copepods or the eggs and larvae of larger invertebrates and fish.

Acronyms	
CALM	Department of Conservation and Land Management
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CWR	Centre for Whale Research, Western Australia
DBCA	Department of Biodiversity, Conservation and Land Management
DoT	Department of Transport
DPIRD	Department of Primary Industries and Regional Development
EPBC	Environment Protection and Biodiversity Conservation
GAB	Great Australian Bight
GSR	Great Southern Reef
IMAS	Institute for Marine and Antarctic Studies
IMCRA	Integrated Marine and Coastal Regionalisation of Australia.
IUCN	International Union for Conservation of Nature
MPA	Marine Protected Area
MPRSWG	Marine Parks and Reserves Selection Working Group
NRM	Natural Resource Management
TNC	The Nature Conservancy
UTAS	University of Tasmania
UWA	University of Western Australia
WA	Western Australia
WAM	Western Australian Museum

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3. Introduction

3.1. Plan for our Parks

The Western Australian (WA) State Government announced "Plan for our Parks" in 2019, which is an initiative that will secure five million hectares of new national and marine parks and conservation reserves across WA by 2024. A new marine park along the south coast was identified as a priority, which would make a significant contribution to the National Representative System of Marine Protected Areas. In particular, a south coast marine park would mean greater representation of the WA South Coast and Eucla Meso-scale Bioregions (Commonwealth of Australia 2006). The Walpole and Nornalup Inlets Marine Park is the only marine park in state waters along the south coast, but the boundaries do not extend into coastal waters.

A Marine Parks and Reserves Selection Working Group (MPRSWG) was appointed in 1986 by the then Minister for the Environment to identify areas of coastal waters in WA suitable for marine reservation. The resulting state-wide review (herein referred to as the Wilson Report) identified 70 areas that could provide a system of reserves that would be representative of the flora, fauna and habitats of WA, should they be established (CALM 1994). Amongst those 70 areas identified state-wide, there were 14 areas of coastal waters, estuaries and inlets along the WA south coast that were selected as potential locations for marine conservation reserves. The Wilson Report serves as a starting point to build upon for determining the most suitable location for the establishment of a south coast marine park(s).

3.2. South coast marine environment

The south coast of WA is characterised by rugged exposed rocky headlands, curved sandy embayments and an extensive macroalgae covered reef network bordered by a series of offshore canyons. This stretch of the WA south coast is part of the Great Southern Reef system (GSR). This system of interconnected reef fringes the Australian coastline from Kalbarri in WA and all along the south coast to northern New South Wales. The GSR supports thousands of species, has high endemism, but remains relatively understudied (Bennett *et al.* 2016; Coleman and Wernberg 2017). An detailed overview of the habitats and biodiversity of the temperate southern coast of Australia is given by Edgar and Shepherd (2013).

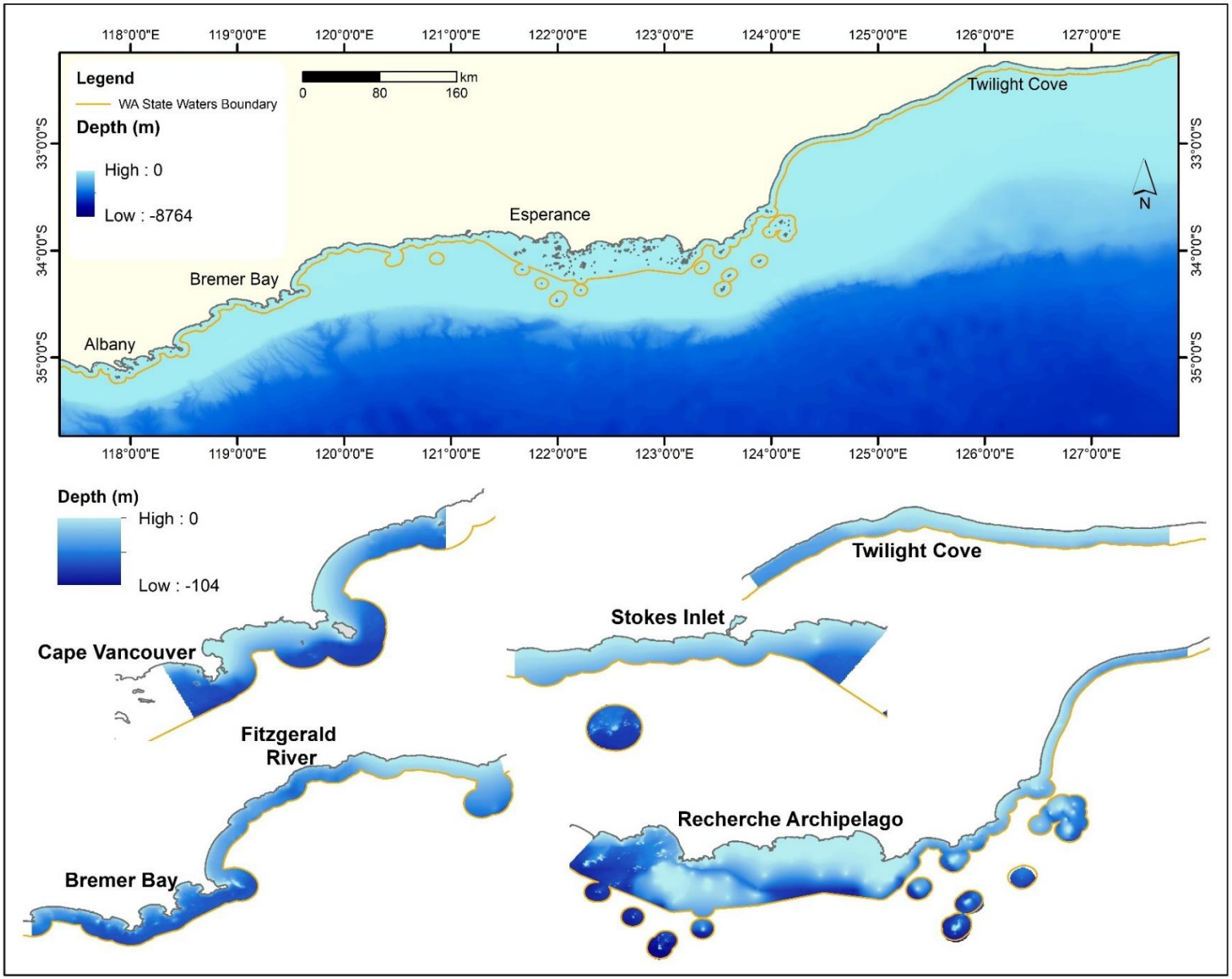

Figure 1: Bathymetry of the south coast of WA between Albany and the WA/SA border. Data sourced from Geoscience Australia (Whiteway 2009).

The distribution of habitats and marine flora and fauna on the south coast of WA is driven by geomorphology, sedimentology and oceanography. The continental shelf is relatively narrow along the south-west portion of the southern coastline, becoming broader across the Great Australian Bight (GAB) (Fig. 1). The stretch of southern coastline in WA is divided into two provincial bioregions, the South West Integrated Marine and Coastal Regionalisation of Australia (IMCRA) Province (from the northern Naturaliste Plateau around Cape Naturaliste to Cape Pasley), and the GAB IMCRA Transition (Cape Pasley to the southern tip of Eyre Peninsula). Further still is the division into the WA South Coast and Eucla Mesoscale Bioregions (Fig. 2) (Commonwealth of Australia 2006). The South West IMCRA Province is characterised by long-term carbonate sedimentation, granites and numerous canyons (Richardson et al 2005). The Recherche Shelf that extends from Cape Leeuwin to Israelite Bay generally consists of inner islands and outcrops and an outer zone of sandy seabed (Fig. 3) (Harris *et al.* 2005). While there are four main rocky reef systems and an archipelago of ~105 islands and ~1,500 islets (Recherche Archipelago) that provides the coast with some protection from predominant south-west swells and winds, the majority of the shelf is exposed to high energy (Lee and Bancroft 2001; Richardson *et al.* 2005). In contrast, the GAB IMCRA Transition is characterised by a mostly flat and shallow shelf exposed to Southern Ocean storms and high levels of erosion, which is broadly separated into three shelf regions by James *et al.* (2001) based on bathymetry from the shallow coast (0-50 m) to the outer shelf (125-170 m). Within the scope of this report, Albany to the WA/SA border, there are six primary sediment compartments and 24 secondary sedimentary compartments that are described in more detail by Eliot *et al.* (2011) and Thom *et al*. (2018).

The south flowing Leeuwin Current transports warm water from the tropics to the south coast and exerts a considerable influence on the circulation and physical characteristics of the coastline (Fig. 4) (Cresswell and Peterson 1993; Wells 2003; Ridgway and Condie 2004), as well as marine life (McGowran *et al.* 1997; Phillips 2001; Feng *et al.* 2009; Kendrick *et al.* 2009). During the austral autumn/winter, the Leeuwin Current is strongest and supresses upwelling of cold water and nutrients for much of the south-west and southern coastlines. In summer, when the Leeuwin Current flow is reduced due to more persistent southerly and south westerly winds, the Flinders Current allows periodic upwelling along parts of the southern coastline (Middleton and Cirano 2002; Middleton and Platov 2003).

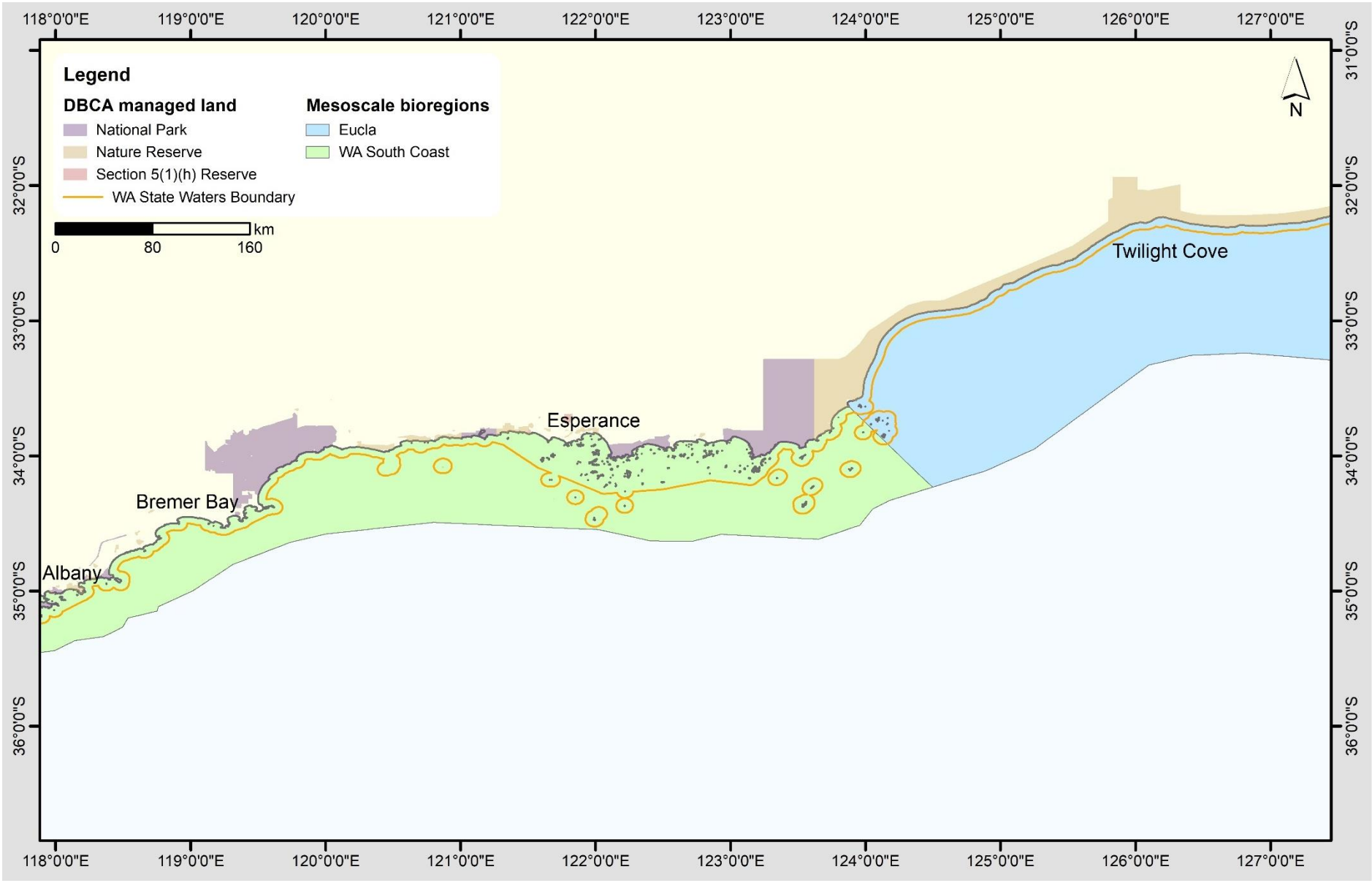

Figure 2: IMCRA Mesoscale Bioregions that occur between Albany and the WA/SA border. Data sourced from data.gov.au (Commonwealth of Australia 2006).

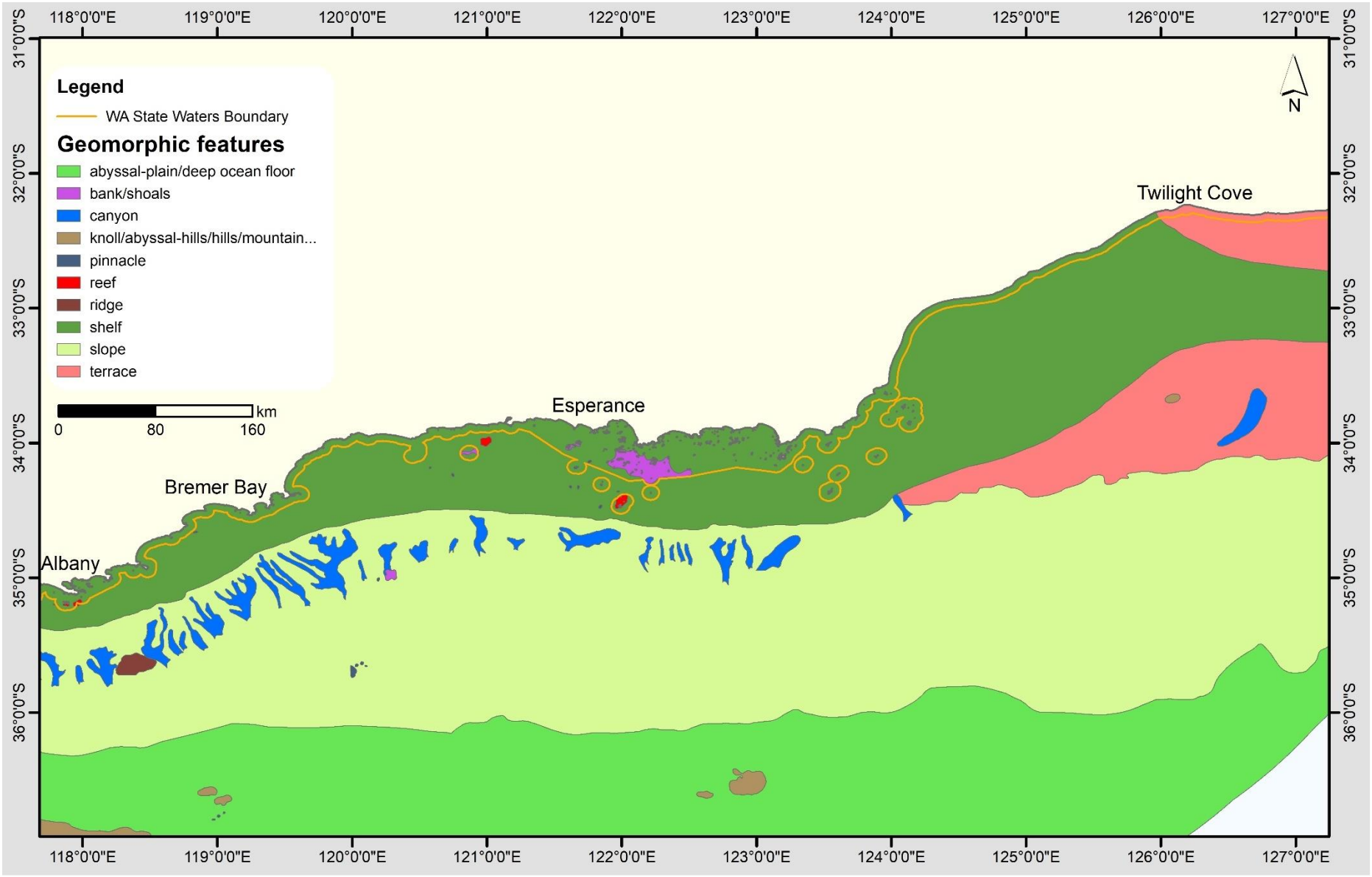

Figure 3: Geomorphic features of the south coast between Albany and WA/SA border. Data sourced from SeaMap Australia (Heap *et al.* 2006).

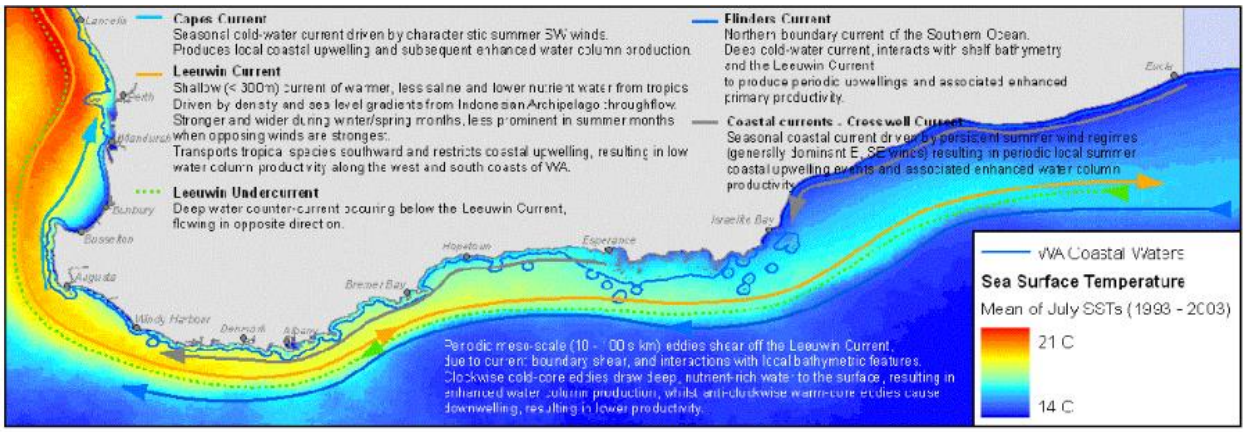

Figure 4: The dominant Leeuwin Current and seasonal currents that influence the oceanography of the south coast. Image taken from Oceans of Opportunity - SCRMPWG (2010).

Biodiversity is high across the southern coastline of WA, and high endemism is a unique feature of these warm to cool temperate waters (McClatchie *et al.* 2006). Approximately 1500 species of alga occur along the south coast which show distinct biogeographic assemblages (Waters *et al.* 2010; Shepherd and Edgar 2013). In the Recherche Archipelago alone, 242 species of algae have been recorded (Kendrick *et al.* 2009), alongside habitat forming rhodolith beds (Goldberg and Kendrick 2005; Goldberg 2006). Climate change and anthropogenic activities are exerting significant pressure on kelp forests leading to range contractions and declines in many fucoids which alters ecosystem function and reduces diversity (Coleman and Wernberg 2017; Martínez *et al.* 2018). Seventeen species of seagrass are known to occur along the south coast of WA, nine of which are endemic, and meadows are able to grow to depths of up to 50-60 m due to clearer waters, compared to tropical Australia (Kendrick *et al.* 2005a). A series of published books were produced by Womersley (e.g., Womersley 1984; Womersley 1987; Womersley 1994) detailing the specifics of algae and seagrasses along southern Australia, and more recently, Huisman (2019) describes the marine plants of Australia, including those occurring along the south coast.

The diversity of invertebrates is better understood for Albany and the Recherche Archipelago than other locations along the south coast (e.g., Wells *et al.* 1991b; Wells *et al.* 1991a; Wells *et al.* 2005c; Wells *et al.* 2005b). The species richness of decapods and echinoderms were compared along the whole southern coastline of Australia and richness was found to be similar west to east from Albany to the WA/SA border (~160-170 species) (O'Hara and Poore 2000).

The diversity of fishes along the south coast of WA is largely comprised of temperate species, though tropical and subtropical species have also been recorded due to the influence of the Leeuwin Current (Hutchins 1994; Hutchins 2001; Hutchins 2005). Tropical fishes occuring in the region are unlikely to form local breeding populations (Gaughan and Santoro 2020). There is a

lower number of neritic fish species than the north-west shelf of WA, but a higher number of Australian endemic species, which contributes to the distinct assemblages found along the south coast compared to the rest of the WA coast (Fox and Beckley 2005). Long-lived, slow growing demersal fish species are a feature of south coast assemblages (Coulson *et al.* 2009; Gaughan and Santoro 2020), with species like the blue groper (*Achoerodus gouldii*) playing important functional roles (Shepherd 2005). The south coast endemic Braun's wrasse (*Pictilabrus brauni*) has only been recorded from Cheynes Beach (Hutchins and Morrison 1996), and the iconic, south coast endemic leafy seadragon (*Phycodurus eques*) inhabits bays along the coast between Albany and Goolwa in South Australia (Stiller *et al.* 2020). Juvenile southern bluefin tuna (*Thunnus maccoyii*) migrate to the south coast of Australia (Hobday *et al.* 2015; Patterson *et al.* 2018a; Patterson *et al.* 2018b) and make use of inshore waters and topographic features (Fujioka *et al.* 2010a; Fujioka *et al.* 2010b; Itoh *et al.* 2011). A more detailed description of the fishes occuring along the temperate south coast of Australia is provided by Gomon *et al.* (2008).

A body of research has focused on the white sharks (*Carcharodon carcharias*) that distribute and forage along the south coast of WA (Fig. 5) (e.g.Taylor *et al.* 2016 ; Braccini *et al.* 2017; McAuley *et al.* 2017; Taylor *et al.* 2018). Tracking of white sharks tagged off the south east coast of Australia, showed a female shark travelled 1900 km to the west, where the animal spent several weeks between Esperance and Bremer Bay close to the coast (Bruce *et al.* 2006). Across the whole south coast study region, the majority of tagged sharks moved within coastal waters less than 100 m and in some cases less than 5 m. Some also crossed open oceanic waters to New Zealand. Genetic sampling of white sharks from the west, south and east coasts of Australia has been used to assess population structure of white sharks exist in Australian waters (Bruce et al. 2018). No nursery grounds for juvenile white sharks in waters along the south coast of WA have yet to be found, though a white shark estimated to be two months old provides some anecdotal evidence of a possible nursery near Salisbury Island (https://www.abc.net.au/news/2020-08-20/white-shark-sharks-esperance-salisbury-island-documentary-lair/12570352).

The south coast, from Geographe Bay to Eucla, is recognised by the IUCN Marine Mammal Protected Areas Taskforce as an important area for marine mammals in terms of their biology, ecology and population structure (IUCN MMPATF 2021)(Fig. 6). For example, eastern and western populations of the southern right whale (*Eubalaena australis*) use the waters along the south coast as a breeding area between May – November and come inshore close to beaches along the coast between Twilight Cove in the east and Augusta in the west for calving, nursing, predation avoidance and socialisation (Fig. 7). The most recent population size estimate in Australia is ~3,500 individuals, with ~3,200 individuals in the south-west and fewer than 300 individuals in the south-east (Bannister 2017; Smith *et al.* 2019). As the population continues to recover and expand, more areas along the south coast will be used for these purposes.

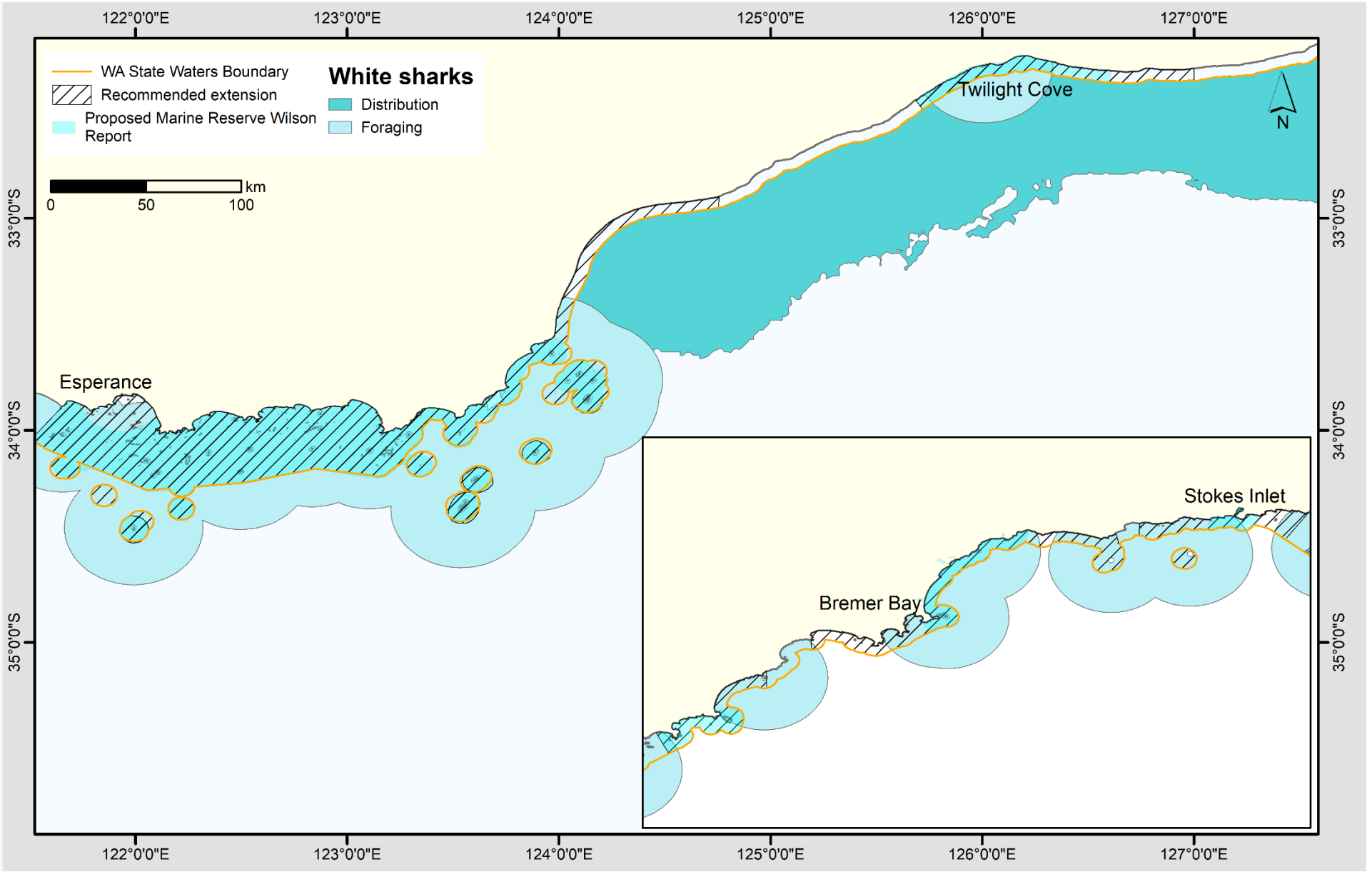

Figure 5: Biologically Important Areas for white sharks (*Carcharodon carcharias*) between Albany and the WA/SA border. Data sourced from the Australian Government National Conservation Values Atlas Map (DSEWPaC 2011).

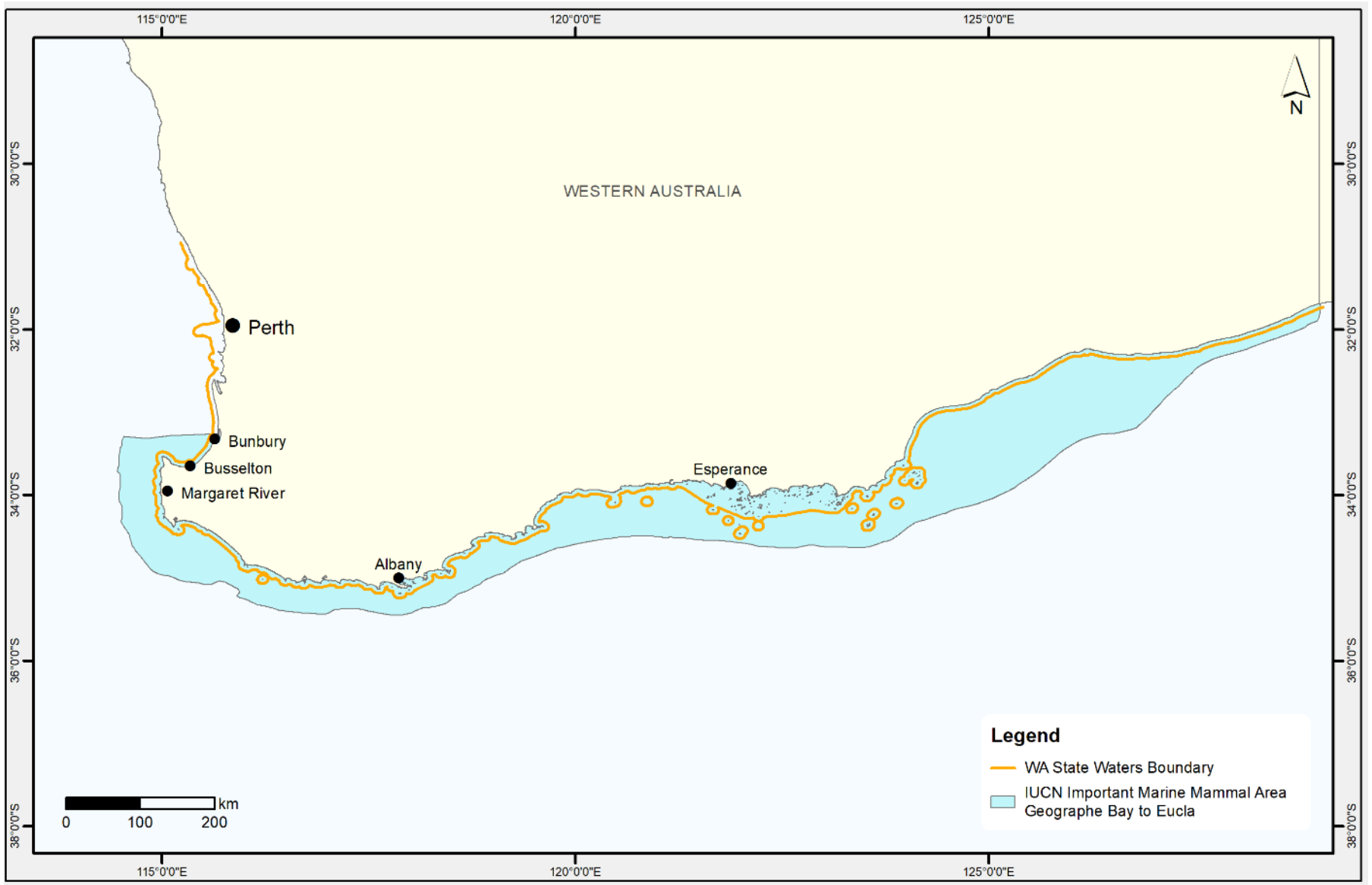

Figure 6: Extent of the IUCN Geographe Bay to Eucla Important Marine Mammal Area. Data sourced from IUCN MMPATF (2021). Geographe Bay to Eucla Shelf and Coastal Waters IMMA. The IUCN Global Dataset of Important Marine Mammal Areas (IUCN IMMA). March/2021. Made available under agreement on terms and conditions of use by the IUCN Joint SSC/WCPA Marine Mammal Protected Areas Task Force and accessible via the IMMA e-Atlas http://www.marinemammalhabitat.org/imma-eatlas.

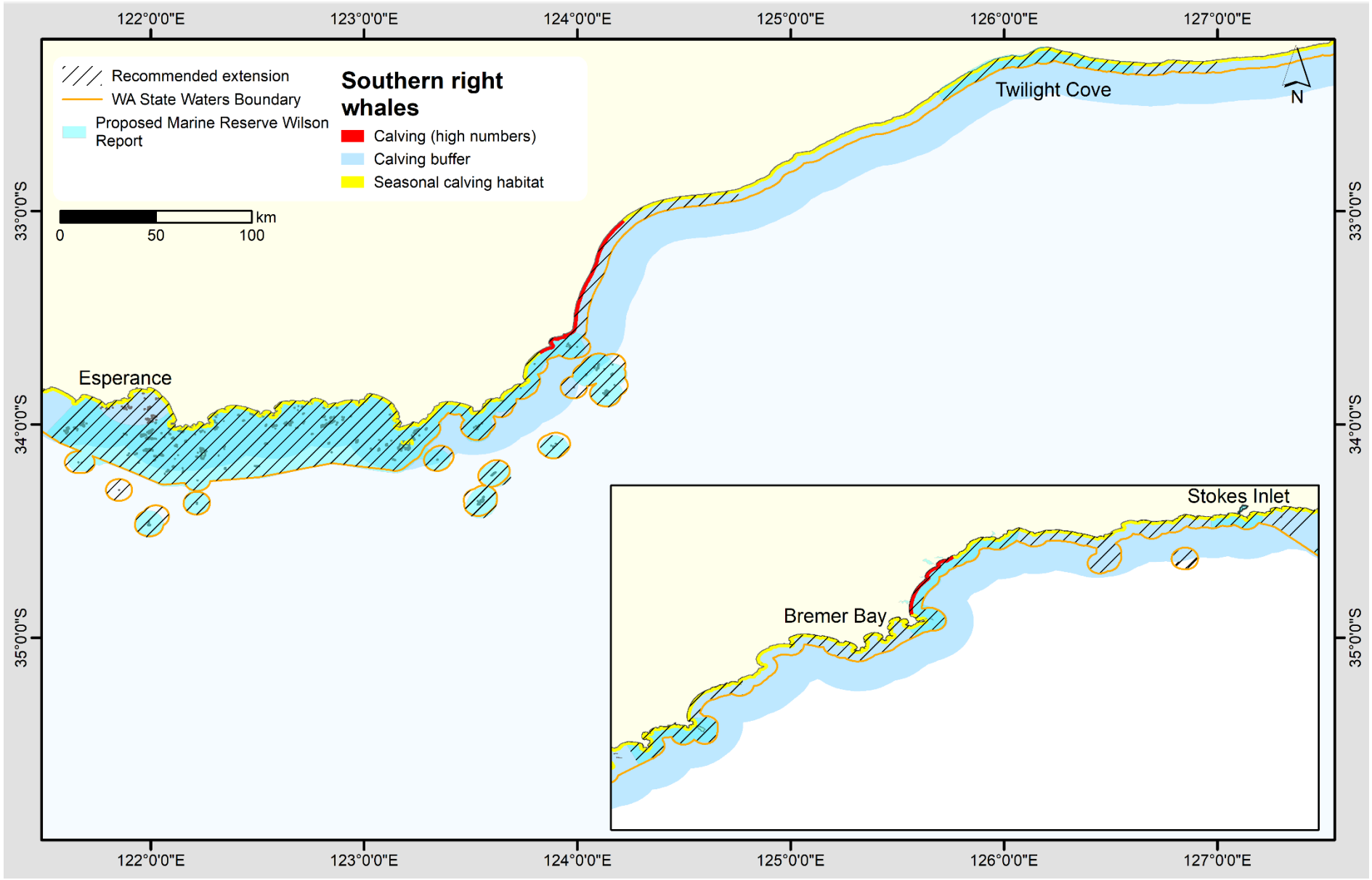

Figure 7: Biologically Important Areas for southern right whales (*Eubalaena australis*) between Albany and the WA/SA border. Data sourced from the Australian Government National Conservation Values Atlas Map (DSEWPaC 2011).

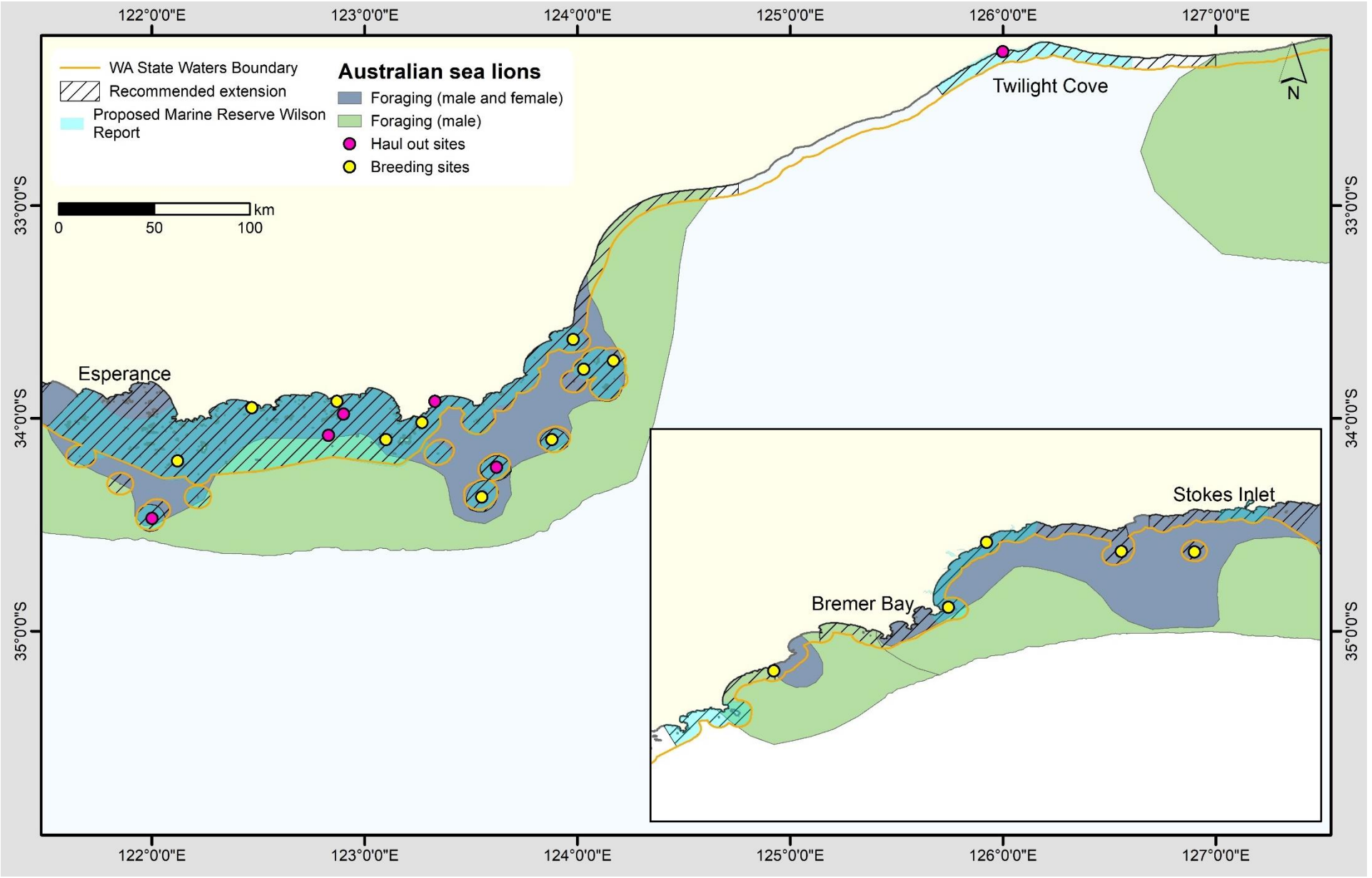

Figure 8: Biologically Important Areas for Australian sea lion (*Neophoca cinerea)* between Albany and the WA/SA border. Data sourced from the Australian Government National Conservation Values Atlas Map (DSEWPaC 2011). See below sections on additional important sites for Australian sea lions not included in this map.

The endemic and endangered Australian sea lion (*Neophoca cinerea*)((Threatened Species Scientific Committee 2020) uses the islands along the south coast of WA as breeding and haul out locations (Fig. 8), as does the long-nosed fur seal (*Arctocephalus forsteri*). Obtaining accurate population information for the endangered and endemic Australian sea lion is difficult given breeding cycles are long (17-18 months) and asynchronous across the ~32 breeding sites identified in WA (Goldsworthy *et al.* 2014; Goldsworthy *et al.* 2021). The current breeding status of some of these sites is also uncertain as only single occurrences of pups have been recorded or pups may have originated from nearby breeding sites. Many of the colonies are remote or difficult to access and the animals spend a larger portion of their adult lives at sea. Monitoring and data collection of sea lions along the south coast has been sporadic (Pitcher 2018), however, the majority of breeding colonies in WA occur along the south coast. A recent assessment of Australian sea lion pup abundance based on data from seven sites in Western Australia and 23 sites in South Australia, shows an estimated decline in pup abundance of 64% between 1977 and 2019 (Goldsworthy 2020; Goldsworthy *et al.* 2021). While this estimate largely reflects South Australia pup abundances, which has more consistently collected data, there is still some indication that pup abundance along the south coast of WA is declining. Interactions with commercial fishing operations and entanglements in fishing gear is identified as a key threat for Australian sea lion populations in Australia. To help alleviate this threat, Gillnet Exclusion Zones were implemented around breeding sites along the south coast and west coast of WA in 2018. Sea lion excluder devices (SLEDs) were also introduced in pots for the South Coast Crustacean Managed Fishery in 2009, which have been effective at preventing sea lions from entering pots (Mackay and Goldsworthy 2017; Gaughan and Santoro 2020).

Various reviews of the south coast of WA have been completed since the Wilson Report and are briefly described below:

- South Coast Terrestrial and Marine Reserve Integration Study (Colman 1998)

The primary objective was to facilitate a regional classification of the south coast marine environment, with respect to ecological, economic and cultural criteria. In addition, Colman (1998) aimed to bring together documented information for the proposed marine conservation reserve areas presented in the Wilson Report. Outcomes included recommendations to facilitate the integrated management of adjacent terrestrial and marine conservation reserves and ensuring that the potential impacts on terrestrial and estuarine ecosystems are understood prior to the establishment of the marine conservation reserves.

- Review of the existing ecological information for the proposed Recherché Archipelago marine conservation reserve (Lee and Bancroft 2001)

The existing ecological information for the Stokes Inlet and Recherche Archipelago region available at the time was summarised in this report. A general description of physical characteristics and biological resources is given. Information was collated from literature searches, publications, Department of Conservation and Land Management (CALM) data and anecdotal information for benthic habitats, marine flora and fauna, estuaries, coastal wetlands and coastal terrestrial biota.

- The south-west marine region: ecosystems and key species groups (McClatchie *et al.* 2006).

Although this review focused on Commonwealth waters, information on inshore waters was included where relevant for important processes and biota. Regional geomorphology, patterns of biodiversity including seabirds, seagrass, macroalgae, invertebrates, benthic communities, fishes and marine mammals are summarised.

- Oceans of Opportunity: a proposed strategic framework for marine waters of WA's south coast (SCRMPWG 2010).

As part of the south coast regional marine planning process, this report provides a brief overview of the south coast marine region and environmental values. In addition, the report describes the economic, social and cultural values, marine issues of relevance to the south coast and outlines key strategies for the marine planning process.

- Review of research and monitoring relevant to natural values in Australia's Commonwealth Marine Reserves (Hoey and Pratchett 2017).

This review focuses on the natural values of the South-west Commonwealth Marine Reserves Network and, although outside of state waters, could help to inform boundary placement and alignment with Commonwealth marine parks.

- Sea Lions, Seadragons and Seaweeds. Environmental values of WA's proposed south coast marine park (Turner and Booth 2021).

This report summarises the main features and natural values of the south coast of WA and the threats to those values. Further to this, areas of high conservation value are presented and recommendations on how to optimise the conservation benefits of a south coast marine park are made.

3.3. Proposed south coast marine parks

The report, *A Representative Marine Reserve system for Western Australia* (Wilson Report), prepared by the MPRSWG and published by CALM in 1994 was the culmination of a series of workshops and meetings to examine information collected on stretches of coast from the Kimberley in the north-west to Eucla at the WA/SA border. At the time of the Wilson Report, there were no existing marine parks on the south coast.

The aims of the Wilson Report were to review the knowledge of the flora and fauna, habitats and geomorphology of the WA coastal waters and identify areas of high conservation, scientific and public recreational value. Areas identified were deemed worthy for marine reservation and the report made a series of recommendations.

The marine flora and fauna of the south coast were poorly known at the time, with only a small collection held at the WA Museum and the majority of knowledge coming from estuarine biota. Ecological studies were very sparse for the south coast. Consequently, the MPRSWG based the assessment of areas for reservation largely on the assumption that areas representative of coastal geomorphology would also be representative of the biota. Four geomorphological areas were identified and two were subdivided further to distinguish representative coastal types.

The following MPRSWG recommendations were made for the five proposed areas included in this report (Fig. 9), and a further overview of the marine values included in the Wilson Report is given in section 5.

- Cape Vancouver to Bald Island

A wide variety of coastal types and habitats are represented. Remoteness and difficult access to the shore provide a degree of protection and the inshore waters have value for recreational activities such as fishing and diving. Recommendation:

"*the state coastal waters between the western boundary of the Two Peoples Bay Nature Reserve and Lookout Point, including the tidal waters of Waychinicup Inlet and encompassing Bald Island, be considered for reservation as a marine reserve for conservation of flora and fauna and recreation*."

- Fitzgerald Biosphere Reserve

Although there was a lack of information about the marine flora and flora on the shores of the Fitzgerald River National Park, the reservation of the coastal waters would have recreational and management value. Limited shore access would afford protection from human impact. Doubtful Island is a nursery area for southern right whales. The existing commercial Australian salmon fishery could also be accommodated through management and the sea lion and fur seal colonies would be protected. The small inlets provide considerable scenic and recreational value to the Fitzgerald National Park. Recommendation:

"*the area of state coastal waters between the mouth of Gordon Inlet and the mouth of Culham Inlet, that is the coast adjacent to the Fitzgerald River National Park, should be considered for reservation as a marine reserve for conservation of flora and fauna and recreation, and that it should be added to the Fitzgerald Biosphere Reserve*;

"*consideration also be given to reservation for the same purposes of the southern part of Doubtful Island Bay encompassing the Doubtful Islands and Point Hood*;

"*legal opinion be obtained on the status of Gordon, St Mary, Fitzgerald, Dempster and Hamersley Inlets and if they are judged to be 'tidal' and therefore excluded from the national park as declared under the Land Act, consideration should be given to reservation of them as marine reserves under the CALM Act and that their management be integrated with that of the national park*."

- Stokes Inlet

The rocky headland-beach is representative of the south coast although the headlands are low and without cliffs. Nearshore limestone reefs with deep channels run parallel to the shore. These reefs are a feature at the eastern ends of the bays, east of Hopetoun. The deep channels are likely habitat for flora and fauna. The area has potential for recreational activities such as sightseeing, fishing and diving. Stokes and Torradup Inlets have high conservation value and are representative of semi-permanently closed lagoonal and riverine estuaries. Recommendation:

"State coastal waters adjacent to the Stokes National Park, encompassing Margaret Cove, Dunster Castle Bay and Fanny Cove, and including the tidal parts of Stokes Inlet and Torradup Inlet, be considered for reservation as a marine reserve for the purposes of conservation of flora and fauna and public recreation, and managed in conjunction with the national park."

- Recherche Archipelago

Information on the flora and fauna of the Recherche Archipelago was sparse. Reservation can be justified on the basis of diverse habitats and protection for sea lions, fur seals and seabird colonies. The area also has high recreational potential for commercial dive tour industry development. Areas of the Recherche Archipelago that may be of higher conservation value were not able to be identified due to the lack of information. Therefore, reservation of the entire area with multi-use zones is warranted. Recommendation:

"t*he waters of the Recherche Archipelago between Butty Head in the west and Israelite Bay in the east, extending to the limit of the State Territorial Sea, including the areas of State Waters surrounding the outer islands but excluding the Port of Esperance, should be considered for reservation as a marine reserve for multiple purposes including conservation of flora and fauna and public recreation*."

- Twilight Cove

This section of coast represents two characteristic coastal types of the Eucla Basin shoreline – beach backed by high, mobile Pleistocene dunes and high limestone cliffs (Baxter Cliffs) with narrow, limestone rock platforms, boulder fields or narrow beaches at their base. Less is known about conservation and recreational values. Recommendation:

"a *survey of the coast between about 50 km east and west of Twilight Cove should be conducted to assess the value of the area as a marine reserve for the protection of marine flora and fauna and coastal landforms*."

The proposed areas for marine reservation are all associated with terrestrial reserves managed by the Department of Biodiversity, Conservation and Attractions (DBCA), which is of benefit to managers. Those include:

Proposed marine conservation reserve	**Associated terrestrial reserves and parks**
Cape Vancouver to Bald Island	Two Peoples Bay Nature Reserve, Waychinicup National Park, Mt Manypeaks Nature Reserve, Bald Island Nature Reserve

Fitzgerald Biosphere Reserve	Fitzgerald River National Park, Doubtful Island Nature Reserve, Glasse Island Nature Reserve, Rocky Islets Nature Reserve
Stokes Inlet	Stokes National Park
Recherche Archipelago	Woody Island Nature Reserve, Recherche Archipelago Nature Reserve, Nuytsland Nature Reserve, Cape Arid National Park, Cape Le Grand National Park
Twilight Cove	Nuytsland Nature Reserve

3.4. Scope and purpose

In response to feedback from the community and stakeholders following consultation regarding a proposed south coast marine park, an updated review of knowledge was needed for the areas recommended for reservation in the Wilson Report to better inform decisions around the location of a proposed south coast marine park.

The scope of this review includes:

- A desktop review of the areas recommended for marine reservation on the south coast between Albany and the WA-SA border (specifically **Cape Vancouver- Bald Island, Fitzgerald Biosphere Reserve, Stokes Inlet, Recherche Archipelago** and **Twilight Cove;** Fig. 9), identifying information gaps and updating what is known about the **flora and fauna, habitats** and **geomorphology** for each of those areas based on the current scientific literature (including published and grey literature).
- Confirmation of the relative importance of each of the proposed areas or additional areas at a regional level.
- Recommendations about whether the boundary for each of these areas should be amended based on the current scientific literature.
- Investigate and provide recommendations about whether additional areas on the south coast between Albany and the WA-SA border not identified in the Wilson Report should be considered for marine reservation based on the current scientific literature.
- Liaising extensively with relevant experts familiar with the biodiversity, habitats and geomorphology on the south coast between Albany and the WA/SA border.

This review mostly focuses on literature outputs since the Wilson Report in 1994, and while a summary of the values reported on in the Wilson Report is provided below, the reader is directed to the Wilson Report for a better understanding of literature prior to 1994. Of significance are the two volumes produced in 1991 from the Third International Marine Biological Workshop in 1988 which focused on the Marine Flora and Fauna of Albany, WA (Wells *et al.* 1991b; Wells *et al.* 1991a). It is acknowledged that some of the studies included in these volumes included data

from other locations along the south coast, including locations within the scope of this review (e.g., a checklist of marine decapod Crustacea of southern WA by Morgan and Jones 1991).

The spatial scope of this review includes the area of ocean extending from the shoreline to the limit of State waters (i.e., 3 nm from the Territorial Sea Baseline) (Fig. 9).

This review does not include subject areas outside of marine flora and fauna biodiversity, habitats and geomorphology, except in instances where processes are influencing biota e.g., oceanographic influences on biota. The purpose of the review was not to consider commercial fishing effort or issues as this information will be considered extensively during the marine park planning process and in the development of a zoning plan, however, ecological information such as species distribution, habitat distribution, spawning grounds, movement patterns, etc. for recreationally and commercially important species has been addressed in this review.

The information, recommendations and knowledge gaps presented in this review are based on the most current scientific literature, however, it is acknowledged that the WA south coast is relatively understudied compared to other areas.

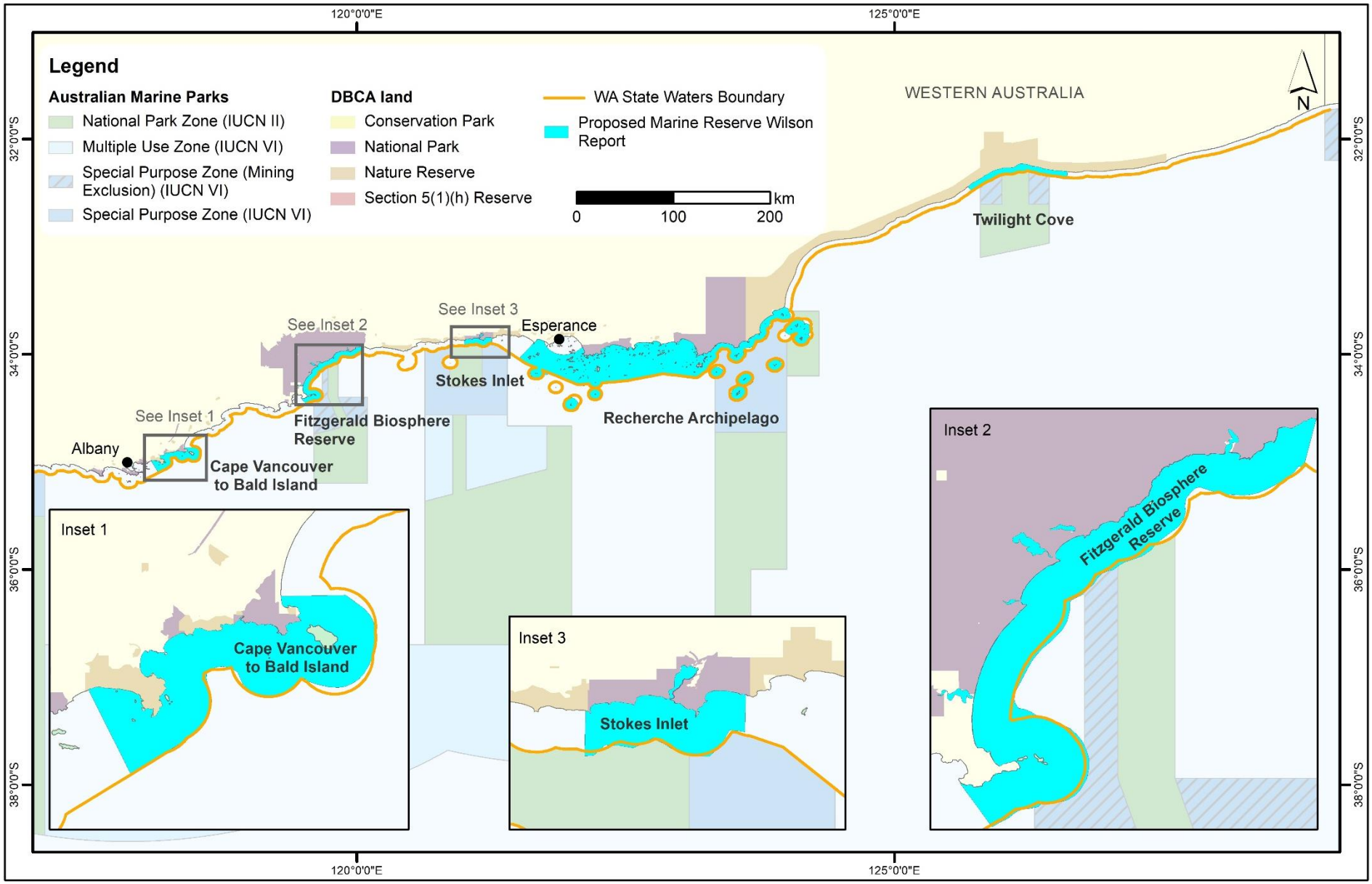

Figure 9: Five proposed areas for marine reservation included in this review (in blue): Cape Vancouver to Bald Island, Fitzgerald Biosphere Reserve, Stokes Inlet, Recherche Archipelago, Twilight Cove.

4. Methodology

The information provided in this review was obtained via two pathways: contacting relevant experts and searching the literature. Seventy-one experts were contacted, firstly by email and in some cases by telephone. They were asked to provide any published research/data (peer reviewed and grey literature) pertaining to the south coast. They were asked to provide the names and contact details of colleagues who may have knowledge of value to the review. Experts were also asked for a 30-minute meeting to discuss the proposed areas, any additional areas that should also be considered and to gather other helpful information that could be relevant (Appendix 1).

A thorough search of the literature was undertaken in order to build upon the information received from key researchers. A combination of search terms was used in library databases and online search engines relating to a location and ecological value, e.g., seagrass AND south coast, seagrass AND Esperance, macroalgae AND Recherche etc. Following this, more general searches were conducted using solely the location names, including but not limited to 'Fitzgerald', 'Stokes Inlet' and 'Recherche Archipelago', in order to identify any ambiguous literature or literature that did not fit within the pre-defined headings.

5. Updated knowledge on areas for reservation since the Wilson Report

5.1. Cape Vancouver to Bald Island

5.1.1. Wilson Report overview

The Wilson Report describes the granite headlands, curved beaches and Pleistocene dunes along the stretch of coast around Cape Vancouver to Bald Island, and identifies a combination of gradually sloping sea floors and steep drop offs. Extensive seagrass beds of *Posidonia* and *Amphibolis* were known to occur off Two Peoples Bay. Dense beds of *P. australis* could be found in Waychinicup Inlet. The intertidal rocky shores of South Point were described in most detail, including the abundance of Roe's abalone (*Haliotis roei*) and the endemic relict gastropod, *Campanile symbolicum.* Cheynes Beach was noted as having similarities in flora and fauna to South Point. Open ocean shores along this stretch of south coast were noted as having dense beds of macroalgae and diverse communities of sedentary suspension feeders (sponges, ascidians and coelenterates). Australian sea lions and long-nosed fur seals were using exposed

rocks and islands as haul out areas and breeding colonies, in particular, Coffin Island and Bald Island. Little penguins (*Eudyptula minor*) were also using Bald Island as a breeding area.

5.1.2. Geomorphology

A nationally consistent geomorphic classification of the coastline between Cape Vancouver and Bald Islands identified mostly sloping rocky bottoms with some stretches of mixed sandy bottom within embayments (Griffin *et al.* 2012).

The seabed of the inshore environment surrounding Cape Vancouver was mapped using multibeam and ground truthing (Fig. 10) (Meeuwig and Radford 2008). A combination of sand, mixed gravel and sand, reef, mixed reef and gravel, and mixed reef and sand was identified.

5.1.3. Marine benthic habitats

Two Peoples Bay (and nearby King George Sound) have extensive perennial seagrass meadows which were suggested for listing, along with five other south coast WA locations, on the superseded Australian Heritage Commission's Register of the National Estate after the undertakings of the Southern Western Australian Seagrass Study (SWASS 1996).

The marine benthic habitats of the inshore environment surrounding Cape Vancouver were mapped using multibeam and ground truthing (Fig. 10) (Meeuwig and Radford 2008). Sessile invertebrate communities were found over much of the area, sometimes interspersed with kelp beds and other algae. Patches of kelp and mixed vegetation were found closer to the shore and around islands. Extending from Two Peoples Bay out east, continuous beds of algae were found.

The eastern boundary of the Cape Vancouver to Bald Island recommended area for reservation just crosses into Cheynes Beach, which has dense seagrass meadows lining the coast (Fig. 11)(Colman 1998).

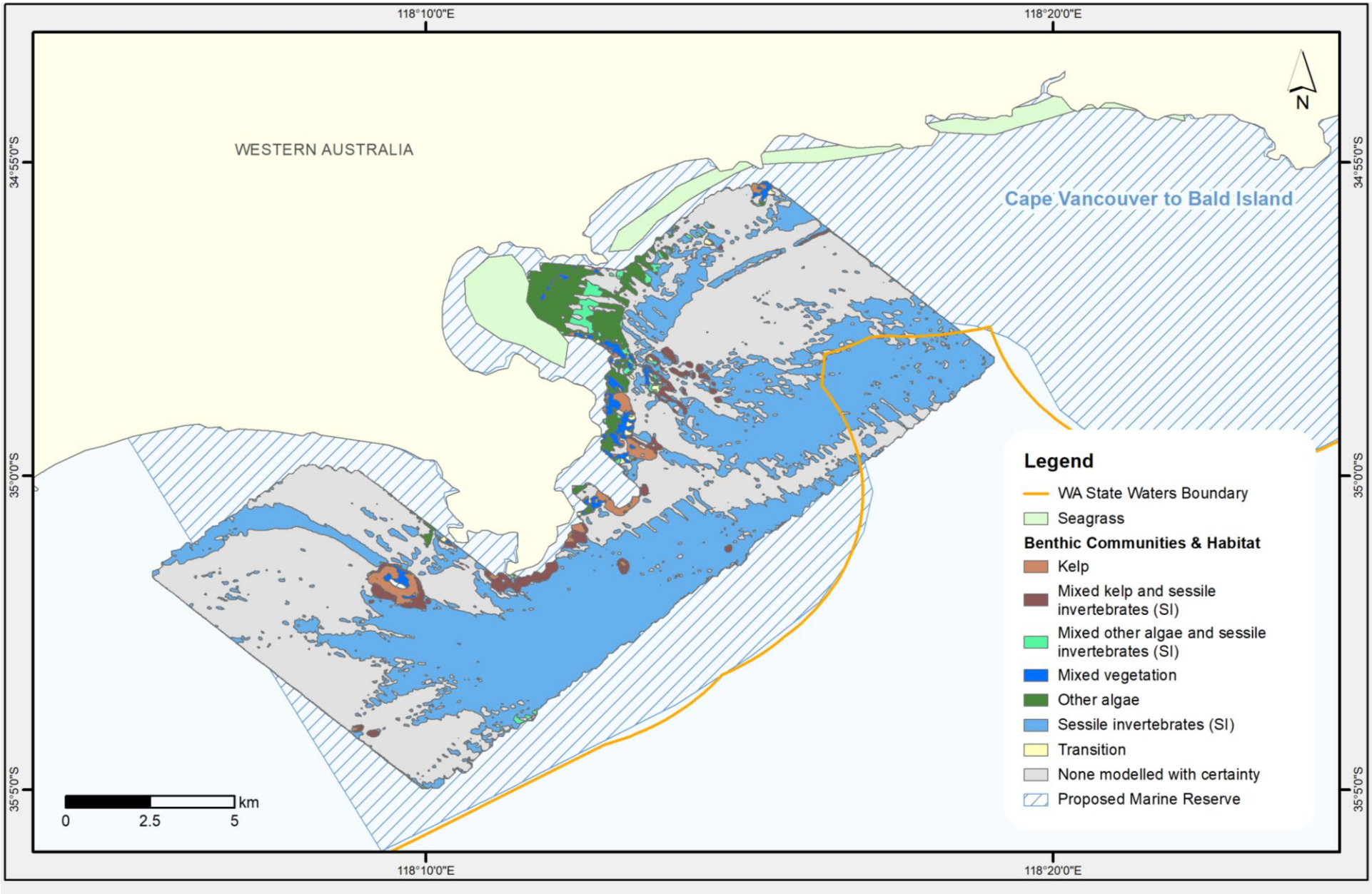

Figure 10: Benthic habitats around Cape Vancouver as shown in (Meeuwig and Radford 2008). Data accessed at http://metadata.imas.utas.edu.au/geonetwork/srv/en/metadata.show?Uuid=c2d5d9d4-7288-4137-a275-9f0662ac5ceb on 15 March 2021.

5.1.4. Marine flora

Based on the benthic habitat mapping by Meeuwig and Radford (2008), several species of algae can be found around Cape Vancouver, including kelp (Laminariales).

At least three species of seagrass are found in Two Peoples Bay, *P. australis*, *P. sinuosa* and *Halophila ovalis*. Seed predation by crustacean species was explored for seeds of *P. australis* (Orth *et al.* 2007).

5.1.5. Marine fauna

A full list of species protected under the Environment Protection and Biodiversity Conservation (EPBC) Act 1999 is given in Appendix 2 and was determined from the Protected Matters Search Tool using the proposed area for marine reservation as the boundary with a 2 km buffer inclusion.

5.1.5.1. Zooplankton

High concentrations of Australian sardine eggs (*Sardinops sagax*) around the Albany region were found to distribute eastward with the Leeuwin Current towards Bremer Bay during the winter months when the current was strongest (Fletcher *et al.* 1994). This was not evident during the summer months when the current was weak.

5.1.5.2. Invertebrates

Scallops occur in sandy habitats along the south coast of WA and tend to occur in pockets of high abundance in more sheltered environments found in the lee of islands, headlands and reef systems (pers. comm. Department of Primary Industries and Regional Development; DPIRD). Given the spatial and temporal variability in their abundance, commercial trawling for scallops does not occur every year. Fishers tend to visit traditional areas of high scallop abundance and perform a test trawl with smaller nets to determine whether the abundance is high enough to expend further fishing effort. The areas with traditionally high abundance of scallops along the south coast between Cape Vancouver and the WA/SA border include Cheynes Beach, Bremer Bay (Doubtful Island), Recherche Archipelago and Israelite Bay (Chandrapavan *et al.* 2020).

Abalone (Roe's, Greenlip and Brownlip) are distributed along the south coast and throughout the five proposed areas for marine reservation in the Wilson Report (including Twilight Cove) (Hart *et al.* 2017). Abalone are typically found in shallow water (1-20 m), and feed predominantly on

red algae that has been dislodged and trapped within reef complexes (Shepherd and Steinberg 1992). Epiphytic red algae growing on seagrass leaves, and subsequently dislodged from oceanic swells, is also an important source of food (Hart *et al.* 2017). Further west around Augusta, Greenlip abalone abundance was positively correlated with purple urchin density and available habitat (Hart *et al.* 2013), which may provide some insight into potential habitat and species patterns along the rest of the south coast of WA.

The octopus, *Octopus* aff. *tetricus* (species name currently under review), occurs along the south coast of WA, and while it is commercially fished within state waters, this is not to the same extent as the west coast of Australia (pers. comm. DPIRD). Given the wide distribution of this octopus species within WA, it is unlikely there are areas of specific ecological importance within coastal waters between Cape Vancouver to the WA/SA border.

Southern rock lobster (*Jasus edwardsii*) occur along the south coast of WA but there are no known specific areas of particular ecological importance between Cape Vancouver and the WA/SA border (pers. comm. DPIRD).

5.1.5.3. Bony fishes

A change in fish assemblages occurs between Albany (reef and sandy associated fish assemblages), Doubtful Bay (macroalgae-associated assemblage) and eastern Recherche Archipelago (sand-associated assemblage) (Galaiduk *et al.* 2017). Modelling identified the presence of macroalgae as the primary environmental driver explaining differences in fish assemblages between the Abrolhos Islands and Esperance, followed by distance along shore, which was a proxy for the sea surface temperature gradients along the coast.

Many labrid species from the cool temperate waters of the Albany region, Bremer Bay and Esperance/Recherche were generally found to increase in abundance following a gradual warming between the sampling years of 2006 and 2015 (Parker *et al.* 2019). The Braun's wrasse (*P. brauni*) is only known from six specimens collected at Cheyne's Beach (Hutchins and Morrison 1996), and survey efforts across the years to learn more about this species have been hindered by its rarity.

Fish assemblages sampled using seine nets in the surf zone between Geraldton and Esperance found that the south coast had a lower number of species overall (29) than the west coast (94) (Ayvazian and Hyndes 1995). Assemblages from Cheynes Beach (possibly out of boundary scope) and Bremer Bay were grouped together based on similarities in fish assemblages, and out of the

15 species from this grouping, *Leptatherina presbyteroides*, *Spratelloides robustus* and *Allanetta mugiloides* had the highest densities. A seahorse, *Hippocampus sp.,* was recorded from this grouping, and was the only species (out of 29 species recorded from the south coast) not found in the surf zone on the west coast of Australia. DPIRD have continued beach seine surveys for 20+ years along the south coast at a subset of locations since the study by Ayvazian and Hyndes (1995), and findings are compiled in an unpublished database. Open-access beach seine commercial catches along the south coast of WA were dominated by Australian herring (90%) and southern sea garfish (7%) between 2000 and 2013 (Department of Fisheries 2015).

Many nearshore fish species, including herring, salmon and whiting, have quite wide ranges and migrate along the whole south coast region (pers. comm. DPIRD). Species such as King George whiting, yellowfin whiting, tarwhine, herring and salmon use protected nearshore waters as nursery areas (pers. comm. DPIRD), but there are no known specific areas of particular ecological importance for nearshore fish species within the coastal waters between Cape Vancouver to the WA/SA border. The south coast is an exposed coastline with limited protected nearshore habitats/embayments, which means the relative importance of estuaries/inlets to nearshore fishes is greater along the south coast compared to the west coast of WA (Ayvazian and Hyndes 1995). For example, the vast majority of fishes caught in Walpole-Nornalup Inlets are marine spawning fishes (Yeoh 2018).

Acoustically tagged juvenile southern bluefin tuna are found to seasonally use the inshore waters and coastal lumps of the south coast for foraging (at least between Albany and Hopetoun), though this behaviour changes interannually depending on the Leeuwin Current (Fujioka *et al.* 2010b; Fujioka *et al.* 2012). Tuna were found to avoid the warmer waters of the Leeuwin Current by moving eastwards in years when the current had a stronger flow and wider spread across the shelf. There is evidence to suggest that when productivity in the offshore continental slope waters is low, tuna use the coastal areas where prey is in abundance (Fujioka *et al.* 2010b).

Australian sardines are distributed along the south coast but there are no known locations within the scope area that are of particular ecological importance (pers. comm. DPIRD). Australian sardines come and go out of embayments and are fished predominantly in King George Sound, Bremer Bay and Esperance. Higher abundances of Pacific sardine eggs were found in shelf waters around the Albany, Bremer Bay and Esperance regions from plankton surveys during the 90s (compared to areas in between these locations)(Gaughan *et al.* 2002; Gaughan *et al.* 2004). The proportion of stations with eggs was found to decrease after the mid-90s, particularly so following the mass mortality event that occurred in 1998/99 (Gaughan *et al.* 2004). The mortality event was possibly due to herpesvirus, and a mortality of over 17,000 tonnes was estimated for Esperance, 11,000 t for Bremer Bay, and 144 t at Albany (Gaughan 2000).

Demersal scalefish species are distributed along the south coast but there are no known locations within the scope area that are of particular ecological importance e.g., no spawning, nursery, or exclusive habitat identified within the scope (pers. comm. DPIRD). Western blue groper (*A. gouldii*) collected from the Albany, Bremer Bay, Hopetoun and Esperance regions were found to be very long lived (~70yrs), late to mature (653 mm *c.* 17 yrs.), late to change sex from female to male (821 mm c. 35 years) and had highly variably recruitment (Coulson *et al.* 2009). The spawning period along the south coast was found to be between early June to late October, which occurs in deeper offshore waters. Similar analyses across the south coast and south-west coast of WA were undertaken for the blue morwong (*Nemadactylus valenciennesi*), which was found to have a maximum age of 21 years and maximum total length of almost one metre (984 mm) (Coulson *et al.* 2010). Only immature blue morwong specimens were found in nearshore waters (<20 m), whereas mature specimens were found in offshore waters. It was suggested that spawning occurs (around mid-summer to early winter) on the lower west coast of WA, which also appears to have more favourable environmental conditions for gonadal development. Larvae are then transported around to the south coast, facilitated by the Leeuwin Current. Bight redfish (*Centroberyx gerrardi*), blue morwong and snapper (*Chrysophrys auratus*) mature at a larger size and greater age along the south coast compared to individuals in waters off the south-west corner of WA (pers. comm. DPIRD)(e.g. Wakefield *et al.* 2015). In addition, the level of spawning of these species is reduced along the south coast and fishers are thus typically catching immature fish.

5.1.5.4. Elasmobranchs

White sharks (*C. carcharias*) are known to frequent the coastal waters along the south coast, including around Bald Island and Two Peoples Bay, as evidenced by acoustic detections (McAuley *et al.* 2017). The area is identified as a Biologically Important Area for white sharks and, in particular, for foraging (DSEWPaC 2011). White sharks have been caught by commercial fishers around the area (Malcolm *et al.* 2001).

The south coast of WA forms part of the distribution of gummy (*Mustelus antarcticus)*, dusky (*Carcharhinus obscurus)*, whiskery (*Furgaleus macki)* and sandbar (*C. plumbeus)* sharks (Braccini *et al.* 2017; Braccini *et al.* 2018). Gummy sharks (likely endemic to southern Australia) are mainly occurring in nearshore waters and depth less than 80 m (Last and Stevens 2009), and pupping is thought to take place in these inshore waters at scattered locations along its temperate distribution (Stevens and West 1997). Dusky sharks are found from the surf zone out to ~400 m depth (Last and Stevens 2009), and pupping occurs in discrete coastal nurseries. These nurseries

have been found between Geraldton and Bremer Bay, with highest abundances of pups found between Lancelin and Albany (Simpfendorfer *et al.* 1996 ; Simpfendorfer *et al.* 1999).

5.1.5.5. Pinnipeds

Coffin Island and Bald Island are identified as important breeding and haul out islands for Australian sea lions and long-nosed fur seals (Shaughnessy *et al.* 1994; Colman 1998). The waters around Bald Island are identified as a Biologically Important Area for foraging by male Australian sea lions (DSEWPaC 2011).

5.1.5.6. Cetaceans

Annual aerial surveys along the south coast waters of WA since 1976 have identified a number of locations used by unaccompanied and mother/calf pairs of southern right whales during the winter months. Southern right whales have been known to occur in Two Peoples Bay, but it is not currently a Commonwealth recognised established aggregation area (Colman 1998; DSEWPC 2012). Southern right whales use the coastal waters along the south coast for calving and resting, and mothers have high site fidelity for calving. The whole south coast between Geographe Bay and Eucla Shelf is designated as an IUCN Important Marine Mammal Area (IUCN MMPATF 2021).

5.1.5.7. Seabirds and shorebirds

The proposed are is a Biologically Important Area for foraging and/or breeding by the bridled tern (*Onychoprion anaethetus*), Caspian tern (*Hydroprogne caspia*), fairy tern (*Sternula nereis*), flesh-footed shearwater (*Ardenna carneipes*), little penguin (*E. minor*), little shearwater (*Puffinus assimilis*) and Pacific gull (*Larus pacificus*) (DSEWPaC 2011).

Little penguins have been recorded on Bald and Coffin Islands. However estimates of numbers were not determined when observed in the 1970s (CALM 1994; Cannell 2001).

Two Peoples Bay and Mount Manypeaks is important for resident waterbirds and south-west endemic birds and is a designated Key Biodiversity Area (KBA) (previously termed Important Bird Area) (Dutson *et al.* 2009; Maurer 2020). Australia has 315 Key Biodiversity Areas, over 170 of which include migratory shorebirds as the trigger species for the designation of the Key Biodiversity Area.

5.1.6. Recommendations for proposed boundary adjustments

We recommend consideration is given to adjusting the boundary of Cape Vancouver to Bald Island eastwards to Haul Off Rock (118°40'E) (Fig. 11) for the following reasons:

- A Commonwealth recognised emerging aggregation area has been identified at Cheynes/Hassell Beach for southern right whales (DSEWPC 2012; Bannister 2016; Bannister 2018; Smith *et al.* 2020). Southern right whales use the coastal waters along the south coast for calving and resting and the whole south coast between Geographe Bay and Eucla Shelf is designated as an IUCN Important Marine Mammal Area (IUCN MMPATF 2021). Southern right whales are expected to increase their use of the coastal waters along the south coast as their population numbers increase.
- Cheynes/Hassell Beach has extensive perennial seagrass meadows. This beach, along with five other south coast WA locations, were suggested for listing on the superseded Australian Heritage Commission's Register of the National Estate after the undertakings of the Southern Western Australian Seagrass Study (SWASS 1996; Colman 1998). Seagrass meadows play an important role in carbon sequestration and should be a major consideration when considering the role of 'blue carbon' under a changing climate.
- Haul Off Rock is a long-nosed fur seal and Australian sea lion breeding site (Colman 1998) and is the western limit of breeding for Australian sea lions along the south coast of WA. Haul Off Rock is also one of only a few islands where both Australian sea lions and long-nosed fur seals can both be found breeding.
- Juvenile southern blue fin tuna use the inshore coastal waters between Albany and Bremer Bay seasonally (Dec-April) finding prey when productivity over the continental slope is low (Fujioka *et al.* 2010b). Providing protection of the cooler inshore waters (more evident when the Leeuwin Current is strong) could aid as a refuge for prey species and other marine life as ocean warming causes distribution shifts.
- The rare endemic labrid, Braun's wrasse is currently only known from Cheynes Beach (IUCN Red list status: Data deficient), which extends to outside of the proposed area.
- The extended boundaries would encompass bays and rocky headlands with different exposure angles to high energy wave action, which would act to represent a greater diversity of habitat types and communities.

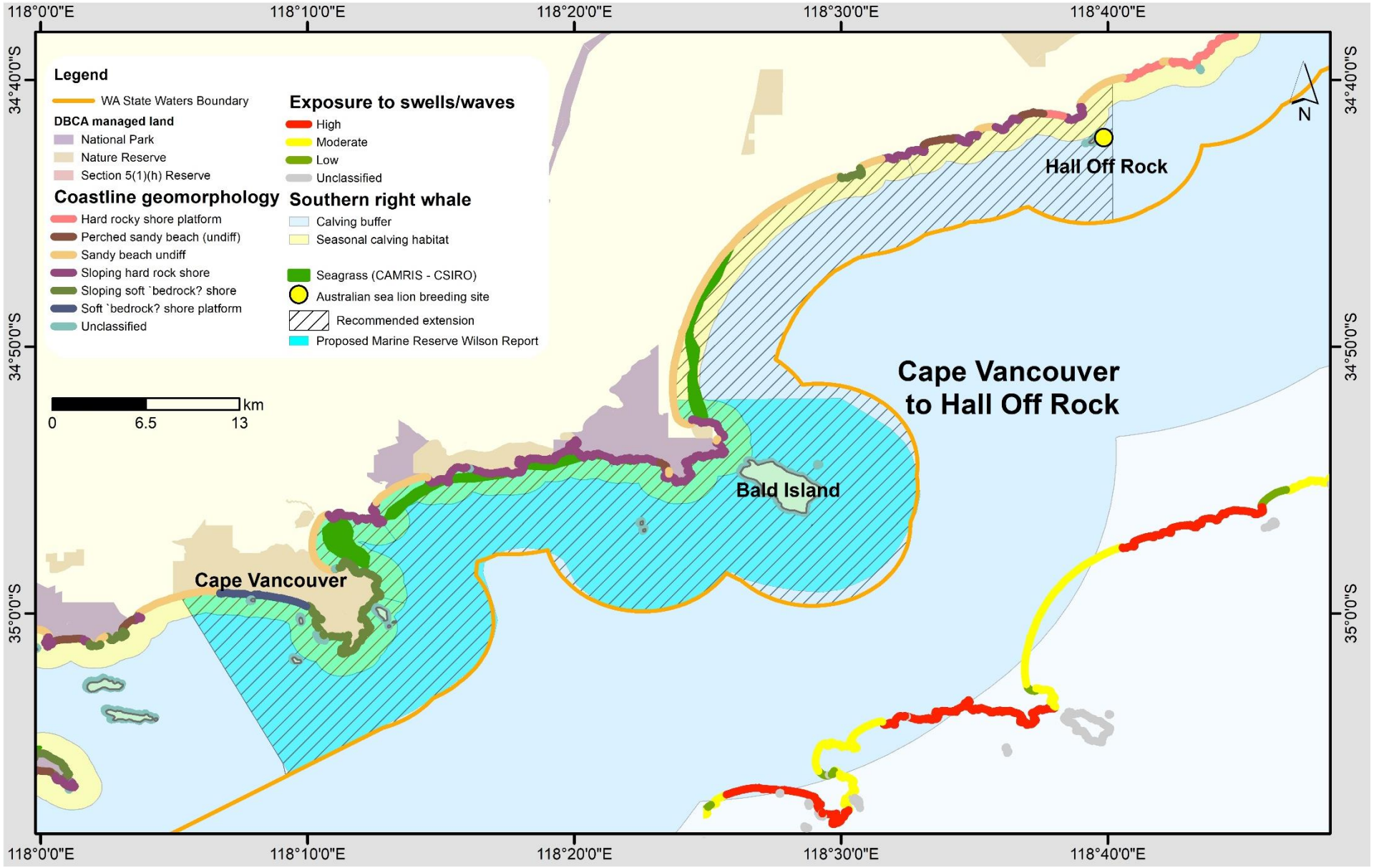

Figure 11: Recommended extension of the Cape Vancouver to Bald Island boundary proposed in the Wilson Report. Coastal geomorphology and exposure data sourced from SeaMap Australia (Griffin *et al.* 2012), southern right whale and Australian sea lion data sourced from the Australian Government National Conservation Values Atlas Map (DSEWPaC 2011), seagrass data sourced from CSIRO Data Access Portal (CSIRO 2015).

5.2. Fitzgerald Biosphere Reserve

5.2.1. Wilson Report overview

The Wilson Report provides a good overview of the geomorphic features of Fitzgerald Biosphere Reserve. The Mount Barren Ranges and rolling hills are characteristic features of the Fitzgerald River National Park. The Mount Barren Range occupies the coast at the eastern end of the national park with rocky shores and cliffs. Prominent headlands exist at Point Charles and Point Ann. Hills are formed of metasediments of the Mount Barren Group (Albany-Frazer Oregon) with Eocene sediments filling the low parts of the landscape. Wide and arcuate beaches backed by Pleistocene dunes sit between the headlands. South of Point Hood and Doubtful Islands, the sea floor slopes steeply to 50 m within 1 km of the shore in contrast to Doubtful Islands Bay where the slope is gentle to 50 m, 10-15 km offshore. Between Point Hood and Hopetoun there are a series of inlets that were classified by Wilson 1994 as semi-permanently open for the purpose of the report. Little information existed on the marine flora and fauna. Metasedimentary rocks of the Mount Barren Group form a rocky shoreline that contrasts with the granite shores typical of the south coast but there had been no flora and fauna surveys to map the species present. Aerial photographs were used to inspect the waters beyond the surf zone and revealed extensive seagrass beds in Doubtful Island Bay but there was no information on species or associated fauna. Southern right whales frequent Doubtful Island Bay and around Point Ann. Australian sea lions and long-nosed fur seals have breeding colonies at Doubtful Islands.

5.2.2. Geomorphology

A nationally consistent geomorphic classification of the coastline of Fitzgerald Biosphere Reserve area identified a combination of mixed sandy bottom and sloping rocky bottoms (Griffin *et al.* 2012).

5.2.3. Marine benthic habitats

The marine benthic habitats of the Fitzgerald Biosphere Reserve area include macroalgae dominated limestone and granite reefs interspersed with sand patches, boulders and bommies to the north-east of Red Islet (Bancroft and Davidson 2000) and medium to dense seagrass to the south-west of Red Islet to Doubtful Islands (Colman 1998). Sandy habitats were not surveyed for biodiversity.

5.2.4. Marine flora

5.2.4.1. Algae

A 1997 marine biological survey of the inshore waters between Groper Bluff and Starvation Boat Harbour, inclusive of the proposed Fitzgerald Biosphere Reserve, found 57 species of brown algae (Phaeophtya), 10 species of green algae (Chlorophyta) and 76 species of red algae (Rhodophyta) (Colman 1998). A follow up survey in 1998 between Red Islet to Starvation Boat Harbour identified 365 species of macroalgae. Over 60% of species were red algae, followed by ~30% brown algae and 10% green algae. The macroalgae covered reefs of Fitzgerald Biosphere Reserve area are dominated by *Ecklonia radiata, Platythalia quercifolia* and *Cystophora* spp., *Scytothalia dorycarpa* and *Sargassum* spp. (Bancroft and Davidson 2000).

There is a shift in composition from dominant canopy forming species to mixed species canopies from the lower west coast to the south coast (Wernberg *et al.* 2003; Goldberg and Kendrick 2005). The algal assemblages associated with *E. radiata* kelp beds at Fitzgerald Biosphere Reserve area were compared to those at Hamelin Bay and Marmion Lagoon to investigate the influence of processes at different spatial scale on the organisation of assemblages (Wernberg *et al.* 2003). A total of 152 macroalgal taxa were identified, 49 of which were unique to the Fitzgerald Biosphere Reserve area. From Marmion Lagoon to Fitzgerald area, the dominance of *E. radiata* decreased and a Fucalean canopy (*Sargassum* spp.*, Cystophora* sp.*, S. doryocarpa*) increased, along with species richness. Small scale processes appeared to be just as important at structuring assemblages as larger geographical scale processes.

5.2.4.2. Seagrass

A 1997 marine biological survey of the inshore waters between Groper Bluff and Starvation Boat Harbour, inclusive of the proposed Fitzgerald Biosphere Reserve area, identified nine species of seagrass: *A. antarctica, A. griffithii, H. australis, Heterozostera tasmanica, P. australis, P. denhartogi, P. kirkmanii, P. robertsoniae* and *P. sinuosa* (Colman 1998). A follow up survey in 1998, between Red Islet to Starvation Boat Harbour, found *A. antarctica, A. griffithii, H. australis, H. tasmanica, P. australis, P. sinuosa* and *Zostera capricorni* (Bancroft and Davidson 2000).

Doubtful Islands Bay through to Red Islet has extensive perennial meadows and were suggested for listing, along with five other south coast WA locations, on the superseded Australian Heritage Commission's Register of the National Estate after the undertakings of the Southern Western Australian Seagrass Study (SWASS 1996).

5.2.5. Marine fauna

A full list of species protected under the EPBC Act 1999 is given in Appendix 3 and was determined from the Protected Matters Search Tool using the proposed area for marine reservation as the boundary with a 2 km buffer inclusion.

5.2.5.1. Sponges

Forty species of Porifera were identified during a 1997 marine biological survey of the inshore waters between Groper Bluff and Starvation Boat Harbour, inclusive of the proposed Fitzgerald Biosphere Reserve area (Colman 1998).

5.2.5.2. Invertebrates

A 1997 marine biological survey of the inshore waters between Groper Bluff and Starvation Boat Harbour, inclusive of the proposed Fitzgerald Biosphere Reserve area, found 39 species of echinoderms, 34 species of molluscs, eight species of cnidarians (including *Turbinaria* spp.) and 32 species of arthropods (Colman 1998). A qualitative description of the benthic habitat around Cave Point describes a large overhang that has sponges, ascidians, bryozoans, gorgonians and other soft corals (Bancroft and Davidson 2000).

See section 5.1.5.2 (Invertebrates – Cape Vancouver to Bald Island) for information relevant to the Fitzgerald Biosphere Reserve area on invertebrate species important for commercial and recreational fishing.

5.2.5.3. Bony fishes

Ninety seven species of fishes were identified during a 1997 marine biological survey of the inshore waters between Groper Bluff and Starvation Boat Harbour, inclusive of the proposed Fitzgerald Biosphere Reserve area (Colman 1998). Four habitat types were surveyed for fishes, limestone reefs, schist/quartzite reefs, granite reefs and seagrass meadows. Sampling was more biased toward the latter two habitats. Western blue groper and blue morwong were noted in abundance, particularly around granite reefs. The survey also noted the presence of the rarely recorded endemic large-tail or smooth cardinalfish (*Vincentia macrocauda*). The species present were typical of warm temperate waters. A total of 88 species of fish were recorded in a follow up survey in 1998 between Red Islet to Starvation Boat Harbour (Bancroft and Davidson 2000).

A similarity analysis of fish assemblages sampled using seine nets in the surf zone between Geraldton and Esperance grouped assemblages from Fitzgerald Biosphere region and Peaceful Bay (further west) together (Ayvazian and Hyndes 1995). Out of 16 species from this grouping, *L. presbyteroides* had the highest densities.

See section 5.1.5.3 (Bony fishes – Cape Vancouver to Bald Island) for information relevant to the Fitzgerald Biosphere Reserve area on fish assemblage associations with habitat (Galaiduk *et al.* 2017), the use of the inshore waters by juvenile southern bluefin tuna (Fujioka *et al.* 2010b; Fujioka *et al.* 2012), and species important for commercial and recreational fishing.

5.2.5.4. Elasmobranchs

Grey nurse sharks (*Carcharias taurus*) have been commonly sighted and anecdotally reported between Fosters Beach and Cape Knob (Colman 1998).

White sharks tagged off Doubtful Island (and Neptune Island group) showed sex-based differences in movement and distribution. Males tended to make more use of coastal and gulf environments. Females make more use of offshore waters. These findings show white sharks using offshore habitats along the south coast more so than previously thought (Bradford *et al.* 2020). The Fitzgerald Biosphere Reserve area is identified as a Biologically Important Area for white sharks and, in particular, for foraging (DSEWPaC 2011).

See section 5.1.5.4 (Elasmobranchs – Cape Vancouver to Bald Island) for information relevant to the Fitzgerald Biosphere Reserve area on demersal shark species.

5.2.5.5. Pinnipeds

The Fitzgerald Biosphere Reserve area is an identified Biologically Important Area for foraging (female and male) and breeding Australian sea lions (DSEWPaC 2011).

Six scat samples of Australian sea lions collected from the proposed area were analysed for diet using metabarcoding. Ray-finned fishes, cephalopods and Chondrichthyes were detected (Berry *et al.* 2017).

Australian sea lions (two females and two pups) tagged at Red Islet were detected in waters less than 50 m. They travelled ~20 km to congregate around Point Ann and Point Charles, which were thought to be foraging areas (Campbell 2008). Breeding sites have been identified at Doubtful Islands and Red Islet (Campbell 2003; Campbell 2008; Hesp *et al.* 2012; Goldsworthy *et al.* 2014).

During the 1997 biological survey by Colman (1998), a haul out location on the mainland, eastern side of Cape Knob, was verified for the long-nosed fur seal. The presence of adults and pups adds evidence for this location being a potential breeding area; the first breeding site on mainland WA (as opposed to islands). Two male subantarctic fur seals (*Arctocephalus tropicalis*) were also observed during the 1997 survey.

5.2.5.6. Cetaceans

The coastal waters of the proposed area are included within the Geographe Bay to Eucla Important Marine Mammal Area (IUCN MMPATF 2021) and are also identified as a Biologically Important Area for calving (DSEWPaC 2011). Doubtful Island Bay is a Commonwealth recognised established large aggregation area for southern right whales and is believed to be one of the most important areas along the south coast (Colman 1998; DSEWPC 2012; Bannister 2016; Bannister 2018; Smith *et al.* 2020). Point Charles Bay, between Point Ann and Point Charles, is also regularly used by whales (Bannister 2001). The vocalisations of southern right whales have been described off Point Ann, including the previously undescribed "spot call" (Ward *et al.* 2017; Ward 2020).

5.2.5.7. Seabirds and shorebirds

The proposed area is a Biologically Important Area for foraging and/or breeding by the bridled tern, Caspian tern, fairy tern, flesh-footed shearwater, little penguin, little shearwater and Pacific gull (DSEWPaC 2011).

Culham Inlet (listed on the Directory of Important Wetlands - WA024) and Gordon Inlet both meet the 'species criteria' for nationally significant areas for sanderling (*Calidris alba*), based on a max count of 30 individuals in 2013 and 200 individuals in 2011, respectively (0.1% threshold) (Weller *et al*. 2020).

Red Islet is known to support a colony of little penguins and a small population of the Recherche Cape Barren goose (*Cereopsis novaehollandiae grisea*), which is a threatened species under the EPBC Act (Halse *et al.* 1995; Colman 1998). Little penguins have also been recorded on Doubtful Islands (Cannell 2001).

5.2.6. Recommendations for proposed boundary adjustments

We recommend consideration is given to adjusting the boundary of the Fitzgerald Biosphere Reserve area west to Groper Bluff (118°53'E) and east to West Island (120°35'E) (Fig. 12) for the following reasons:

- Extending the boundary west to Groper Bluff will cover extensive sandy habitats, seagrass meadows, schist/quartzite reef and limestone and granite high and low profile reefs, including intertidal reefs (Colman 1998).
- The extended boundaries would encompass bays and rocky headlands with different exposure angles to high energy wave action, which would represent a greater diversity of habitat types and communities.
- Bremer Bay has extensive perennial seagrass meadows and was suggested for listing, along with five other south coast WA locations, on the now superseded Australian Heritage Commission's Register of the National Estate after the undertakings of the Southern Western Australian Seagrass Study (SWASS 1996).
- Glasse Island in Bremer Bay in an important island for Australian sea lions (Colman 1998; Wellard pers. comm.), and West Island is identified as an important breeding/haul out location (Colman 1998).
- Wray Bay, Dillon Bay and Bremer Bay are areas recognised by the Commonwealth as emerging aggregation sites for southern right whales (DSEWPC 2012).
- Of the seven coral species occurring along the south coast, *Turbinaria reniformis* is the dominant species at Bremer Bay. It is likely that the species has altered its thermal tolerance range to exist in Bremer and is also at its most temperate boundary (Veron and Marsh 1988; Ross 2018; Ross *et al.* 2018).
- Tissues collected from leafy seadragon (*P. eques*) specimens identified a genetic barrier between Bremer Bay and Hopetoun (Stiller *et al.* 2017; Stiller *et al.* 2020).
- Common seadragons (*Phyllopteryx taeniolatus*) are also known to occur in Bremer Bay (Wilson *et al.* 2016).
- Surveys of shorebirds in Bremer Bay in February 2013 found 506 individuals representing 12 species, including seven residents and five migratory species (Taylor 2013).
- Surveys of shorebirds at Hopetoun in February 2013 found 1299 individuals representing 17 species, including nine residents and nine migratory species (Taylor 2013).
- Juvenile southern blue fin tuna seasonally (Dec-April) use the inshore coastal waters between Albany and Bremer Bay (Fujioka *et al.* 2010b) for finding prey when productivity over the continental slope is low. Providing protection of the cooler inshore waters (more evident when the Leeuwin Current is strong) could aid as a refuge for prey species and other marine life as ocean warming causes distribution shifts.
- Sponges collected from the *Haliclona* genus from 10-15 m at Bremer Bay (and elsewhere in south-west WA) were found to support a unique endofauna assemblage (Abdo 2007). These sponges are exploited for pharmaceutical purposes, and further pressures on these sponges, may contribute to reducing endofaunal diversity and sponge garden habitat.

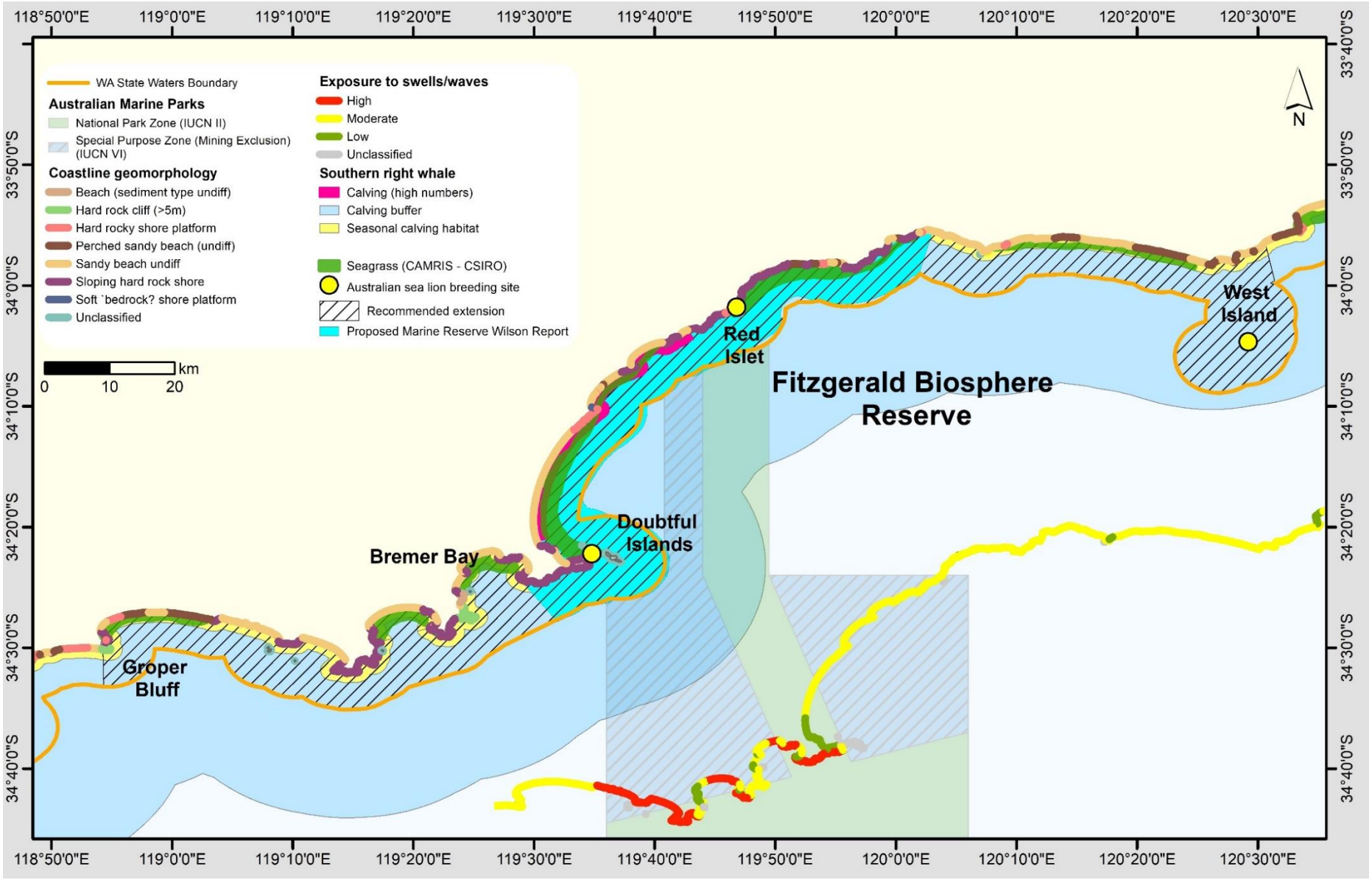

Figure 12: Recommended extension of the Fitzgerald Biosphere Reserve boundary proposed in the Wilson Report. Coastal geomorphology and exposure data sourced from SeaMap Australia (Griffin *et al.* 2012), southern right whale and Australian sea lion data sourced from the Australian Government National Conservation Values Atlas Map (DSEWPaC 2011), seagrass data sourced from CSIRO Data Access Portal (CSIRO 2015).

5.3. Stokes Inlet

5.3.1. Wilson Report overview

The Wilson Report describes the granitic rock headlands broken by arcuate beaches that are backed by Quaternary dunes. Shoal Cape at the western end of Fanny Cove is exposed to high wave energy whilst Fanny Cove is moderately protected. West of Shoal Cape is limestone and beach which is protected by three parallel, near shore limestone reefs, two inner reefs break the surface whilst the outer reef is several meters deep. Between the reefs there are deep channels the deepest of which is ~25 m. The inner reefs are deeply undercut and cavernous. There are also slopes of limestone slabs. Little information was available describing the flora and fauna of Stokes Inlet, but aerial photographs suggest the presence of seagrass beds and anecdotal evidence suggests that the deep channels between the limestone reefs support diverse fish and invertebrate faunas.

5.3.2. Geomorphology

A nationally consistent geomorphic classification of the coastline of Stokes Inlet identified a mostly mixed sandy bottom, interspersed with sloping rocky bottoms around headlands, sandy lagoons and small patches of rocky platform (Griffin *et al.* 2012). The stretch of coastline is typical of the exposed south coast with a combination of arcuate beaches backed by Quaternary dunes and granite rocky headlands, though headlands are relatively low lying compared to other locations along the south coast (Hodgkin and Clark 1989; Colman 1998). Three parallel limestone reefs occur across a 1 km stretch to the west of Shoal Cape. The reefs are separated by deep channels and offer protection to the shoreline. These parallel reefs line the coast between Hopetoun and Esperance (CALM 1994). Limestone shores are also a common feature along this stretch of coastline, forming intertidal rocky platforms when exposed.

5.3.3. Marine benthic habitats

The inshore (< 1 km from shore) benthic habitats found within the Stokes Inlet recommended area include seagrass meadows of varying densities, low profile reef and heavy limestone reef with or without macroalgae and bare sand (Fig. 13)(Colman 1998; DPaW 2006).

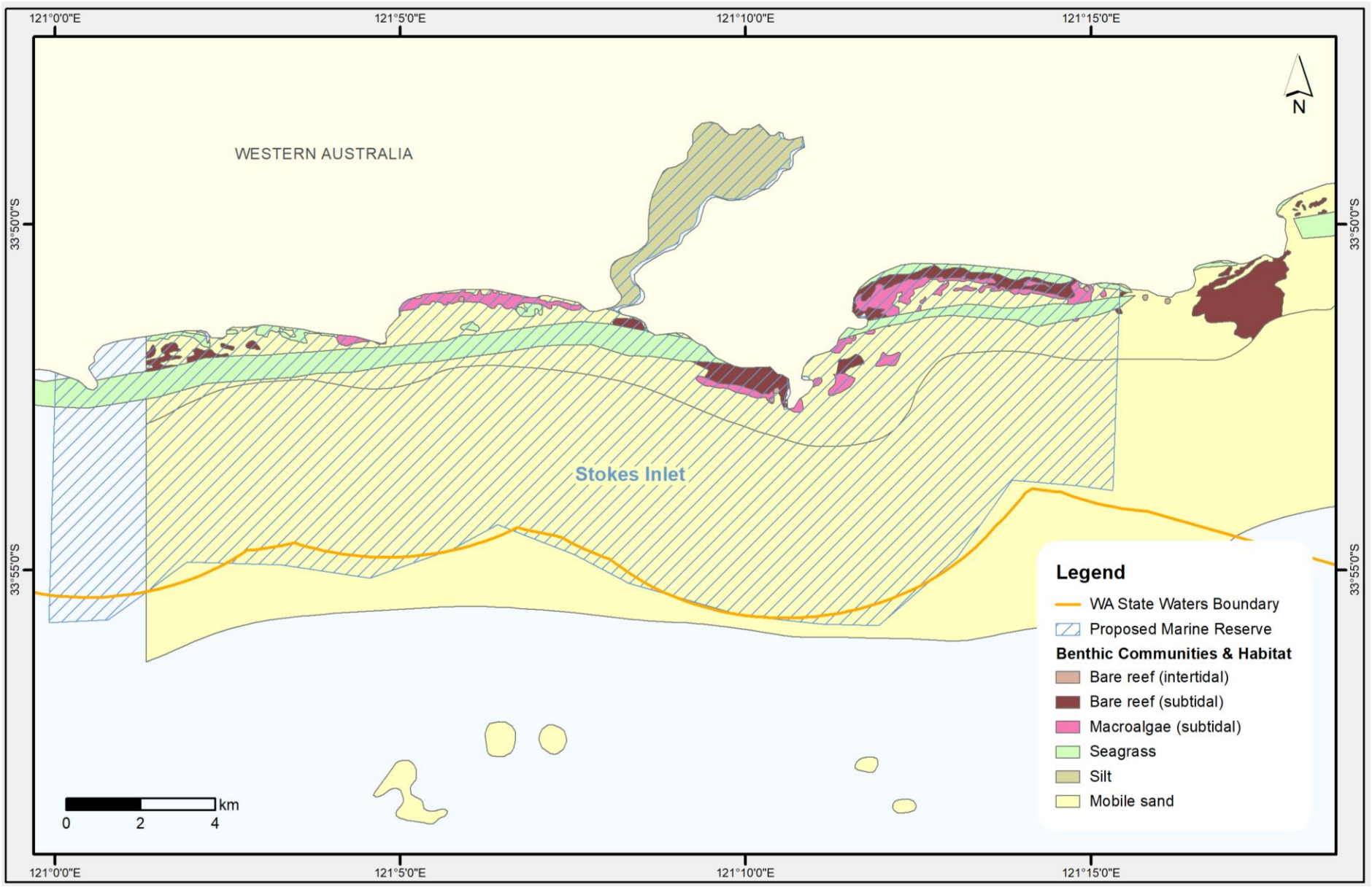

Figure 13: Benthic habitats of Stokes Inlet. Data sourced from SeaMap Australia (DPaW 2006).

The extensive perennial seagrass meadows of Margaret Cove to Fanny Cove were suggested for listing, along with five other south coast WA locations, on the Australian Heritage Commission's Register of the National Estate (now superseded) after the undertakings of the Southern Western Australian Seagrass Study (SWASS 1996).

5.3.4. Marine flora

No specific information was available on the species or biology of seagrasses or algae at Stokes Inlet, though dense beds of *Posidonia* and *Amphibolis* are probable based on aerial photographs (Colman 1998).

5.3.5. Marine fauna

A full list of species protected under the EPBC Act 1999 is given in Appendix 4 and was determined from the Protected Matters Search Tool using the proposed area for marine reservation as the boundary with a 2 km buffer inclusion.

Anecdotal information from abalone divers and commercial shell collectors presented in Colman (1998) mentions a diverse community of invertebrates and fishes occurring in the channels of the parallel reefs that stretch west of Shoal Cape. No detailed diversity or biological studies have been carried out for the marine environment within the proposed boundaries.

5.3.5.1. Invertebrates

See section 5.1.5.2 (Invertebrates – Cape Vancouver to Bald Island) for information relevant to Stokes Inlet on invertebrate species important for commercial and recreational fishing.

5.3.5.2. Bony fishes

See section 5.1.5.3 (Bony fishes – Cape Vancouver to Bald Island) for information relevant to Stokes Inlet on fish species important for commercial and recreational fishing.

5.3.5.3. Elasmobranchs

The Stokes Inlet area is identified as a Biologically Important Area for white sharks and, in particular, for foraging (DSEWPaC 2011).

See section 5.1.5.4 (Elasmobranchs – Cape Vancouver to Bald Island) for information relevant to Stokes Inlet on demersal shark species.

5.3.5.4. Pinnipeds

Stokes Inlet is an identified Biologically Important Area for foraging female and male Australian sea lions (DSEWPaC 2011).

5.3.5.5. Cetaceans

Southern right whales and humpback whales (*Megaptera novaeangliae*) have been known to frequent the coastal stretch of water of Stokes Inlet and surrounds (Lee and Bancroft 2001; Smith *et al.* 2019; Smith *et al.* 2020). The coastal waters of Stokes Inlet are included within the Geographe Bay to Eucla Important Marine Mammal Area (IUCN MMPATF 2021) and are also identified as a Biologically Important Area for southern right whale calving (DSEWPaC 2011).

5.3.5.6. Seabirds and shorebirds

Stokes Inlet is a Biologically Important Area for foraging and/or breeding by the black-faced cormorant, bridled tern, Caspian tern, fairy tern, flesh-footed shearwater, little penguin, little shearwater and Pacific gull (DSEWPaC 2011).

Stokes Inlet is one of a few locations along the south coast where the hooded plover (*Thinornis rubricollis*), Australia's most endangered resident shorebird, has been observed in numbers of 20 or more (Taylor 2013). The abundance of red-necked stints (*Calidris ruficollis*) has previously exceeded the National Significance Flyway population threshold (325) at Stokes Inlet (951) (Weller *et al.* 2020). Birds surveyed at 15 sites between Stokes Inlet and Cape Arid by the Esperance Bird Observers Group in February 2013, observed six migratory species (n = 1256) and seven resident species (n = 1978) across this stretch of coastline. Surveys in 2012 also showed relatively similar counts (Taylor 2013).

5.3.6. Recommendations for proposed boundary adjustments

We recommend consideration is given to adjusting the boundaries of Stokes Inlet west (~33 km) and east (~24 km) to align with the boundaries of the South-West Corner Commonwealth Marine Reserve boundary, inclusive of Investigator Island (Rocky Island) and Lake Gore RAMSAR wetland boundaries (Fig. 14), for the following reasons:

- Aligning state and Commonwealth marine park boundaries allows for continuous protection from the high intertidal mark through to deep open ocean, inclusive of a range of depths and habitats. At the very least, the western boundary of Stokes Inlet should be extended to 120°52'E to align with the Commonwealth National Park Zone (IUCN II – swswcnpz15) (McLeod *et al.* 2009; Edgar *et al.* 2014).
- Red Island, just east of the current recommended area, is noted as a seabird breeding island (Lee and Bancroft 2001). The extent to which seabirds forage within the marine habitats inshore of the island would require further determination.
- Investigator Island is an identified breeding island for the endangered Australian sea lion (Campbell 2008).
- Extending the boundaries east would encompass the macroalgae habitat around Red Island and extensive (> 1km stretches) subtidal reef flats south and east of the headland near Quagi Beach and north of Red Island (DPaW 2006).
- The Lake Gore RAMSAR wetland (WA026) abuts the coast and is home to a diverse range of resident and migratory species. The area is a Key Biodiversity Area (previously termed Important Bird Area) for resident waterbirds (Dutson *et al.* 2009; Maurer 2020). The number of red-capped plovers at Lake Gore (320 when surveyed in February 2013) exceeded the 0.1% National Significance Flyway population threshold (Taylor 2013). The 'species criteria' for a nationally significant area for sanderling and sharp-tailed sandpiper was also met, based on a max count of 33 individuals in 2009 and 85 individuals in 2015, respectively (>0.1% threshold) (Weller *et al*. 2020).

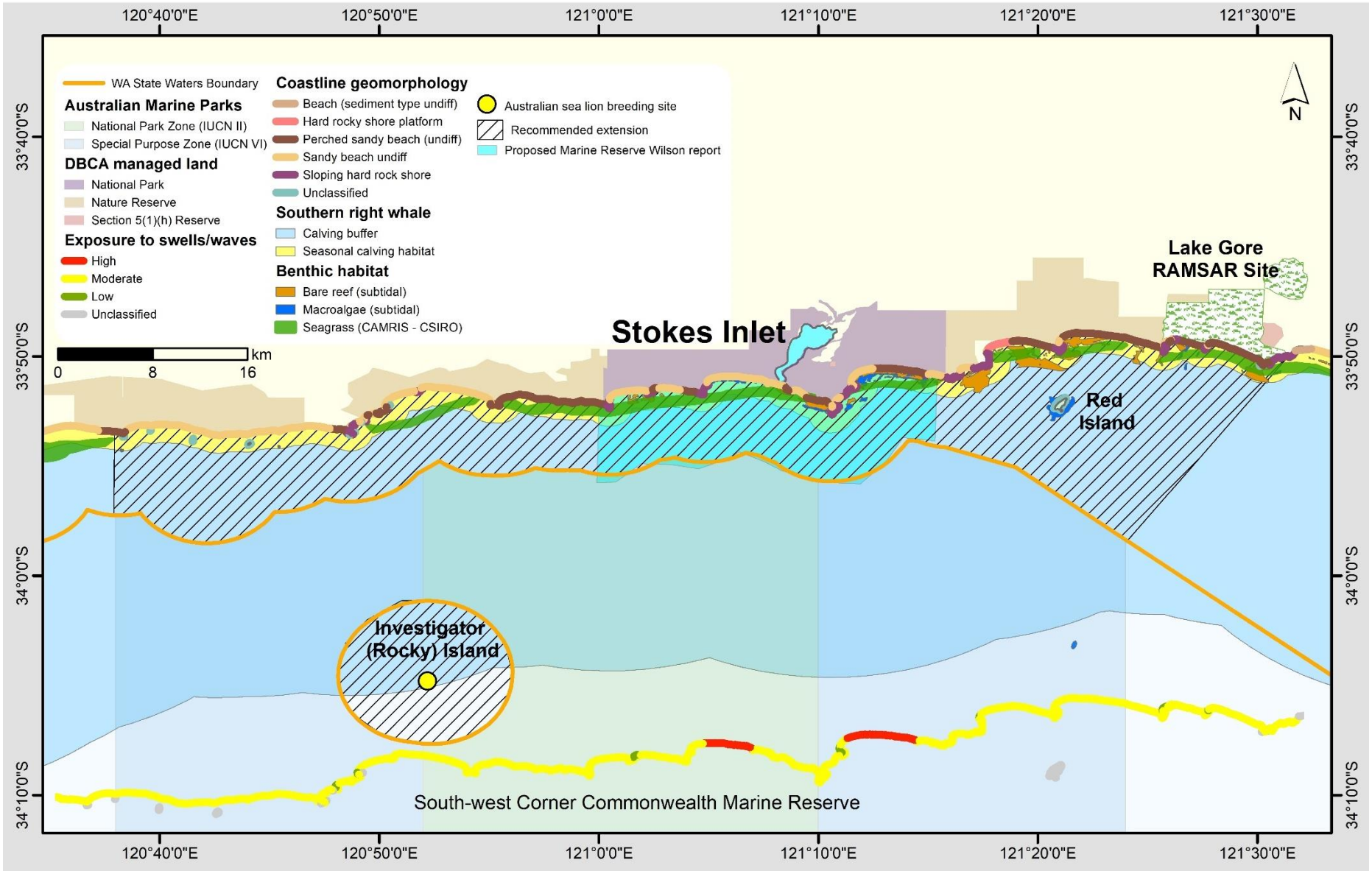

Figure 14: Recommended extension of the Stokes Inlet boundary proposed in the Wilson Report. Coastal geomorphology, exposure and benthic habitat data sourced from SeaMap Australia (DPaW 2006; Griffin *et al.* 2012), southern right whale and Australian sea lion sourced from the Australian Government National Conservation Values Atlas Map (DSEWPaC 2011), seagrass data sourced from CSIRO Data Access Portal (CSIRO 2015).

5.4. Recherche Archipelago

The Recherche Archipelago has received the most research effort out of the five areas recommended for marine reservation, as evidenced below. Significant gains in knowledge were achieved after the Twelfth International Marine Biological Workshop focused on Esperance and the Recherche Archipelago in February 2003. Two volumes were produced by the WA Museum, the University of WA and the WA branch of the Australian Marine Sciences Association (Wells *et al.* 2005c; Wells *et al.* 2005b). These volumes included research findings on seagrasses and macroalgae, animal biology, molluscs, and a suite of other invertebrates and fishes. Kendrick *et al.* (2005b) provides a good introduction to the marine biology of Esperance and the Recherche Archipelago. A Fisheries Research and Development Corporation project also focused on characterising the fish habitats of the Recherche Archipelago during 2002-2003, which added significant benthic habitat and marine biota knowledge (Kendrick *et al.* 2005a).

5.4.1. Wilson Report overview

The Recherche Archipelago was recognized in the Wilson Report as one of the major coastal features of the South Coast covering a distance of ~200 km. Most of the islands are exposed to wave action that is moderate to high. The islands have smooth and steep sides sloping into the sea whilst sheltered shores contain boulders and rock pools. The depth around the islands averages ~40 m but depths can reach 70 m. The sublittoral zone contains vertical rock walls. Wilson (1994) found a paucity of information on flora and fauna and relied on aerial photographs to identify areas of seagrass. Some specimens of *P. sinuosa* were collected from 47 m. Anecdotal evidence suggested rock slopes above 20 m depth are dominated by macroalgae with invertebrates colonising the substrate below that depth including sponges and coelenterates. Fish fauna is diverse with abundant blue groper and queen snapper. Many of the islands and rocky outcrops are used by Australian sea lions and long-nosed fur seals for haul out and the area supports the largest breeding colonies in the state for both species. Several islands were also reported to be important nesting areas for the little penguin.

5.4.2. Geomorphology

The geomorphology of the Esperance coastline is characterised by exposed rocky granite headlands, steep rocky slopes and quartzose sandy beaches at the ocean interface, and submerged limestone reefs and carbonate sands (Sanderson *et al.* 2000; Kendrick *et al.* 2005b; Griffin *et al.* 2012). Most notably, the Recherche Archipelago is comprised of rocky granite and

sometimes limestone capped islands (105) and shoals (~1500) in inshore and offshore waters. While the south coast of Australia is relatively exposed to the Southern Ocean, the Recherche Archipelago affords some protection for the coast of Esperance. As a result, many of the islands are exposed to high wave energy. The geomorphology of the region has, understandably so, formed the basis of geological focused studies on sediments and facies, seabed mapping exercises and benthic habitat characterisation.

Ryan *et al.* (2020) describes the physical properties, morphology and distribution of sediment particles in Esperance Bay, inclusive of calcareous algae rhodolith, bryozoan, molluscan, foraminiferan, terrigenous, relict intraclast and undifferentiated bioclast sediments. The different habitats/geomorphic units of Esperance Bay (e.g., planar sands, inshore and offshore seagrass meadows, reefs, and rhodolith beds) were comprised of a variety of these sediment types. Bryozoans and bivalves are significant carbonate producers in these cool water environments (Richardson *et al.* 2005).

The sediment facies have been detailed for Esperance Bay and nearby islands, and include coarse bioclastic sands, medium carbonate sands, medium quartz sands, coarse palimpsest sand, rhodalgal muddy sand and basal Pecten-gravel lag (Ryan *et al.* 2008). Storm events play a significant role for sediment transport across the region, and despite the highly energetic environment, calcareous algae covered sediments/rhodolith beds can still form and be preserved. Erosion of cliff faces contributes to the quartz component of the carbonate sediments, while the carbonate content comes from erosion of limestone and skeletal fossil fragments in sedimentary rocks (bioclasts) (Tecchiato *et al.* 2016). The surface sediment facies of the eastern margin of Recherche Archipelago, around Six Mile Island, and further east past Twilight Cove is dominated by rhodoliths (James *et al.* 2001; Richardson *et al.* 2005).

Earlier work by Cann and Clarke (1993) examined the surficial sediments around Esperance Bay and described how tests of foraminifera were a major contributor to bioclastic carbonates, and that the Leeuwin Current influenced the high abundance of the tropical species, *Marginopora vertebralis*, in the region. The foraminiferan assemblages of the sedimentary environments of Esperance Bay included 92 species from 56 genera (Buosi *et al.* 2020). Four main assemblages were distinguished and were related to differences in sediment texture, seagrass meadows, depth, shoreface morphology and hydrodynamics (De Muro *et al.* 2018; Buosi *et al.* 2020).

The cluster of islands around Woody Island near Esperance Bay have formed the focus of methodological studies using multibeam sonar to map bathymetry and habitats, and as such, detailed benthic habitat maps are available for these particular islands (Parnum *et al.* 2004; Parnum 2007; Hamilton and Parnum 2011) (Appendix 6).

The seabed geomorphology of Esperance Bay has been used to describe and predict the occurrence of different benthic habitats and vice versa. Seagrass meadows in the bay play an important role for maintaining beach morphodynamics by supplying carbonate sediments to beaches via onshore flow (Tecchiato *et al.* 2016; Tecchiato *et al.* 2019). An eastward movement of sediments was also identified for the bay. The increased diversity of inner shelf benthic habitats has also been linked to wave abrasion and localised sediment transport and accumulation (Ryan *et al.* 2007).

5.4.3. Marine benthic habitats

The most extensive benthic habitat mapping exercise for the Recherche Archipelago region was undertaken in 2002-2003 and aimed to link different shallow water habitat types (< 20 m) to geomorphology and hydrodynamics (Fig. 15)(Kendrick *et al.* 2005a). Expansive areas of seagrass with varying densities have been identified throughout Esperance Bay and stretching around to Cape Le Grand as well as throughout Duke of Orleans Bay (Fig. 15 & 16) (Kendrick *et al.* 2005a). Less expansive areas have also been noted around Cape Arid, north of Middle Island and shoreward of many of the islands. Overall, across the Recherche Archipelago area, seagrass meadows were estimated to cover 212 km^2 and could be found growing 30 km from shore around islands and at depths of 50-60 m. Seagrasses can grow at deeper depths along this stretch of coastline compared with tropical Australia due to the clearer waters. More recently, Esperance Bay has been mapped using a combination of side scan sonar, towed video and multibeam bathymetry which show seagrass meadows spanning the bay to a depth pf ~ 30m (Tecchiato *et al.* 2019). Dense meadows were found in sheltered regions, and sparse meadows in areas of higher wave energy and human activity. A comparative analysis of seagrass vegetation for several years between 1956 and 2001, pre and post port construction, concluded that high seagrass cover has persisted in Esperance Bay despite increased anthropogenic pressure (Hegge and Kendrick 2005).

Rhodoliths are unattached red coralline algae that create dense beds of 'lumpy' and 'warty' looking clumps. Around Esperance and the Recherche Archipelago, rhodolith beds are often found in deeper waters just seaward of seagrass beds and reefs (Fig. 15) (Kendrick *et al.* 2005a; Harvey *et al.* 2017). Kendrick *et al*. (2005a) estimated rhodolith beds to cover ~ 144 km^2 across the region. Their robust morphologies and mostly small sizes (< 20 mm) are reflective of a high energy wave exposed bay (Goldberg 2006). Rhodolith beds are recognised for providing important habitat for a diverse range of fauna and other algae, such as for the 36 species representing 11 phyla in Esperance Bay (Mathis *et al.* 2005), and the 52 species of epiphytic

foliose and filamentous macroalgae attached to rhodoliths around the western Recherche Archipelago (Goldberg and Kendrick 2005).

Broad stretches of low profile reef are found around Esperance Bay, Cape Le Grand and Cape Arid. Patches of high profile reef occur around islands (Kendrick *et al.* 2005a). Areal extent of reef habitat of the Recherche Archipelago is estimated to cover 35,203 km^2 (Kendrick *et al.* 2005a), which is significantly more coverage than any location in the south-west coastal waters of WA (McClatchie *et al.* 2006). Sponge communities can be found on low profile reefs (Baxter 2003; Ryan *et al.* 2020).

Extensive planar sands fill the spaces between seagrass meadows, reefs and rhodolith beds across the region (Fig. 15) (Kendrick *et al.* 2005a).

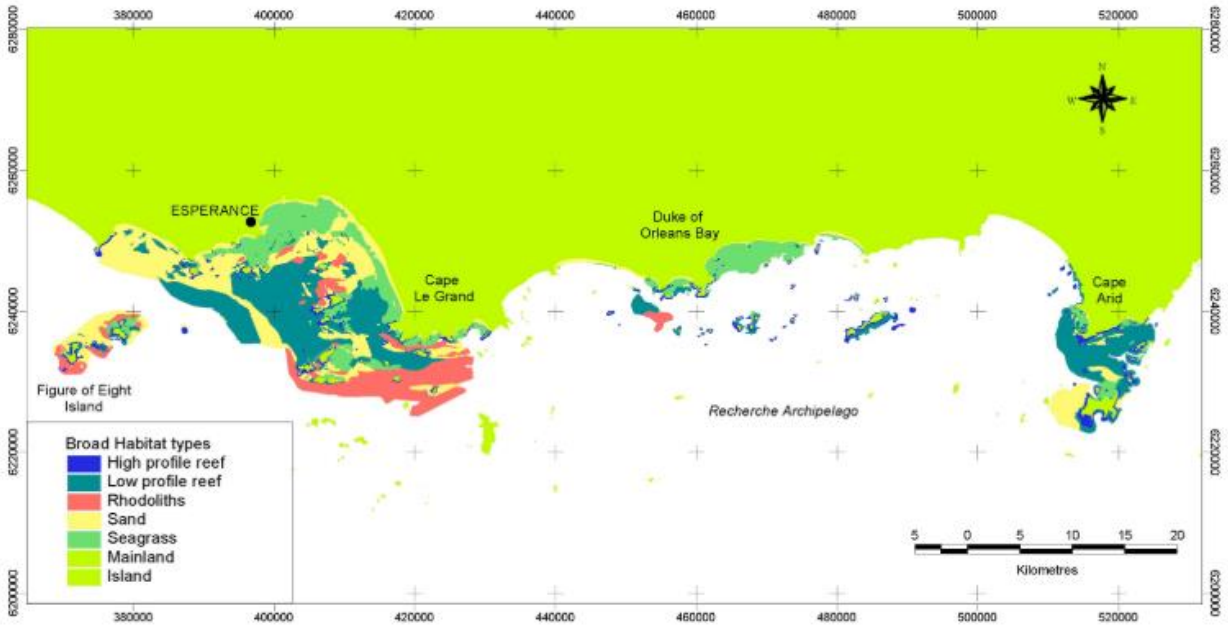

Figure 15: Benthic habitats of the Recherche Archipelago showing the extent of rhodolith beds during a 2002-2003 mapping exercise. Image sourced from Kendrick *et al*. (2005a).

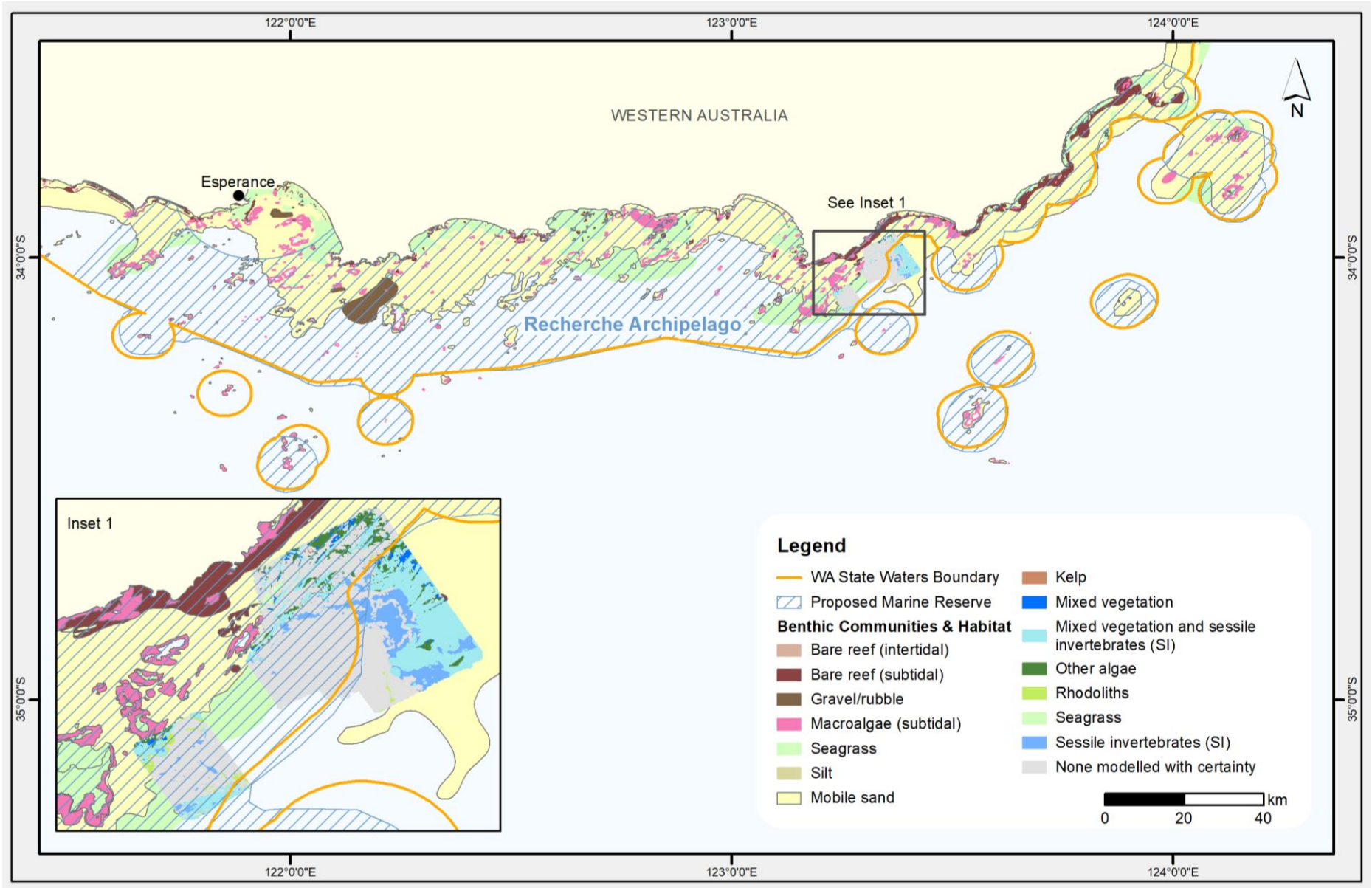

Figure 16: Benthic habitats of Recherche Archipelago. Sourced from SeaMap Australia (DPaW 2006; Meeuwig and Radford 2008). See Fig. 14 for additional rhodolith bed habitat extent.

5.4.4. Marine flora

5.4.4.1. Macroalgae

The estimated ~1500 species of algae along the south coast of Australia make this among one of the richest locations in the world (Shepherd and Edgar 2013).The Recherche Archipelago has a significant proportion of those species. The macroalgae assemblages around Esperance and the Recherche Archipelago are generally typical of assemblages found along the south coast (Kendrick *et al.* 2005a). A catalogue of macroalgae species from nine inshore and offshore islands from the western Recherche Archipelago was produced after sampling efforts in 2002 and 2003 (Goldberg and Kendrick 2005; Kendrick *et al.* 2005a). Around 242 species were identified, 60% of which were red algal species (Rhodophtya). Range extensions were recorded for some species. A further analysis of macroalgae specimens from Black Island alone, revealed the occurrence of more than 250 species (Mathis *et al.* 2005), consisting of canopy forming, understory and epiphytic forms. Given the complexities of macroalgae identification, several studies have focused specifically on taxonomy for distinguishing between species and describing new species from specimens found in the Esperance and Recherche Archipelago region (Goldberg and Huisman 2004; Goldberg and Huisman 2005; Goldberg *et al.* 2006a; Cremen *et al.* 2016; Belton *et al.* 2019).

In instances where taxa can be highly diverse, as is the case for macroalgae, surrogates may be used to help predict species diversity and reduce sampling effort. For the Recherche Archipelago, species richness performed most consistently as a surrogate for macroalgae species diversity across different locations (inshore vs offshore islands), depths and exposures to swell (Goldberg *et al.* 2006b). Dominant taxa and higher taxonomic levels also had some success in predicting species diversity under certain conditions. Smale (2010) investigated a wider stretch of coastline from Recherche Archipelago to Kalbarri and found that genus and family level surrogates performed well but less so at large spatial scales. Smale (2010) concluded that spatial scales should be a strong consideration when determining the suitability of surrogates in biodiversity monitoring.

Several ecological studies have focused on macroalgae from Esperance and the Recherche Archipelago. In the western region of the Recherche Archipelago, depth and exposure to swell influenced the differences observed in subtidal macroalgal assemblages; canopy dominated assemblages were often found at depths < 10 m whereas mixed canopy and understorey assemblages were found at depths > 10 m and lower species richness was observed for highly exposed sites (Goldberg and Kendrick 2004). The high species turnover of the Recherche

Archipelago, particularly for shallower waters (<10 m), could be partly attributed to the highly energetic physical environment and/or different dispersal ranges of propagules (Goldberg *et al.* 2004; Goldberg *et al.* 2006b). High species turnover is also more pronounced at small spatial scales (quadrat and patch level) compared with site or regional spatial scales (Smale *et al.* 2010; Smale *et al.* 2011). Macroalgae richness decreases with increasing distance from islands (up to 500 m away). Recolonisation and recruitment of macroalgae assemblages is suggested to largely come from local populations, more so for canopy forming species than epiphytic and understory species (Goldberg *et al.* 2004). A colonisation experiment at Woody Island suggested that algal diversity and patterns in colonisation were likely influenced by environmental factors more than barrier effects from understory and canopy layers (Goldberg 2007).

A fine scale examination of subtidal macroalgae assemblages between Cape Leeuwin and Fleurieu Peninsula (South Australia), inclusive of the Recherche Archipelago, found that the canopy forming *E. radiata* did not primarily occur as monospecific stands, which was important to consider when making generalisations/predictions about associated invertebrate assemblages along the south coast (Goodsell *et al.* 2004). There is a shift in composition from dominant canopy forming species, *E. radiata* and *Sargassum*, along the lower west coast of Australia to mixed species canopies at Recherche Archipelago (Wernberg *et al.* 2003; Goldberg and Kendrick 2005).

The nutrient status of eight macroalgae species from several locations around Esperance were examined using stable carbon and nitrogen isotopes ratios (Phillips 2005). Variation in nutrient status due to varying nutrient supply could not be reliably determined.

5.4.4.2. Seagrass

Fifteen species of seagrass have been recorded from the Esperance and Recherche Archipelago area (Kirkman and Kuo 1990). Nine of those are commonly occurring: *A. antarctica, A. griffithii, P. sinuosa, P. ostenfeldii complex, P. australis, P. angustifolia, Thalassodendron pachyhizum, Heterozostera nigricaulis* and *H. polychlamys* (Kilminster *et al.* 2018).

Seagrass was the most common habitat type throughout Esperance Bay and meadows were dominated by *Posidonia* sp., followed by *Amphibolis* sp. then *Halophila* sp (Tecchiato *et al.* 2019).

More specific studies have looked at the nutrient content and leaf morphologies of *P. kirkmanii* and *P. australis*, which were co-occurring, along with *A. griffithii* in a mosaic of patches in Wylie Bay (Cambridge *et al.* 2005; Moore *et al.* 2005).

5.4.5. Marine fauna

A full list of species protected under the EPBC Act 1999 is given in Appendix 5 and was determined from the Protected Matters Search Tool using the proposed area for marine reservation as the boundary with a 2 km buffer inclusion.

5.4.5.1. Zooplankton

The species of carnivorous zooplankton identified from shelf waters off Esperance, as well as Bremer and Albany, during winter and summer were not comprised of cold water forms. This finding was attributed to the Leeuwin Current transporting warmer water species into the region. Siphonophores and chaetognaths dominated the composition of carnivorous zooplankton. The Leeuwin Current also likely influenced the lower number of species at Esperance compared with Bremer and Albany (Fletcher and Gaughan 1997).

Zooplankton samples were collected all along the shelf between Fremantle (WA) to Adelaide (SA) to investigate the distribution of pilchard eggs (Fletcher and Tregonning 1992). Relatively high concentrations of one- and two-day old eggs were found to occur between Albany and Recherche Archipelago, though most sampling was carried out adjacent to state waters.

5.4.5.2. Sponge communities

Sponge diversity is relatively high at the Recherche Archipelago (~300 species of Demosponge) compared to other locations around WA e.g., 109 at Houtman Abrolhos and 243 at Marmion Lagoon (Fromont 1999; McDonald *et al.* 2005; McQuillan 2006). Benthic biodiversity surveys carried out in 2002-2003 across different depths of the Esperance and Recherche Archipelago region found that sponges dominated specimen collections (644 individuals, ~72%), with Poecilosclerida and Dictyoceratida being the dominant orders (Kendrick *et al.* 2005a; McDonald *et al.* 2006). McDonald *et al*. (2006) explained that the spatial patterns of different sponge orders, and differences in abundance for some orders, were related to depth, exposure and substrata.

A list of extant sponges from Recherche Archipelago were used in a comparison of fossilised and modern sponge fauna from southern Australia (Łukowiak 2016). Overall, modern sponges only show moderate differences to those from the late Eocene.

5.4.5.3. Invertebrates

5.4.5.3.1. Chelicerata – sea 'spiders' and mites

The diversity of pycnogonids, or sea spiders, around Esperance and the Recherche Archipelago are largely known from specimens collected in 2002 and 2003 from the benthos and currently includes 15 species from 11 genera (Bamber 2005a). These collections added new records for the south coast and also extended previously known range extensions of species with few records.

From sediment collections around tidal and shallow subtidal areas, over 40 species of meiobenthic mites were described from 14 genera (Bartsch 2005c; Bartsch 2005a; Bartsch 2005b; Bartsch 2007). The diversity of species was lower than the ~80 species recorded for Rottnest Island and 19 of the ~40 species from Esperance have also been recorded elsewhere in Australia.

5.4.5.3.2. Crustaceans

Peracarid crustaceans collected from the benthos in Esperance Bay in 2002 and 2003 largely comprised of Tanaidaceans, which were more numerous than amphipods, isopods and mysids (Bamber 2005b). A total of 26 species of Tanaidaceans were identified from almost 600 individual specimens. At the time, 24 of these species were new discoveries.

Southern rock lobster (*J. edwardsii*) occur along the south coast of WA but there are no known specific areas of particular ecological importance between Cape Vancouver and the WA/SA border (pers. comm. DPIRD).

5.4.5.3.3. Molluscs

Molluscs have been the most extensively studied invertebrate taxa around the Esperance and Recherche Archipelago region. Collective survey efforts summarised by Wells et al (2005a) recorded 347 species consisting of 273 gastropods, 49 bivalves, 15 chitons, six cephalopods, and four scaphopods. Most of these species have temperate distributions. A total of 31 species were identified as endemic to WA. Of these, 25 species were affiliated with tropical waters and were likely present in the region due to the influence of the LC. Molluscs were found distributed across a range of habitats in the region, including intertidal sandy beaches, seagrass meadows and macroalgal beds. The number of mollusc species was also found to increase with increasing distance from islands (Goldberg *et al.* 2004). More detailed descriptions of some of the taxa collected during the Twelfth International Marine Biological Workshop in Esperance, which are included in the above summary, can be found in the references below. Detailed descriptions are

provided for: the slit worm shell (*Stephapoma nucleogranosum*) (Bieler and Simone 2005), the bivalve *Eucrassatella donacina* (Taylor *et al.* 2005), cantharidine trochid gastropods and limpets found in seagrass meadows (Hickman 2005a; Hickman 2005b), the endemic infaunal clam *Venerupis galactites*, which attaches to *Posidonia* seagrass rhizomes (Bieler *et al.* 2005), the endemic corallivorous gastropod *Coralliophila mira* (Koh-Siang 2005) and diet studies for predatory gastropods occupying different intertidal rocky shores (Kohn *et al.* 2005; Wells and Keesing 2005).

Endemic species of gastropods, bivalves and polychaetes were found to dominate infauna assemblages within the Bandy Creek Boat Harbour in Esperance Bay (Kohn and Blahm 2005). Sediment collections along the intertidal area revealed a total of 43 species, and species richness increased from open beaches to the inner part of the harbour. The polychaete, *Armandia bilobata*, and mollusc, *Paphies elongata*, were dominant at open beach locations (out of a total of three species identified), whereas the polychaete, *Pseudopolydora paucibranchiata* and mollusc, *Nassarius burchardi*, were among the dominant species closet to the harbour. Construction of the harbour has provided suitable habitat and protection from the Southern Ocean.

While abalone (Roe's, Greenlip and Brownlip) are distributed along the south coast, the commercial catch of abalone is higher at Recherche Archipelago, which suggests a higher abundance of abalone in this area compared to elsewhere within the south coast scope area (Hart *et al.* 2017). Cape Arid and Duke of Orleans Bay are two areas within the Recherche Archipelago with particularly high commercial catches.

Cuttlefish (*Sepia apama*) specimens from Esperance and elsewhere across the southern coastline of Australia (Perth to Queensland), were used to better understand life history characteristics and determine whether *S. apama* could be separated into more than one species (Kassahn *et al.* 2003). Overall, specimens from WA were genetically different from South Australia/Victoria and New South Whales specimens, though reproductive isolation was not strongly evident, thus more than one species could not be supported.

See section 5.1.5.2 (Invertebrates – Cape Vancouver to Bald Island) for information relevant to Recherche Archipelago on scallops and octopus.

5.4.5.3.4. Oligochaetes – worms

Tubificidae, a family of oligochaete worms, were collected from the intertidal and shallow subtidal sedimentary environments around Esperance (Erséus and Wang 2005). Of the 18 species

identified, five were new to science. The remainder had previously been identified at other locations around WA. The species identified from Esperance raised the total for WA to 95 species of Tubificidae. Similarly, seven species from the family Enchytraeidae were also identified and described from the same sediment collections around Esperance and included two new species and species previously identified in WA (Rota *et al.* 2007).

5.4.5.3.5. Cnidarians – Hydroids and corals

Hydroid specimens (sedentary life stages of species from the diverse class Hydrozoa, ~ 3700 species) have been collected from shallow water reefs across the Recherche Archipelago, seagrass meadows and beach drift from the inner shores of Esperance. These specimens represent 77 species (Watson 2005). This collection includes six new species and numerous new records and range extensions for the region. Hydroids were found attached to seagrass leaves and algae fronds, sponges, other hydroids and invertebrates as well as hard substrate surfaces. Hydroids constituted a very small percentage (2%) of the fauna collected from benthic biological surveys in 2002-2003 (Kendrick *et al.* 2005a)

The diversity of coral species shows an obvious decline from tropical to temperate waters along the coast of WA. Only five out of seven species of hard coral have been identified at the Recherche Archipelago (Veron and Marsh 1988). Corals constituted a very small percentage (2%) of the fauna collected from benthic biological surveys in 2002-2003 (Kendrick *et al.* 2005a).

5.4.5.3.6. Echinoderms

Sea stars (Asteroidea) were collected from a range of depths (< 30 m) at sheltered and exposed sites across the Recherche Archipelago. Sea stars were found to inhabit substratum dominated by sponges and algae as well as seagrass meadows (McDonald 2005a). Twelve species were identified from six families which, at the time, represented ~11% of the species found across the temperate waters of southern Australia.

Benthic biological surveys in 2002-2003 found sea stars comprised ~7% of benthic faunal collections (Kendrick *et al.* 2005a).

Ophiuroid (brittle stars) and crinoids (feather stars) from Esperance, Bremer Bay and Albany, as well as elsewhere along the south coast of Australia, were phylogenetically analysed to better determine cryptic species (Naughton *et al.* 2014a; Naughton *et al.* 2014b). It was recommended that more sampling of *Clarkcoma canaliculata* and *C. pulchra* brittle stars was needed across the GAB before reliably determining the presence of cryptics (Naughton *et al.* 2014b). Collections of

the feather stars, *Cenolia trichoptera* and *C. tasmaniae,* across the south coast revealed five separate species, rather than two (Naughton *et al.* 2014a).

5.4.5.4. Ascidians

Solitary ascidians were collected across the Recherche Archipelago from a range of depths (< 30 m) and sheltered and exposed sites, which resulted in the identification of six species from three families (McDonald 2005b). The species found were common across the temperate waters of southern Australia and the differences in depths of occurrence and morphologies are adaptations that would help alleviate against high energy wave action.

A benthic biological surveys in 2002-2003 found that ascidians comprised ~7% of benthic faunal collections throughout the Recherche (Kendrick *et al.* 2005a).

5.4.5.5. Bony fishes

The most comprehensive study of fish assemblages of the Esperance and Recherche Archipelago region comes from a series of baited remote underwater video system (BRUV) drops and benthic habitat mapping conducted in May-June 2002 (Kendrick *et al.* 2005a; Harvey *et al.* 2013). In total, 90 species of bony fishes, sharks and rays from 43 families were identified. Distinct fish assemblages were found across broad categories of seagrass meadows, reef, rhodolith beds and sand habitats (Kendrick *et al.* 2005a). Modelling of ten temperate species found strong associations with benthic environmental variables. Substrate type, water depth and macroalgae were able to successfully predict probable occurrences of nine species (Chatfield *et al.* 2010). The Recherche Archipelago provides suitable habitat for predators of molluscs, cephalopods and crustaceans due to extensive beds of macroalgae and seagrass. An obvious presence of K-selected demersal species (long-lived, slow growing) was an important feature of assemblages in the region, e.g., western blue groper and foxfish wrasse. A faunal break in fish assemblages was also noted around Cape Le Grand, warranting further investigation (Kendrick *et al.* 2005a; Harvey *et al.* 2013).

A more complete checklist of fishes found at the Recherche Archipelago (and Israelite Bay) comes from a combination of museum collections and in water visual census surveys between 1977 and 1984 and includes a record of 263 fish species (Hutchins 1994; Hutchins 2001; Hutchins 2005). Twenty percent of the species identified were endemic to WA and a further 12% had shared distributions in the western waters of South Australia. The majority of the species identified were temperate, though tropical, subtropical and cosmopolitan species also occurred. The majority of species were also associated with rocky reefs, followed by seagrass meadows.

A similarity analysis of fish assemblages sampled using seine nets in the surf zone between Geraldton and Esperance grouped assemblages from Esperance and Albany together (Ayvazian and Hyndes 1995). Out of 14 species from this grouping, *Spratelloides robustus* had the highest densities.

The fish assemblages of three areas of the Recherche Archipelago were surveyed using stereo baited remote underwater videos to determine whether proximity to the town of Esperance had an influence of fish abundance and size (i.e., anthropogenic impacts)(Rosengart 2020). Assemblage composition varied across locations; larger fish were observed furthest away from town, while abundance (largely of smaller fish species) was highest closer to town. There was no strong evidence that diversity and biomass were influenced by proximity.

Baker (2006a) explored the inshore demersal fish assemblages along the south coast in more detail but with a focus on Commonwealth waters.

Fish assemblages from Esperance were included in a south-west WA scale study on regional scale environmental drivers of high endemism. Demersal fish community composition and biogeographical range in south-west WA are influenced by the presence of canopy-forming macroalgae. Where these macroalgae were found on complex hard substrate environments, there tended to be higher diversity and endemism, second to hard coral habitats (Galaiduk *et al.* 2017).

Baited remote underwater video recordings of fish assemblages from Esperance (as well as Albany and Bremer Bay) were used to inform the drivers of community structure from tropical (Dampier) to temperate waters (Esperance) (Ford and Roberts 2018). Ecological drift was a strong driver of community structure (Ford and Roberts 2020).The influence of geographical distance and environmental gradients on species turnover was evident (Ford and Roberts 2018). Niche specialisation was a characteristic of endemic temperate species rather than tropical species. Ford and Roberts (2019) further discuss that the endemic species in temperate waters have evolved with a relatively homogenous abiotic and biotic environment compared with more complexity in tropical regions, and while endemics hold keystone roles in community structure, they can be vulnerable to natural and anthropogenic perturbations.

Many labrid species from the cool temperate waters of the Albany region, Bremer Bay and Esperance/Recherche were generally found to increase in abundance following a gradual warming between the sampling years of 2006 and 2015 (Parker *et al.* 2019).

An assessment of the habitat associations and distribution of three species from the Australasian endemic genus *Parma* included data from Esperance (as well as Albany and Bremer Bay) to show that all three species across the south west coast could be found around vertical or overhanging rocks rather than continuous beds of algae (Saunders *et al.* 2014).

Endemic species sampled from Esperance (and Albany) were used in a wider study of south-west WA to investigate the 'abundant centre' hypothesis. Only two out of eight species conformed to the pattern of greatest abundance at the centre of distribution (Tuya *et al.* 2008).

Analysed otoliths from sea sweeps, *Scorpis aequipinnis*, collected from the Esperance region but representative of the south coast in general, found this species to attain a greater maximum fork length (477mm) and greater maximum age (68yrs) than its congener, *S. lineolatus*, from the eastern Australian coast (330mm and 54yrs, respectively) (Coulson *et al.* 2012). An analysis of gonads also determined the spawning period for *S. aequipinnis* along the south coast to be between early May and late July, which is different to blue morwong (Jan-May), western blue groper (Jun-Oct), snapper (Oct-Nov) and foxfish (Oct-Feb). Biological characteristics of three co-occuring species of armorhead, were compared by Coulson et al. (2016). Maximum ages of 55, 36 and 49 years were determined for *Pentaceropsis recurvirostris*, *Paristiopterus gallipavo* and *Parazanclistius hutchinsi*, respectively, and spawning was estimated to occur between May-Aug, Jun-Jan and Mar-Jun, respectively. Mature individuals were captured within 200 m of the coast (30-120 m deep) which suggests that these species spawn in relatively shallow waters.

A comparison of the diet of the predatory fish, *Neosebastes pandus*, from temperate Esperance and subtropical Rottnest Island suggested that the higher contribution of invertebrates, instead of fish, in the diet of specimens from Esperance may be explained by differences in habitat (Greenwell *et al.* 2018). Esperance has less structurally complex granite based reefs and fine quartz sands, whereas Rottnest Island has coarser carbonate sands and limestone derived quartz, and more structurally complex limestone reefs that provide more refuge for a greater variety of teleosts.

Further dietary studies have focused on the harlequin fish (*Othos dentex*) sampled from Albany to Esperance (French *et al.* 2014; French *et al.* 2017), *C. auratus* (previously *Pagrus auratus)* and *Pseudocaranx georgianus* from Esperance (French *et al.* 2012), the plankton feeding Pacific sardine (*S. sagax*) (Malseed 2004) and the ontogenetic changes in diet, feeding behaviour and activity of the western blue groper (Shepherd 2005).

The stomach contents of juvenile bluefin tuna caught from the coast (around Recherche Archipelago and elsewhere) out to the 200 m isobath were mostly comprised of teleost prey, mainly pilchards, blue mackerel and jack mackerel (Itoh *et al.* 2011).

Otoliths of five species of coastal fish collected from Esperance/Recherche Archipelago, Bremer and Albany were used to link growth patterns to oceanographic/climate phenomena (El Niño and La Niña) at large spatial scales and different habitat types along the WA coastline (Ong *et al.* 2018). Otoliths taken from western blue groper between Albany and Esperance were analysed to determine whether temperature was influencing growth (Rountrey *et al.* 2014). They found that body size is likely to increase in the future due to increasing water temperatures, despite the species being relatively insensitive to past climate changes.

See section 5.1.5.3 (Bony fishes – Cape Vancouver to Bald Island) for more information relevant to Recherche Archipelago on fish species important for commercial and recreational fishing.

5.4.5.6. Syngnathids

Dedicated surveys have not be carried out to determine the full diversity of syngnathids along the south coast, let alone the Esperance and Recherche Archipelago area (Baker 2006b).

The first live records of the ruby seadragon (*Phyllopteryx dewysea*) were collected from the Recherche Archipelago at ~50 m depth using a remotely operated vehicle (Rouse *et al.* 2017). Before these records, only four dead specimens had been used to describe the third known species of sea dragon. Its occurrence at deeper depths than leafy and common sea dragons is perhaps the reason for the lack of sightings. The waters around Recherche Archipelago are suggested to harbour a population of ruby seadragons and there are efforts underway to gain protection for this species at national and state levels.

Tissues collected from leafy sea dragon specimens at Cape Le Grand were genetically similar to Hopetoun samples but not Bremer Bay and Albany, which provides evidence for a genetic barrier between Bremer Bay and Hopetoun (Stiller *et al.* 2017; Stiller *et al.* 2020).

Common seadragons are also known to occur around the bays of Esperance (e.g. Lucky Bay and Tanker Jetty in Esperance Bay)(Wilson *et al.* 2016). Two genetic groups have so far been identified, a western clade and eastern clade, with a split occurring somewhere in the GAB.

5.4.5.7. Elasmobranchs

During a survey of Recherche Archipelago waters in 2002, demersal elasmobranchs such as eagle rays (*Myliobatis australis*), smooth stingrays (*Dasyatis brevicaudata*) and gummy sharks (*Mustelus antarcticus*) were found to be the most prevalent apex predators captured on video footage (Harvey *et al.* 2013).

White sharks were tagged off WA (n = 57) and South Australia (n = 177) between 2007-2015 in order to investigate broadscale coastal movements of white sharks off WA (McAuley *et al.* 2017). The largest number of receivers and the longest duration of receivers occurred around the Perth Metropolitan region and, as such, the largest number of sharks (n = 52) and majority of detections (n = 21,199) have occurred here. In terms of activity rate, the number of detections per 100 days of operation, the Recherche Archipelago array (excluding the receivers at Two People's Bay due to a whale carcass) was the most active out of the locations where acoustic receivers were set up, though two tagged sharks accounted for 81% of these detections. Acoustic data collated since 2009 provides evidence for white sharks being present more consistently across seasons off the south coast of WA rather than the lower west coast of WA. Of particular relevance to Recherche Archipelago was the higher detection rates in inshore waters (< 10 km from shore). White sharks have been caught by commercial fishers around Recherche Archipelago (Malcolm *et al.* 2001).

The Recherche Archipelago area is identified as a Biologically Important Area for white sharks and, in particular, for foraging (DSEWPaC 2011).

See section 5.1.5.4 (Elasmobranchs – Cape Vancouver to Bald Island) for more information relevant to Recherche Archipelago on demersal shark species.

5.4.5.8. Pinnipeds

The islands of the Recherche Archipelago support the largest breeding colonies of Australian sea lions and long-nosed fur seals in WA, and is an identified Biologically Important Area for foraging, breeding and haul outs by Australian sea lions (DSEWPaC 2011).

Breeding colonies of Australian sea lions occur on Termination, Mackenize, Kimberley, Kermadec, Taylor, Glennie, George, Wickham, Salisbury, Cooper, Round, Six Mile, Ford, and Spindle Islands (Gales 1990; Colman 1998; Campbell 2003; Campbell 2011; Hesp *et al.* 2012; Goldsworthy *et al.* 2014). Tagging and tracking of Australian sea lions from islands across Recherche Archipelago show that sea lions are distributed from ~100 km east of Albany to ~100 km east of Cape Arid as well as a Twilight Cove on the WA south coast (Hesp *et al.* 2012). Individuals forage in nearshore,

mid shelf and outer shelf waters (Campbell 2008; Goldsworthy *et al.* 2014). Some females were also tracked returning to the same location over several months which suggests females may specialise in specific habitats when foraging e.g. inshore or offshore locations (Goldsworthy *et al.* 2014). Females also exhibit high natal site fidelity i.e. returning to the same island colony (Campbell *et al.* 2008).

Five Australian sea lion scat samples collected from the Recherche Archipelago, and from other locations, were analysed using metabarcoding to determine the diet of Australian sea lions (Berry *et al.* 2017). Cephalopods were detected most often in scats from Recherche, followed by ray finned fishes (Actinopterygii) and Chondrichthyes.

Photographs were taken of Australian sea lions from Esperance and the Recherche Archipelago (as well as Red Islet, Middle Doubtful Island, Haul off Rocks, Albany and other WA locations) to determine whether whisker spot patterns could be a reliable method for individual identification (Osterrieder *et al.* 2015). Reliability was high for small populations (e.g., 50 animals) but reduced with increased population size.

Long-nosed fur seals are also distributed along the south coast and breeding colonies around Esperance and Recherche have been identified on Seal Rock, Hood, Libke, Finger, Draper, Beaumont, Cooper, Salisbury, New Year, Daw and Cranny Islands, along with additional islands used as haul out locations (Shaughnessy *et al.* 1994; Gales *et al.* 2000; Campbell *et al.* 2014). Long-nosed fur seals have been increasing in abundance along the south coast, with an estimated growth of 10% pa between 1989-1999, slowed to ~1% pa between 1999-2011 (Gales *et al.* 2000; Campbell *et al.* 2014). Some colonies showed declines in pup production, while others showed increases. The most recent population estimate in WA is 17,200 individuals (Campbell *et al.* 2014).

5.4.5.9. Cetaceans

The coastal waters of Recherche Archipelago are included within the Geographe Bay to Eucla Important Marine Mammal Area (IUCN MMPATF 2021) and are also identified as a Biologically Important Area for calving by southern right whales (DSEWPaC 2011).

Water depths less than 10 m in gently sloping bays around Cape Arid (Yokinup Bay) is a Commonwealth recognised established small aggregation area for southern right whales (DSEWPC 2012; Bannister 2016; Bannister 2018; Smith *et al.* 2020). A conservation management plan was devised for southern right whales in 2012 (Department of Environment 2012).

Humpback whales (*M. novaeangliae*) use the coastal waters of Recherche Archipelago as part of their migratory pathway (Lee and Bancroft 2001)

Bottlenose dolphins (*Tursiops truncatus*) are commonly observed around the Esperance and Recherche Archipelago region, and common dolphins (*Delphinus delphis*) in offshore waters (Lee and Bancroft 2001).

5.4.5.10. Seabirds and shorebirds

The Recherche Archipelago is considered as a significant location for seabird communities and resident waterbirds and is designated as a Key Biodiversity Area (previously termed Important Bird Area) (Surman and Nicholson 2006; Dutson *et al.* 2009; DPaW 2016; Maurer 2020). Several threatened species use the area whilst foraging including the wandering albatross (*Diomedea exulans*), grey-headed albatross (*Diomedea chrysostoma*), black-browed albatross (*Diomedea melanophris*), (northern) giant petrel (*Macronectes halli*) and fairy tern (*Sterna nereis nereis*). Though more recent surveys are needed to update population statuses, Recherche Archipelago was considered a key location for the Pacific gull (*Larus pacificus*) with 21 breeding pairs previously recorded (Surman and Nicholson 2006). The Recherche Archipelago is also noted as a Biologically Important Area for foraging and/or breeding by the black-faced cormorant, bridled tern, Caspian tern, fairy tern, flesh-footed shearwater, greater-winged petrel, little penguin, little shearwater and Pacific gull (Fig. 17) (DSEWPaC 2011).

Surveys of shorebirds around Esperance in February 2013 counted 9,275 individuals representing 15 species, including nine resident and six migratory species (Taylor 2013). The coastline of Esperance Bay meets the 'species criteria' for a nationally significant area for sanderling based on a max count of 50 individuals in 2010 (>0.1% threshold) (Weller et al. 2020). Yokinup Bay also meets this criteria with 453 sanderlings being counted in 2014.

Early work across the 1950s to 1980s has detailed the breeding status of seabirds on islands throughout the Recherche Archipelago (e.g. Abbott 1976; Abbott 1978), including for little penguins, flesh-footed shearwaters, white face storm petrels and Pacific gulls. A later survey of ten islands in 1982 recorded the little penguin, great winged petrel, flesh-footed shearwater, among other species (Colman 1998). Little penguins have previously been recorded at Bellinger, Ben, Boxer and Charley Islands (Colman 1998; Cannell 2001).

The islands of the Recherche Archipelago were noted as the only breeding islands remaining for the endangered Recherche Cape Barren goose (Halse *et al.* 1995; Colman 1998; Lee and Bancroft 2001).

Modelled estimates show a decline in the eastern curlew (*Numenius madagascariensis*) and ruddy turnstone (*Arenaria interpres*) abundance around Recherche Archipelago, and areas of increased and decreased abundance for red-necked stints and sooty oystercatchers depending on location (Clemens *et al.* 2016).

Continual recordings of seabirds and shorebirds are submitted to Birdlife Australia by community groups and tourism operators.

5.4.6. Biological oceanography

In response to the Wilson Report and the need to better understand the marine environment of the Recherche Archipelago, van Hazel (2001) examined the broad scale oceanography of the region. It is likely that upwelling favourable conditions are created during summer months due to prevailing south and south-easterly winds and a weakened Leeuwin Current. Evidence of high chlorophyll (increased productivity) can also be seen in satellite imagery. It is suggested that a summer coastal current, the Cresswell Current, may be present and operating similar to the Capes Current. Island eddies may also exist and influence the biota and pelagic productivity around islands, but higher resolution imagery/data is needed to confirm the existence and extent of these eddies.

The Leeuwin Current influence is evident along the south coast of Australia, particularly in autumn/winter months when the current is strongest. The waters of the Leeuwin Current seasonally inundate the Recherche Archipelago as the current moves southward away from the Archipelago. Though a large proportion of species are temperate, the Leeuwin Current has influenced the occurrence of subtropical and tropical biota in the region (Kendrick *et al.* 2009).

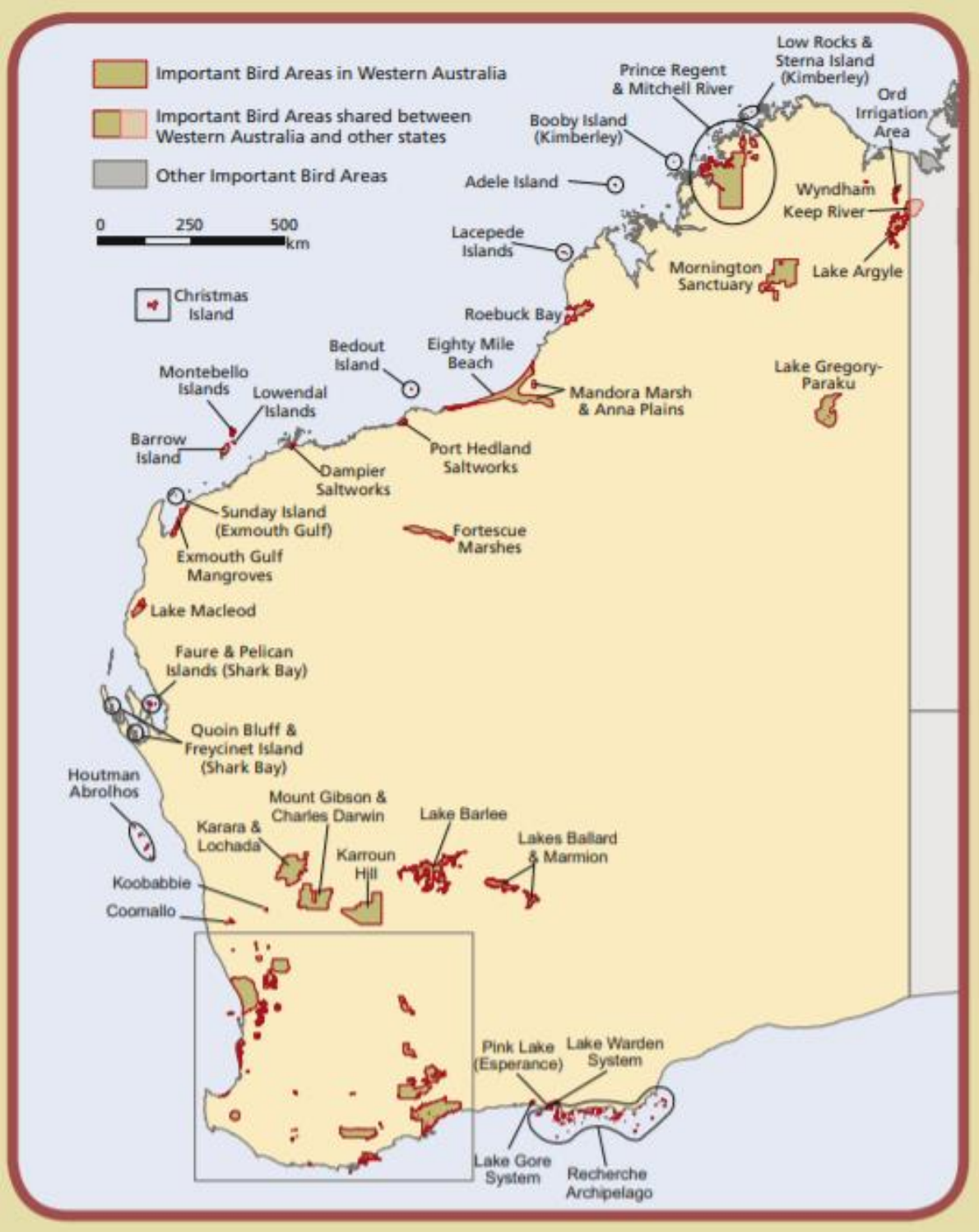

Figure 17: Key Biodiversity Areas (previously termed Important Bird Areas) identified in WA. Recherche Archipelago is important for seabirds and resident waterbirds. Two Peoples Bay and Mount Manypeaks (relevant to Cape Vancouver to Bald Island proposed boundary) is important for resident waterbirds and south-west endemics. Image taken from Dutson (2009) and qualified at http://www.keybiodiversityareas.org/kba-data.

5.4.7. Recommendations for proposed boundary adjustments

We recommend consideration is given to adjusting the boundaries of Recherche Archipelago to include more, if not all, of Esperance Bay, as well as east to Point Culver (124°45'E) (Fig. 18a & 18b) for the following reasons:

- Extending the eastern boundary to Point Culver will incorporate an established recognised large aggregation area for southern right whales (DSEWPC 2012).
- Israelite Bay to Point Culver has extensive meadows of dense, medium and sparse seagrass habitat, as well as sandy habitat, which allows for a greater diversity of habitats to be incorporated into one marine park (Edgar *et al.* 2014).
- Israelite Bay area has previously been proposed for reservation on the basis of high conservation value (Colman 1998).
- Israelite Bay meets the 'species criteria' for a nationally significant area for sanderling, based on a max count of 100 individuals in 2016 (>0.1% threshold) (Weller et al. 2020).
- The stretch of coastline from the Recherche Archipelago to Twilight Cove, encompassing Israelite Bay, is likely to contain significant rhodolith beds (Harvey *et al.* 2017).
- Esperance Bay has a diverse array of habitats that would help support connectivity patterns with the islands of the Recherche Archipelago.

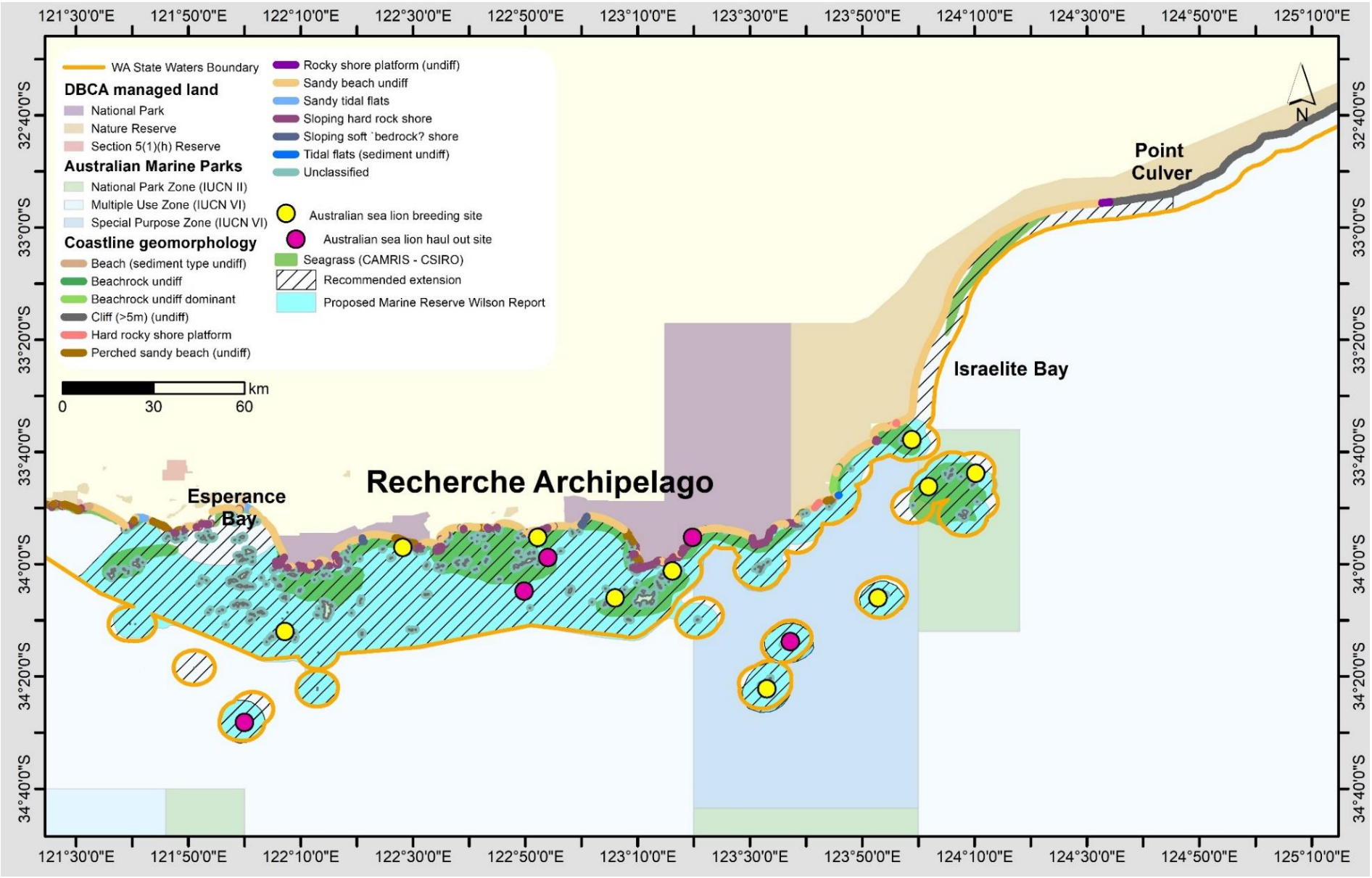

Figure 18a: Recommended extension of the Recherche Archipelago boundary proposed in the Wilson Report. Coastal geomorphology data sourced from SeaMap Australia (Griffin *et al.* 2012), Australian sea lion sourced from the Australian Government National Conservation Values Atlas Map (DSEWPaC 2011), seagrass data sourced from CSIRO Data Access Portal (CSIRO 2015). See Fig. 14 and 15 for more detailed benthic habitat mapping.

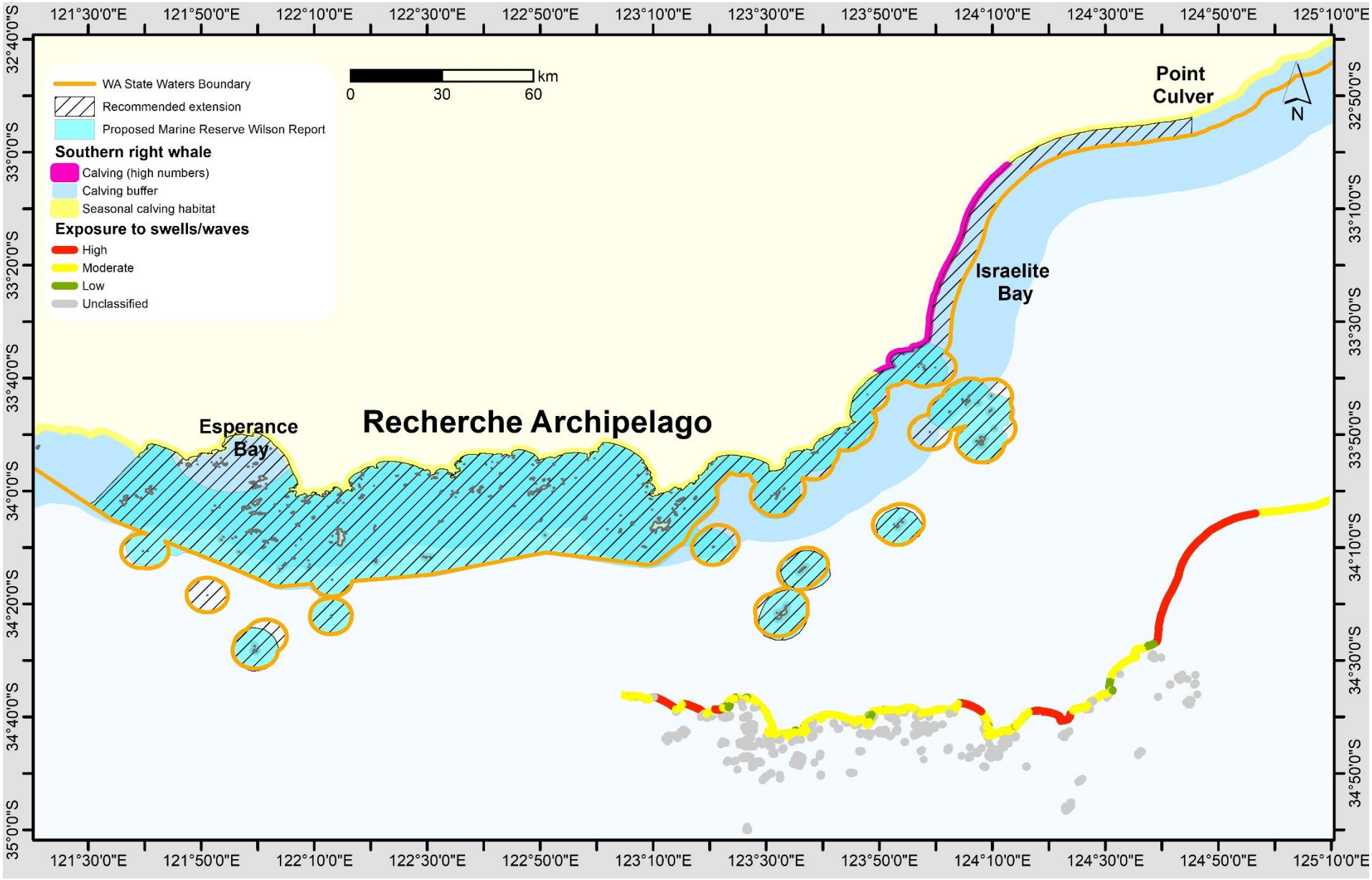

Figure 18b: Recommended extension of the Recherche Archipelago boundary proposed in the Wilson Report. Coastal exposure data sourced from SeaMap Australia (Griffin *et al.* 2012), southern right whale sourced from the Australian Government National Conservation Values Atlas Map (DSEWPaC 2011).

5.5. Twilight Cove

5.5.1. Wilson Report overview

Twilight Cove, located on the western side of the GAB within the Eucla basin, includes two coastal types typical of the shores in that sedimentary basin. The Wilson Report describes the beach backed by mobile Pleistocene dunes in the east and the high limestone Baxter cliffs to the west, with boulder fields and narrow beaches or limestone platforms at their base. It was reported that there was a lack of information on the flora and fauna and once again, aerial imagery was used to identify areas of seagrass beds off the beach that were sheltered by limestone reef. The Wilson Report included a number of nesting sites for the little penguin and a breeding colony of Australian sea lions at the base of Baxter cliffs. There was no information on fish or macroalgae communities.

5.5.2. Geomorphology

A nationally consistent geomorphic classification of the coastline of Twilight Cove identifies a combination of mixed sandy bottom, rocky platform and hard rocky reef (Griffin *et al.* 2012). The Roe Terrace off Eucla extends for 75 km alongshore in shallow inshore waters (30-50m) (Fig. 3) (James *et al.* 2001; Harris *et al.* 2005; Richardson *et al.* 2005). It is a smooth, relatively flat and seaward sloping surface covered in a thick blanket of sediment, which is the only inshore terrace feature within the state waters along the south coast of WA. The Baxter Cliffs span Point Culver to Twilight Cove, covering ~190 km.

The dominant surface sedimentary facies occurring along the shelf region of Twilight Cove (stretching from Roe Plains to Six Mile Island) is rhodolith (James *et al.* 2001; Richardson *et al.* 2005). Bivalves and bryozoans are common carbonate producers of these cool water environments and make up significant components of the surficial sediments of Twilight Cove and surrounds.

5.5.3. Marine benthic habitats

Rhodoliths have been collected from Twilight Cove for herbarium collections (Harvey *et al.* 2017). Significant rhodolith beds are likely to stretch west along the coast from Twilight Cove to Recherche Archipelago.

To the west of Twilight Cove at the base of the limestone cliffs, the inshore area is mostly sandy with patches of low reef and large boulders (Hutchins 1994). Directly off the beach of Twilight Cove, submerged patchy reef platforms were found at ~5 m depth. This submerged patchy reef around Twilight Cove were covered in sparse macroalgae. Extensive seagrass beds occur to the east of Twilight Cove (CSIRO 2015) (Fig. 19).

5.5.4. Marine flora

There have been no specific studies on species or biological characteristics of marine flora within the proposed boundary of Twilight Cove.

5.5.5. Marine fauna

A full list of species protected under the EPBC Act 1999 is given in Appendix 7 and was determined from the Protected Matters Search Tool using the proposed area for marine reservation as the boundary with a 2 km buffer included.

5.5.5.1. Invertebrates

The invertebrate fauna of Twilight Cove has received little attention, if any, in comparison to other locations along the south coast. A review of neighbouring GAB waters in South Australia shows high biodiversity, including temperate species and those with tropical affinities (McLeay *et al.* 2003). Sampling of the benthic protection zone off the coast of Head of Bight and other locations in the eastern GAB using benthic sleds collected 797 species (Ward *et al.* 2006; Sorokin *et al.* 2007). Assemblages were dominated by sponges, echinoderms and cnidarians. Ascidians and bryozoans were also well represented. If the eastern GAB has one of the world's most diverse soft sediment communities (CoA 2008), the diversity off Twilight Cove could be higher than what is currently thought, which is a low diversity of species due to low habitat diversity.

See section 5.1.5.2 (Invertebrates – Cape Vancouver to Bald Island) for information relevant to Twilight Cove on invertebrate species important for commercial and recreational fishing.

5.5.5.2. Bony fishes

Fish assemblages were surveyed at 23 locations along the WA coast, including Albany, the Recherche Archipelago and Twilight Cove (Hutchins 1994). Out of the 728 species identified, 36 species or reef fishes were identified from Twilight Cove (max depth 10 m), which was lower than nearby Recherche Archipelago (~172) and Albany (~120). All species were warm-temperate

species, except for juvenile subtropical *Halichoeres brownfieldi*. All species were very low in abundance, though five species, *Notolabrus parilus, S. aequipinnis, Kyphosus sydneyanus, Pempheris klunzingeri* and *Scorpis georgianus* were found to be more abundant that others. Fewer species observed at Twilight Cove may be due to the lack of habitat diversity and shallowness. Of the platform reefs and sandy habitats surveyed, slightly higher fish diversity was noted over the reefs, though surge and poor visibility were factors preventing further surveys.

See section 5.1.5.3 (Bony fishes – Cape Vancouver to Bald Island) for information relevant to Twilight Cove on fish species important for commercial and recreational fishing.

5.5.5.3. Elasmobranchs

Twilight Cove is identified as a Biologically Important Area for white sharks and, in particular, for foraging (DSEWPaC 2011). White sharks have been caught by commercial fishers in waters adjacent to Twilight Cove (Malcolm *et al.* 2001).

See section 5.1.5.4 (Elasmobranchs – Cape Vancouver to Bald Island) for information relevant to Twilight Cove on demersal shark species.

5.5.5.4. Pinnipeds

The Baxter Cliffs at Twilight Cove is noted as a haul out and breeding colony for Australian sea lions and is the only record of breeding on the mainland as opposed to islands (Dennis and Shaughnessy 1996; Dennis and Shaughnessy 1999; Campbell 2008).

5.5.5.5. Cetaceans

The coastal waters of Twilight Cove are included within the Geographe Bay to Eucla Important Marine Mammal Area (IUCN MMPATF 2021) and are also identified as a Biologically Important Area for calving by southern right whales (DSEWPaC 2011). A Commonwealth recognised emerging aggregation area for southern right whales has been identified at Twilight Cove (DSEWPC 2012; Bannister 2016; Bannister 2018; Smith *et al.* 2020).

5.5.5.6. Seabirds and shorebirds

The proposed area is a Biologically Important Area for foraging and/or breeding by the flesh-footed shearwater, little penguin, little shearwater and Pacific gull (DSEWPaC 2011).

Shorebird surveys during February 2013 counted 60 individuals representing four species from Kanidal Beach, of which three were resident and one was migratory. The red-capped plover was one of the resident species and 32 individuals were counted (Taylor 2013). Kanidal Beach is included in the Nuytsland Nature Reserve shorebird area, which is nationally significant area for the sharp-tailed sandpiper and ruddy turnstone based on a max count of 92 in 2008 and 31 in 2007, respectively (>0.1% threshold) (Weller *et al.* 2020).

Breeding is generally not known to occur on the mainland for little penguins. However, there are reports of nesting on the mainland near Twilight Cove (CALM 1994; Colman 1998).

5.5.6. Recommendations for proposed boundary adjustments

We recommend consideration is given to adjusting the boundaries of Twilight Cove east to 127°00'E (Fig. 19) for the following reasons:

- Seagrass meadows stretch from Twilight Cove east to 127°E (CSIRO 2015), and inclusion of these would result in greater representation of seagrass habitats and associated biodiversity within the proposed expanded area.
- Extending the eastern boundary will improve connectivity with the sanctuary zone in South Australia waters (starts at Wilson Bluff) and provide for better connectivity for species on the move.
- Twilight Cove is an emerging aggregation area for southern right whales and their use of coastal waters is predicted to increase as their population numbers continue to recover.
- Significant rhodolith beds are likely to spread from Recherche to the WA/SA border (inclusive of Twilight Cove) based on surveys and collections (Harvey *et al.* 2017), and rhodolith beds in different regions have their own unique structure, environmental tolerances and associated marine life.

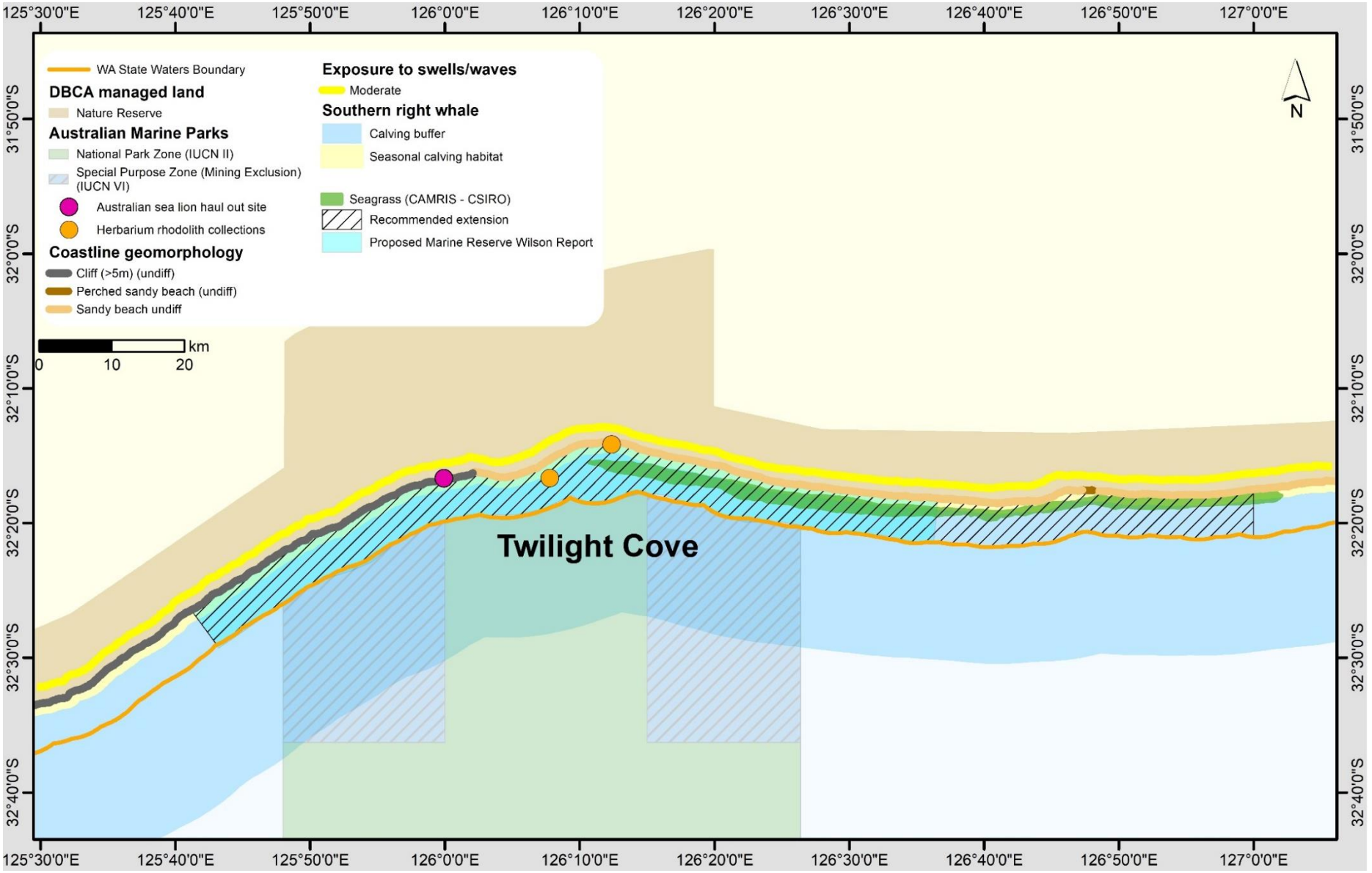

Figure 19: Recommended extension of the Twilight Cove boundary proposed in the Wilson Report. Coastal geomorphology and exposure data sourced from SeaMap Australia (Griffin *et al.* 2012), southern right whale and Australian sea lion sourced from the Australian Government National Conservation Values Atlas Map (DSEWPaC 2011), seagrass data sourced from CSIRO Data Access Portal (CSIRO 2015), rhodolith data sourced from Rhodolith distribution in Australia (Harvey *et al.* 2017).

6. Relative importance of the proposed areas for marine reservation

A framework for prioritising the implementation of marine reserves in WA was developed by the Marine Parks and Reserves Scientific Advisory Committee following the Wilson Report (Simpson and Bancroft 1998; CALM n.d.).

The following criteria were used to prioritise the 70 areas for reservation proposed in the Wilson Report:

- Ecological value (E1)
- Comprehensiveness (E2)
- Bioregional representation (E3)
- Level of existing and/or potential threats (E4)
- Functional integrity (E5)
- Integration of terrestrial and marine management (E6)
- Cultural values (H1)
- Existing information (H2)
- Level of existing and/or potential conflict (H3)
- Socio-political considerations (H4)
- Strategic importance (H5)
- Opportunity (H6)
- Linkages to public sector programs (L1)
- Linkages to private sector programs (L2)

One of the aims of this report is to confirm the relative importance of the five south coast proposed areas for reservation at a regional level. Given the scope of this report, we provide comment on the ecological criteria only. A description of the ecological criteria is provided below as per CALM (n.d.) and Simpson and Bancroft (1998) and a score between 1-5 is given for each criteria.

Ecological value (E1) - Ecological values include the physical, chemical, geological and biological attributes and processes of natural systems. Spatial scales range from local and regional to global scales. Temporal scales range from seconds to evolutionary timescales. Biological attributes include species, populations, communities and ecosystems. The ecological value of natural systems can be assessed from the following characteristics:

- Uniqueness: Contains unique species, populations, communities or ecosystems. Global uniqueness would afford an area a conservation value of international significance (e.g., stromatolites in Hamelin Pool Marine Nature Reserve).
- Representativeness: Representativeness is the degree to which the area in question represents a species, population, community or ecosystem type within a particular marine bioregion. Physiographic features and ecological processes or other natural characteristics can also contribute to the representativeness of an area.
- Dependency: Ecological processes are highly dependent on biotically structured systems. Examples include coral reefs, kelp 'forests', mangrove 'forests' and seagrass meadows. For example, these areas may contain nursery or juvenile areas or contain feeding, breeding or rest areas for migratory marine fish, reptiles, birds or mammals or are a source of larvae for downstream ecosystems.
- Diversity: The area has a high variety of species, populations, communities and ecosystems.
- Productivity: The species, populations, communities or ecosystems of an area have a high natural biological productivity.
- Naturalness: The area has a high degree of naturalness (i.e., is not disturbed or degraded by anthropogenic activities).
- Integrity: The area is a biologically functional unit (i.e., an effective, self-sustaining ecological entity).
- Vulnerability: The area is highly susceptible to degradation by natural events or anthropogenic activities. Biotic communities associated with coastal populations may have a low tolerance to changes in environmental conditions or may exist close to the limits of their tolerance (defined by water temperature, salinity, turbidity or depth).

Comprehensiveness (E2) - A stated aim of the WA Government is that "… the principal thrust of the [Government's] marine conservation effort will be to have one comprehensive system [of marine reserves] under the CALM Act" (WA Government, 1994; 1998). This criterion addresses the issue of comprehensiveness and, therefore, applies at a state-wide scale. Thus, areas for consideration as marine reserves that are not already represented within the state bioregional framework (e.g., South coast) will rate highly (i.e. they increase the comprehensiveness of the state-wide system).

Bioregional representation (E3) - This criterion relates to the extent to which a proposed reserve would be representative of the ecological attributes of the marine bioregion that it is situated within (IMCRA, 1998) and acknowledges the ecological 'sense' and practical benefits in managing fewer but larger ecosystem-scale reserves than numerous smaller scale reserves. For the purposes of this framework, if a proposed area is equal to or greater than 30% (Bohnsack, 1996;

Ballantine, 1997) of the bioregion, it is considered to have a high degree of bioregional representation and, as such, scores highly for this criterion. The application of this criterion within the prioritizing framework should not be confused with the overall goal of achieving adequate representation of ecosystem types within each marine bioregion. The target can also be achieved by numerous smaller marine reserves within the bioregion.

The level of existing and/or potential threats (E4) - This criterion reflects one of the two major objectives of the marine reserve system which is to provide a formal framework to ensure integrated, equitable and sustainable management of human activities. The level of existing and potential threats is related to the nature and intensity of current and future uses, respectively, of an area on the assumption that as usage increases the level of threat to ecological and social values also generally increases. As such, the higher the level of current or projected use, the higher the score for this criterion.

Functional integrity (E5) - This criterion explicitly acknowledges the critical issue of spatial scale in marine management and is based on the assumption that management based on ecological boundaries is likely to be more effective, from an ecological perspective, than management based on sociological boundaries. Ideally, the spatial scales of marine conservation reserves should be reconciled with the spatial scales of key ecosystem processes, given the primacy of the conservation objective (i.e., the area is maintained as a biologically functional unit; i.e. is an effective, self-sustaining ecological entity). Thus, the more a proposed marine conservation reserve complies with this condition, the greater the functional ecological integrity of the reserve and the higher the score for this criterion.

Integration of terrestrial and marine management (E6) - This criterion acknowledges the functional linkages between terrestrial and marine systems and, as such, the importance of integrating marine and terrestrial management frameworks. Because integrated management is obviously easier to achieve within a single agency, proposed marine reserve areas adjoining DBCA managed lands would score higher for this criterion than marine areas adjoining terrestrial areas that are not managed by DBCA.

A review of the original scores given to each of the five proposed areas for reservation is provided in Appendix 8 along with justification for any changes in scoring based off this literature review. Of relevance to the five proposed areas forming the focus of this report, CALM (n.d.) identified the Recherche Archipelago as the highest priority for marine reservation out of the 14 proposed areas along the south coast (Hardy Inlet to Twilight Cove), followed closely by Fitzgerald Biosphere Reserve (3/14) and Cape Vancouver to Bald Island (7/14) (based off weighted sums). Stokes Inlet and Twilight Cove ranked 10th and 11th out of 14.

Based on the six ecological criteria only and combined with knowledge from this review and expert comments, we find the relative importance of each of the five areas at a regional level could be prioritised as follows:

Ranking	Proposed area	CALM score for ecological criteria only	This report's score for ecological criteria only
1	Recherche Archipelago	24	27
2	Fitzgerald Biosphere Reserve	21	24
3	Cape Vancouver to Bald Island	19	21
4	Stokes Inlet	18	20
5	Twilight Cove	17	18

7. Recommendations for new areas of marine reservation along the south coast

After considering the recommendations for boundary extensions for each of the five proposed areas for marine reservation, no new separate extensive areas were further identified from the literature summarised in this report. However, the recommendations below warrant further investigation as to whether they could improve the representation of marine habitats and biodiversity within a proposed south coast marine park.

- Cheyne Bay
    - A distinctive outcrop of Pallinup Sandstone was noted to occur at Cheyne Bay (further east of Cheynes Beach), which provides a different shore formation and character to other rocky shores along the south coast (Colman 1998). In the absence of comprehensive biodiversity surveys, geomorphological features are still a relatively good predictor of habitat diversity. Late Eocene bivalves, gastropods and other molluscan fauna have been examined and identified from Pallinup Sandstone formations from the Eucla Basin (terrestrial sites) (Darragh and Kendrick 2000; Darragh 2017), but not from coastal outcrops.
    - Cheyne Island was documented as having a substantial colony of little penguins (CALM 1994; Cannell 2001). Cheyne Island is a nature reserve, but the surrounding waters are not currently protected.

- Eucla
    - The waters off Eucla were identified as one of six 'centres of rarity' along the south coast of Australia for rare algal species based on predictive modelling. The study found that rare species were often associated with sandy substrates and low nutrient environments (Scott 2012).

- Productivity hotspots
    - There is evidence of upwelling from Albany and Bremer Canyon (e.g., Akhir 2010) but relatively little is known about the canyon systems that lie adjacent to the state managed coastal waters. An understanding of how these canyons are connected with coastal waters may help to identify additional areas worthy of protection within state waters e.g., at sites of regular upwelling hotspots or high larval connectivity.

- Cool water refuges
    - Similar to productivity hotspots, the coastal waters along the south coast of WA should be investigated to find areas where cooler water masses are seasonally upwelled. These cooler waters could act as refuges and may help species and habitats to survive the threat of climate change (McLeod *et al.* 2009). Juvenile southern blue fin tuna have already been observed using these cooler waters suppressed against the southern coastline during strong Leeuwin Current, most likely in response to shifts in prey distributions with temperature.

8. Gaps relevant to marine park planning along the south coast

While there are many gaps specific to individual species or habitats, an extensive list is not provided here. Rather, more broader scale gaps relevant for marine park planning are provided, which have been informed by the lack of information in sourced literature.

- Improving knowledge on marine flora and fauna species distributions and assemblages (e.g., from benthic and pelagic ecosystems) including depth gradients, west to east gradients and proportions of endemism
- Improving the accuracy of population estimates and trajectories for the endangered Australian sea lion along the south coast of WA
- Comprehensive biological surveys over sandy habitats in all regions, including Fitzgerald Biosphere Reserve and Recherche Archipelago, which have had biological surveys conducted over other habitats
- Better understanding of habitats and biodiversity at Stokes Inlet and Twilight Cove
- Investigating whether the Esperance region is an area of diversification of seagrasses
- Improved understanding of intertidal habitats and the influence of wave exposure
- Predicting scenarios of trophic cascades under increasing anthropogenic influences and climate change
- Comprehensive bathymetry and benthic habitat mapping for the five proposed areas, and stretches of coastline in between proposed areas, to ensure no significant geomorphological features or habitats are missed
- Understanding the influence of adjacent canyons for coastal circulation, connectivity, and sediment transport
- Local and regional scale oceanographic influences on genetic diversity, connectivity of marine species, and the inflow of material from offshore waters to inshore, particularly around the islands and reefs of the Recherche Archipelago
- Consideration of how climate change factors into marine park planning along the south coast and if there are areas along the south coast that can act as refuges for marine species, e.g., cooler water, upwelling environments
- An understanding of potential impacts of marine heatwaves on south coast inshore habitats and biota
- Quantify upwelling and biological responses, which would also be of benefit to fisheries management
- Identification of spawning, aggregation and breeding areas, such as for elasmobranchs and keystone fishes

9. Available datasets relevant to the south coast of WA

The following table presents a list of databases where data relating to the south coast proposed areas for marine reservation can be found, and in many cases, freely downloaded. Some of these databases were used to inform the maps presented throughout this report. It is recognised that this table may not include all relevant databases.

Database	Website	Data type	Relevant spatial extent
Atlas of Living Australia	https://biocache.ala.org.au/occurrences/search?q=qid:1616044853658	Marine and terrestrial species occurrences and distributions	South Coast
AusSeabed Marine Data Portal	https://portal.ga.gov.au/persona/marine	Coastal geomorphology, bathymetry, sedimentology	South Coast
AFD - Australian Faunal Directory	https://biodiversity.org.au/afd/home	Online catalogue of taxonomic and biological information	National
Australian Government	https://data.gov.au	Multibeam, LIDAR, laser, bathymetry, coastal compartments, maritime archaeological sites, shipwrecks, aquaculture sites	Albany WA – Eyre SA
Australian Research Data Commons (ARDC)	https://researchdata.edu.au/	Benthic habitats, bathymetry, rocky reef biota	South Coast
BirdLife International	http://datazone.birdlife.org	Species lists, distribution maps, Key Biodiversity Area (Important Bird Area) boundaries, IUCN Red List Categorisation, threats and habitats	National
Department of Transport	www.transport.wa.gov.au/imarine/	Nautical charts Tide, wave and weather data, geographic data	National

Database	Website	Data type	Relevant spatial extent
Digital Earth Australia- Geoscience Australia	www.ga.gov.au/dea	Intertidal digital elevation and extent models, high and low tide composites, waterbodies	National
Environmental Resources Information Network (ERIN)	https://www.environment.gov.au/fed/catalog/main/home.page	Marine benthic substrate (sediment types), bathymetry, Collaborative Australian Protected Areas Database (CAPAD)	National including South Coast
Geoscience Australia	https://ecat.ga.gov.au/geonetwork/srv/eng/catalog.search#/search?from=1&to=20	Bathymetry, coastal geomorphological units, coastal sediment compartments, marine connectivity database	National including South Coast
Global Archive	https://globalarchive.org/	Stereo-BRUV and DOV data for fishes	Albany, Two Peoples Bay, Point Ann, Esperance, Middle Island
Global Biodiversity Information Facility (GBIF)	https://www.gbif.org/	Marine and terrestrial biodiversity datasets	Global – filterable by country/region including south coast occurrences
Integrated Marine Observing System (IMOS)/ Australian Ocean Data Network (AODN)	http://imos.org.au/ https://portal.aodn.org.au/search	Sea surface temperature and surface chlorophyll satellite imagery maps via OceanCurrent Various physical and biological datasets National Reference Station at Esperance between 2008 – 2012/13	National – filterable by region
NationalMap	https://nationalmap.gov.au/about.html	Bathymetry, satellite imagery, coastal elevation models	National
NatureMap	https://naturemap.dbca.wa.gov.au/	Species lists, reports and maps of flora and fauna	South Coast
National Conservation Values Atlas	http://www.environment.gov.au/webgis-framework/apps/ncva/ncva.jsf	Biological important areas for key species, geomorphic features and key ecological features	National
OZCAM - Online Zoological Collections of	https://ozcam.org.au/index.html	Marine and terrestrial species occurrences and distributions	National

Database	Website	Data type	Relevant spatial extent
Australian Museums			
Reef Life Survey	https://reeflifesurvey.imas.utas.edu.au/static/landing.html	Biodiversity and occurrence of fishes, invertebrates, habitat	Albany to Daw Island
Rhodolith distribution in Australia	https://www.google.com/maps/d/u/0/viewer?mid=1F8SoZodr-zqq07AEjQxYxc8xoR8&ll=-31.923050694419473%2C125.55374044513789&z=6	National rhodolith collections	National including Recherche Archipelago, Israelite Bay to Twilight Cove
SeaMap Australia	https://seamapaustralia.org/	Seagrass habitat, coastal geomorphology, reef classification, benthic biota	Cape Vancouver – Bald Island, Fitzgerald Biosphere Reserve, Stokes Inlet, Recherche Archipelago, Israelite Bay.
Species Profile and Threats Database	http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl	Species and ecological communities listed under the EPBC Act 1999	National
WA Waves – UWA	https://wawaves.org/	Real time data on horizontal and vertical water motions collected by surface wave buoys	King George Sound and elsewhere along the WA coast
Western Australia Marine Oil Pollution Risk Assessment (WAMOPRA)	http://wamopra.navigatusconsulting.com/map	Coastal oil pollution risk assessment tool	Albany – SA/WA border

10. Metadata analysis

An analysis of the metadata is useful for the marine park planning process at it allows managers to see where there has been biased research effort and highlights areas of research to focus on to improve decision making. Included here is a brief analysis of the metadata based on the literature referenced in this report. Some literature is specific to certain locations or values, while some may be appliable more broadly across the south coast. In total, ~244 pieces of literature/datasets are included in this report. The majority of literature sourced for this report has come from published scientific papers (~119), followed by reports (~56) and books (~50) (Fig 20).

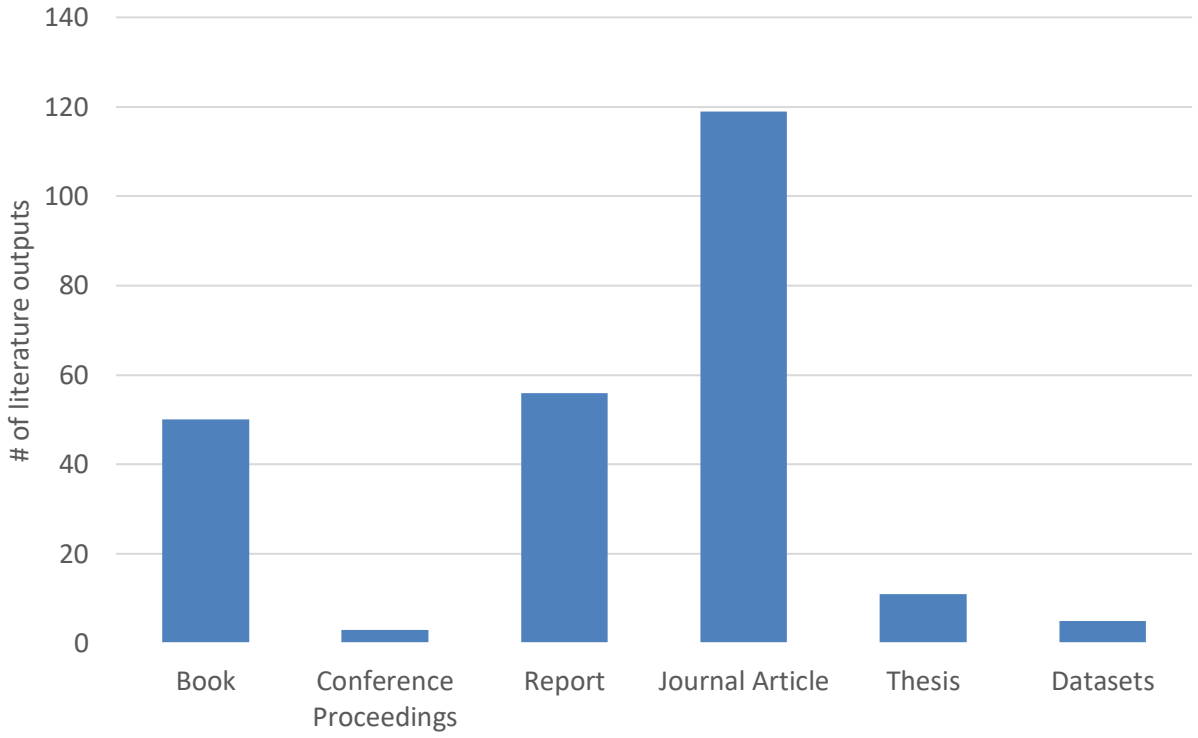

Figure 20: Formats of literature included in this report.

The earliest literature referenced in this report is 1976, however, the scope of this report was to focus on literature produced since the Wilson Report, which was released in 1994. There was a large spike in literature outputs in 2005 (Fig. 21), which was mostly due to the two volumes published on Esperance and the Recherche Archipelago following the Twelfth International Marine Biological Workshop (Wells *et al.* 2005c; Wells *et al.* 2005b).

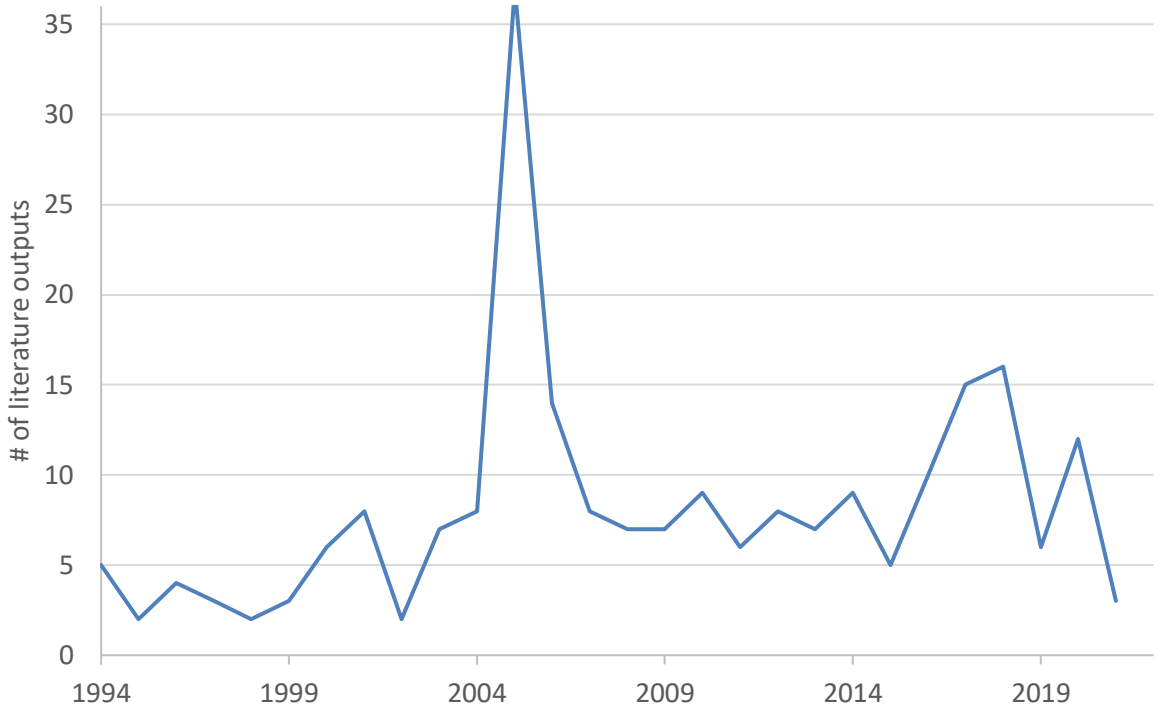

Figure 21: The number of literature outputs produced between 1994 and 2019 within the scope of this report along the south coast.

Most of the research effort (62%), within the scope of this report, has focused on the Esperance and Recherche Archipelago area (Fig. 22). Twilight Cove and Stokes Inlet have received little research attention compared to the other proposed areas for marine reservation.

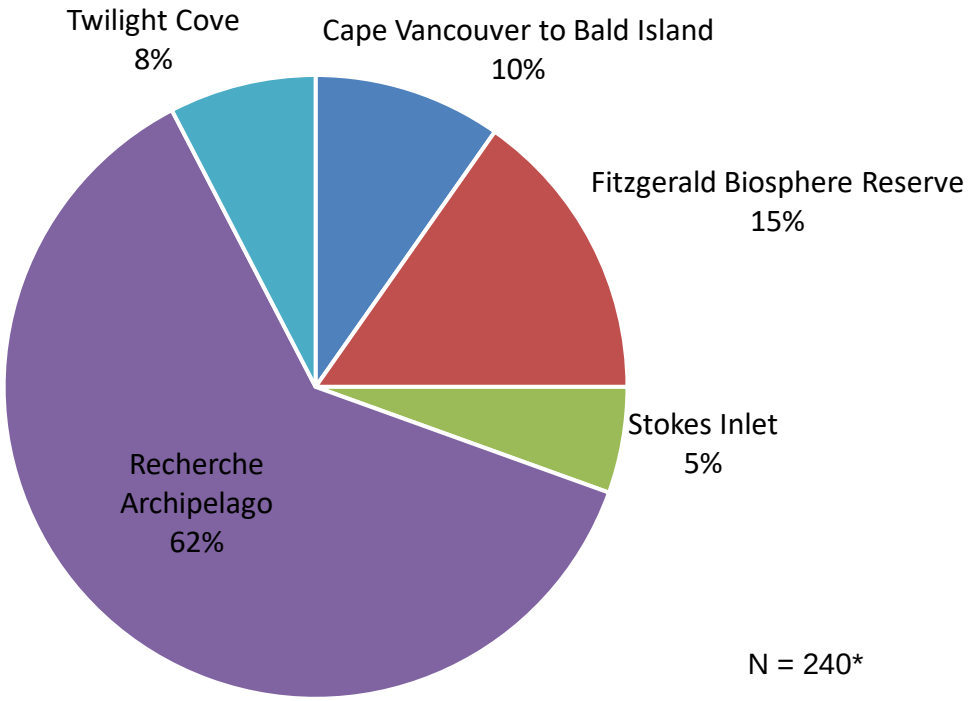

Figure 22: Percentage of research specifically relating to each of the proposed areas for marine reservation. * Some research is relevant to more than one area.

Literature concerning marine fauna (66%) within each of the five proposed areas for marine reservation is greater than marine flora (15%), geomorphology (10%) and marine habitats (9%) (Fig. 23). It is recognised that other research not pertaining to these four subject areas is available for the south coast of WA. For example, fisheries related information on catch and stock assessments is not included in this report as commercial fishing effort and issues will be considered extensively during the marine park planning process. However, information relating to the distribution and/or biology for species targeted by commercial and recreational fishers is included. Within the subject area of marine flora, macroalgae (73%) has received more attention than seagrasses (Fig. 24). Within the subject of marine fauna, bony fishes (29%) and invertebrates (23%) have received the most research attention (Fig. 25).

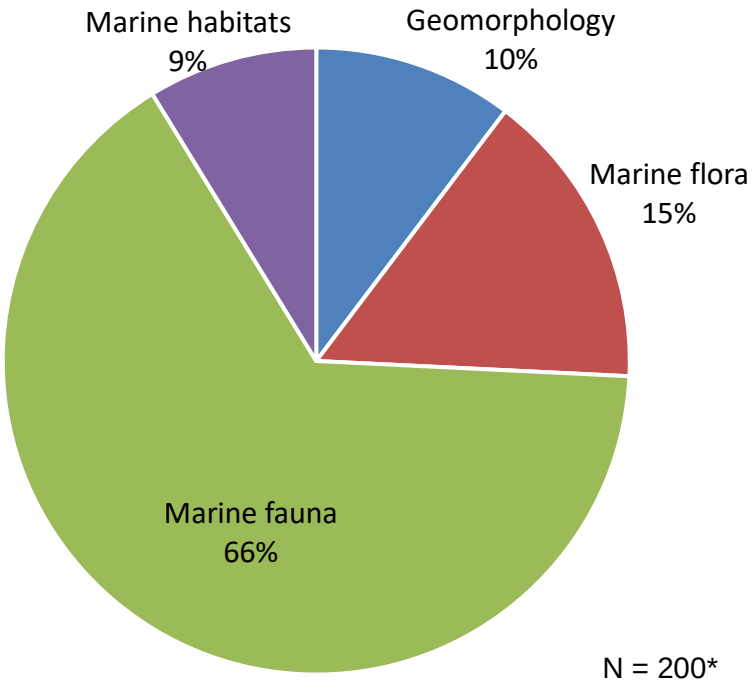

Figure 23: Percentage of research specifically relating to each of the four subject areas included in the scope of this report. * Some research is relevant to more than one subject area.

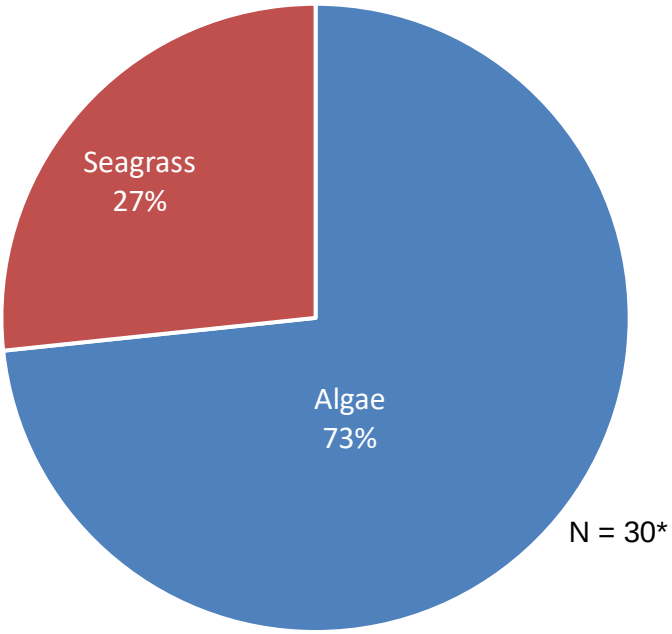

Figure 24: Percentage of species and biological research relating to macroalgae and seagrass within the five proposed areas for marine reservation. * There is some overlap with marine benthic habitats.

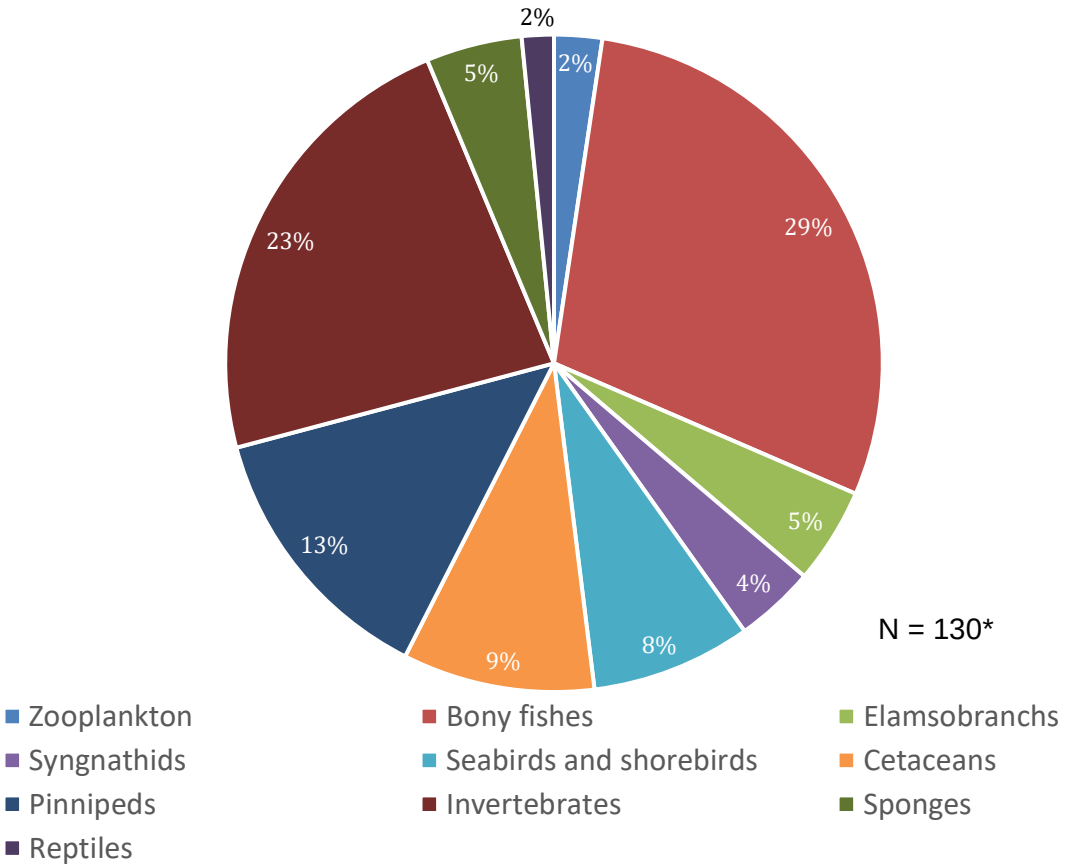

Figure 25: Percentage of biological research relating to marine fauna within the five proposed areas for marine reservation. * Some research is relevant to more than one taxon.

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12. Appendix 1

One component of this scope of works involved engaging with relevant scientific experts on the south coast marine environment and/or on spatial planning. A total of 54 experts were engaged for the purposes of this report (see acknowledgements section), and provided literature, datasets and/or additional contacts. The below table presents the relevant comments/suggestions made from a subset of these experts in relation to recommended areas for marine reservation on the south coast of WA, and we would like to acknowledge the following scientific experts for their insightful comments: Kirsty Alexander (UWA), Kevin Bancroft (DBCA), Neville Barrett (IMAS/UTAS), Lynnath Beckley (Murdoch University), Sahira Bell (UWA), Chris Burton (Western Whale Research), Marion Cambridge (UWA), Alma de Rebeira (Eyre Bird Observatory), Graham Edgar (UTAS), Ian Eliot, James Fitzsimmons (TNC), Chris Gillies (TNC), Euan Harvey (Curtin University), Alistair Hobday (CSIRO), John Huisman (DBCA), Curt Jenner (CWR), Micheline Jenner (CWR), Gary Kendrick (UWA), Chandra Salgado Kent (Oceans Blueprint), Lisa Kirkendale (WAM), Tim Langlois (UWA), Ryan Lowe (UWA), Kathryn McMahon (ECU), Glenn Moore (WAM), Kathy Murray (DBCA), Mick O'Leary (UWA), Harriet Paterson (UWA), Paul Van Ruth (IMOS), Ralph Talbot Smith (DoT), Kate Sprogis (Murdoch University), Fiona Valesini (TNC), Di Walker, Rebecca Wellard (Curtin University), Nerida Wilson (WAM) and the Department of Primary Industries and Regional Development (DPIRD).

General comments about the WA south coast
Flora and Fauna ● The south coast is recognized by the IUCN Marine Mammal Protected Areas Taskforce as an important area for marine mammals in terms of biology, ecology and population structure – pers. comm. Chandra Salgado Kent. ● The expected continued increase in abundance of southern right whales (*Eubalaena australis*) will lead to more areas along the south coast being used for calving, nursing and socialisation. These whales often come in close to beaches for this purpose. The population is expanding, but work from the southern hemisphere has shown that some populations are not breeding - pers. comm. Chris Burton. ● Maps do not accurately reflect the occurrence of southern right whales along the south coast. Some areas are important for them, but some are not officially listed as important – pers. comm. Kirsty Alexander. ● Black Point to Bremer Bay contains ideal habitat for southern right whales to utilise in the future – pers. comm. Chris Burton.

- GAB is the main breeding area for southern right whale western and eastern populations. Western population is ~2,500-3000 individuals, eastern population is much smaller. 30yrs ago there were hardly any SRW – pers. comm. Chris Burton.
- Pelagic fish use the inshore areas of the south coast e.g., southern blue fin tuna (*Thunnus maccoyii*) and yellowtail kingfish (*Seriola lalandi*). *Seriola lalandi* are associated with inshore features such as lumps/mounds – WA has a healthy population compared to the east coast – pers. comm. Alistair Hobday.
- There is a migration break (for leafy seadragons) between Bremer and Hopetoun. A natural barrier exists but it is not well understood. There is lower genetic diversity in leafy seadragons in WA compared to SA – pers. comm. Nerida Wilson.
- It is quite possible a nursery area exists for white sharks (*Carcharodon carcharias*) around Salisbury Island/ Recherche Archipelago, and other locations along the south coast – pers. comm. Euan Harvey.
- Many islands support corals and the associated biodiversity including little vignettes of relatively high fish species diversity scattered along the south coast – pers. comm. Gary Kendrick.
- Endemism is high, Recherche Archipelago is a hotspot but there is a lack of sampling throughout the south coast region – pers. comm. Glenn Moore.
- There is potential for previously undescribed species of cryptic fish to be present – pers. comm. Lynnath Beckley.
- Marine macroalgal species richness and endemism are high along the south coast with > 500 species of macroalgae recorded from the Recherche Archipelago – pers. comm. Gary Kendrick.
- Species lists of marine plants for specific areas may be available based on what is held in the various herbaria (WA primarily, but Adelaide will also have significant holdings due to Bryan Womersley's work). They will not be comprehensive as the south coast is under collected – pers. comm. John Huisman.
- There is evidence of extensive seagrass meadows between Israelite Bay and Point Culver – pers. comm. Marion Cambridge.
- The WA southern coast is a temperate biodiversity and endemism hotspot - pers. comm. Gary Kendrick.
- Biological systems are changing at a fine scale (100 m's) along the south coast (mostly referring to Recherche Archipelago) – it will be different again in 10 yrs time – pers. comm. Euan Harvey.
- There are many fish species along the south coast for which there is no biological information because they are not targeted by commercial or recreational fishers. Although not important from the perspective of these fishing sectors, these species,

such as buff bream, dusky morwong and banded sweep, are likely to be ecologically important for the region given they are likely herbivorous and feed on algae - pers. comm. DPIRD.

- The catch/abundance of snapper drops off east of Albany. There are some spawning aggregations west of Albany, out of scope. Hapuka are typically distributed in deeper waters and may be using deep water canyons where they intersect with the edge of the continental shelf - pers. comm. DPIRD.

Habitats

- Fitzgerald waters have granite and silicate sands. Hopetoun has more limestone. A biophysical break exists between Bremer Bay and Hopetoun. A different composition of species exists around Bremer Bay compared to Hopetoun, e.g., for algae species *Cystophora*, likely due to the geology of both areas forming contrasting habitat – pers. comm. Gary Kendrick, Euan Harvey.

Geomorphology

- The distribution of active canyons very likely dominates upwelling and nutrient supply to the inshore waters, and there may be potential areas where sediment is lost from the shelf to offshore waters and canyons. Very little is known about these features and more research is needed – pers. comm. Ian Eliot.
- The complex geology of the south west coast influences the distribution and composition of flora and fauna – pers. comm. Ian Eliot.
- There has not been a lot of depth gradient work in the region – pers. comm. Euan Harvey

Oceanography

- Projected weakening of the Leeuwin Current may impact species distributions – pers. comm. Alistair Hobday
- It is expected that there will be a southward shift in species distributions, but an east – west shift along the south coast is less likely –pers. comm. Alistair Hobday
- Cooler water temperatures are likely to persist (at least in pockets) along the southern coast that could provide refuge for some species, but this is not fully understood – pers. comm. Alistair Hobday
- Coastal oceanography is understudied along the south coast of WA – the south coast is a high energy environment, and wave exposure is a key influencer (as opposed to the Kimberley/north of Australia). The high energy plays a major role in sediment

transport and influences the distribution of habitats and species – pers. comm. Ryan Lowe.

Other

- Microplastics are being found in beach sand. Higher levels are being found at the more exposed ends of beaches – pers. comm. Harriet Paterson.
- The south coast is poorly studied when compared to other regions such as Shark Bay, Ningaloo, the Pilbara and The Kimberley – pers. comm. Lisa Kirkendale.

Marine park planning

Boundary placement and zoning

- Proposed boundaries should be based on CAR (Comprehensive, Adequate and Representative) approach and principles – pers. comm. Gary Kendrick.
- State marine park boundaries should connect up with Commonwealth marine park boundaries and DCBA managed terrestrial parks, so that continuous protection is provided inshore to offshore, inclusive of intertidal areas – pers. comm. Euan Harvey, WAM and others.
- Broadscale/comprehensive sampling along the south coast to describe the abundance, distribution and community structure of marine communities are not necessary to inform marine park planning. The representation of broad geomorphological features and depths along the coast within a Comprehensive Adequate and Replicated network of marine sanctuaries provide the principles to inform marine park planning– pers. comm. Tim Langlois.
- In the absence of comprehensive biodiversity information, geomorphology is likely still one of the best predictors of habitat and should still be used to guide boundaries, while being supported by biological studies. Similarly, capturing coastlines with different exposures to wave action will also help to provide more comprehensive protection - pers. comm. Kathy Murray, Ryan Lowe.
- Parks need to be comprehensive and provide connectivity across habitats – pers. comm. Neville Barratt.
- The south coast needs a series of no take zones. There needs to be replication and representation – pers. comm. Tim Langlois.
- Comprehensive habitat mapping is required to underpin the process of boundary placement – pers comm. Neville Barrett.
- If there are discrete communities, e.g., with natural boundaries between them, then that can be used to justify decisions on boundaries – pers. comm. Tim Langlois.
- Understand where fishers go and factor that into decisions on boundary placements –

pers. comm. Tim Langlois.

- Marine Sanctuaries should not simply be placed where no fishing occurs. A Comprehensive Adequate and Representative network of marine sanctuaries will include some areas close to recreational fishing access and some areas far from access. Coastal no-take Marine Sanctuaries that allow shore fishing are likely to not provide adequate protection and are "useless" for biodiversity conservation, tourism, science, education and biodiversity appreciation – pers. comm. Tim Langlois.
- Parks/zones need to cover depth gradients, sediment gradients, and social gradients (e.g., proximity to anthropogenic activities) – pers. comm. Tim Langlois.
- Socioeconomic impacts of no take zones should be incorporated into the MPA planning process – pers. comm. Tim Langlois.
- Opening and closing of estuaries is dependent on water quality – not set times every year – so if there was a marine reserve close to or joining an estuary, this would be a consideration – pers. comm.
- Potential locations for port development on the south coast need to be considered – pers. comm. Ralph Talbot Smith.
- Will gaps in knowledge be investigated before park boundaries are decided – pers. comm. Ryan Lowe and others

Climate change

- The reserve system needs to be robust against climate change – pers. comm. Alistair Hobday.
- Species will move at different rates with a warming climate, some not at all. Steppingstone MPAs along the coast for species that are moving quickly should be considered, refuges further south will exist when they arrive, and for populations not moving, they are safeguarded where they are long term. Any MPA network along a latitudinal span is to some degree a steppingstone network, for example the NSW and VIC MPA networks with their bioregional representation approaches (although not completed in NSW) are good examples – pers. comm Graham Edgar.

Fishing

- It is possible to manage commercial fishing around lumps and nearshore features, but also need to manage recreational fishing as it can exert significant pressure – pers. comm. Alistair Hobday.
- Parks and zones should not be proposed for fisheries regulation, they should be proposed based on biodiversity – pers. comm. Tim Langlois.
- Some survey findings of recreational fishers show that ~ 80% are happy with no-take

zones and ~75-80% perceive the environmental benefits – pers. comm. Tim Langlois.

- Some islands are popular for aquaculture e.g., Esperance Bay area. These need to be considered when planning for parks – pers. comm. Euan Harvey.
- There are numerous popular fishing spots around the Esperance region so it would probably be better to consider a series of small no take zones around the Recherche Archipelago – pers. comm.

Stakeholder engagement

- South Coast National Resource Management (NRM) have been instrumental in growing community support for marine parks in the past, they should be engaged once again to associate the community with the whole south coast planning process – pers. comm. Gary Kendrick.
- It is important to engage with recreational fishers – (pers. comm. Euan Harvey.
- There is strong interest from the Indigenous communities to get involved with research along the south coast – pers. comm. Gary Kendrick.
- Tourism activities are likely to grow (e.g., whale watching) and this needs to be managed – pers. comm. Kirsty Alexander.

Cape Vancouver to Bald Island

- Two Peoples Bay has seagrass meadows down to ~45 m and has good biodiversity. – pers. comm. Gary Kendrick.
- There are interesting reef systems around e.g., granite reefs around Coffin Island. Many islands have well developed coral reef systems e.g., cabbage corals - pers. comm. Gary Kendrick
- Many Peaks and Two Peoples Bay (east of Albany) contain impressive sponge gardens - pers. comm. Euan Harvey.
- Braun's wrasse (*Pictilabrus brauni*) is an example of a WA south coast endemic fish species, a species that has only been recorded between Cheyne Beach and King George Sound – pers. comm. Glenn Moore.

Fitzgerald Biosphere Reserve

- Doubtful Bay to Fitzgerald has important habitat for southern right whales. Pairs are sometimes seen around Point Ann – pers. comm. Chris Burton.
- Fitzgerald Biosphere is special and very important – definitely needs consideration – pers. comm. Di Walker.
- There is some sediment drift to offshore waters - pers. comm. Di Walker.

Esperance – Recherche Archipelago

- Include from west of town through to Middle Island in the marine park – good area and could extend out to 3nm – would likely be supported by the community – pers. comm. Gary Kendrick.
- 604 species of sponge have been documented from the Esperance region. The Great Barrier Reef has ~800 recorded species for the whole area – pers. comm. Gary Kendrick.
- > 500 species of seaweed have been recorded – pers. comm. Gary Kendrick.
- More work on seagrasses is required in the Esperance region as it is a potential area for diversification – pers. comm. Gary Kendrick.
- Submarine canyons are found east of Middle Island that are unexplored and could be protected – pers. comm. Gary Kendrick.
- Recherche Archipelago has high recreational value for fishing and SCUBA diving – pers. comm. Gary Kendrick.
- In between islands, subtidal seagrass meadows extend to depths of ~40-50 m – pers. comm. Gary Kendrick.
- Extensive rhodolith beds exist and are important habitats for fishes – pers. comm. Gary Kendrick.
- The Recherche has highly oligotrophic clear water, with little runoff/nutrient input, and supports high biodiversity. It is a biodiversity hotspot with a high level of endemism – pers. comm. Gary Kendrick.
- Islands are different (biologically) heading out to sea and different communities exist on different sides of the islands – pers. comm. Euan Harvey.
- An inshore change in diversity of plants and animals is evident compared to islands and offshore – pers. comm. Euan Harvey.
- A break in benthic habitats exists around eastern Middle Island, Recherche Archipelago – pers. comm. Gary Kendrick.

Twilight Cove

- Important area of habitat for southern right whales – pers. Comm. Curt Jenner and Micheline Jenner.
- Southern right whales are often seen close to shore, possibly using the noisy surf zone to avoid predation by killer whales (*Orcinus orca*) – pers. comm. Kate Sprogis; for more information see Nielsen, M. L., Bejder, L., Videsen, S. K., Christiansen, F., & Madsen, P. T. (2019). Acoustic crypsis in southern right whale mother–calf pairs:

infrequent, low-output calls to avoid predation? Journal of Experimental Biology, 222(13).

- There has been increasing 4x4 vehicle activity along the coast close to Twilight Cove in recent years – pers. comm. Alma de Rebeira.
- Seabed characteristics are pretty flat – pers. comm. Mick O'Leary.

Suggestions for boundary extensions inside of scope

- Fitzgerald boundaries could extend west of Bremer Bay to Cape Knob to protect the bay as it is an important area for the Australian south coast endemic leafy seadragon (*Phycodurus eques*). Could also extend the eastern boundary past Hopetoun to Starvation Bay – pers. comm. Nerida Wilson and Gary Kendrick.
- Hopetoun has high diversity and different composition compared to Bremer Bay, ~12 species of *Cystophora* (a brown algae) were recorded there for example – pers. comm. Gary Kendrick.
- Israelite Bay has extensive seagrass meadows and macroalgae in relatively shallow water. The aspect of the bay likely has an influence on the diversity. The eastern boundary of the Recherche Archipelago could extend east to incorporate Israelite Bay – pers. comm. Kevin Bancroft and Marion Cambridge.

Additional areas for consideration outside of scope

Estuaries, inlets and wetlands

- Some estuaries are tidal and essentially marine environments and should be considered – pers. Comm. Di Walker.
- Some species of marine teleosts such as the Australian herring (*Arripis georgianus*) and WA salmon (*Arripis truttaceus*) opportunistically use estuaries and inlets as nursery grounds along the south coast – pers. comm. Ian Eliot.
- When sandbars break for estuaries, connectivity becomes very important with the coast and offshore waters. Estuaries need to be considered/included – pers. comm.
- RAMSAR wetlands and birds should be considered when investigating connectivity. The Lake Warden system and Lake Gore are important – pers. comm. Di Walker.
- Extending the proposed marine reserve boundaries to the high water mark in estuaries and inlets would accommodate nearshore marine fishes (and even some 'offshore species', e.g., snapper, gummy sharks) that rely on protected habitats during their life cycles (pers. comm. DPIRD). Walpole Inlet and Oyster Harbour are important nursery areas for juvenile elasmobranchs e.g., gummy sharks. Gummy sharks are migratory and use the waters along the south coast of WA, as well as the south-west (e.g., Braccini et al. 2017), so nursery areas such as Walpole Inlet are important for

broader populations – pers. comm. DPIRD.

- Waychinicup Inlet is different from other inlets along the south coast due to its unique geomorphology and permanently open entrance channel. It is likely to be ecologically unique and provide sheltered nursery habitat for marine fish species - pers. comm. DPIRD.

Augusta – Albany

- The stretch of coastline from Augusta to Albany should be considered for marine parks – pers. comm. Lynnath Beckley.
- Current boundaries should be expanded to cover more areas likely to be used by southern right whales as their population grows (e.g., Black Point to Bremer Bay and Flinders Bay near Augusta). It is expected that they will use habitat further west and north (such as Flinders Bay and Geographe Bay) in the future – pers. comm. Chris Burton.
- The extreme high tide mark and the salt marshes should be protected in Albany – pers. comm. Di Walker.
- Around Albany, the offshore waters have beach terraces and great sponge gardens. It also backs onto terrestrial state parks – so a marine coastal park would suit this area – pers. comm. Gary Kendrick.
- Albany could have strong community support for a marine park. Many locals have commented on the decline in abundance and size of some recreationally fished species over the last ~30 years and most recreational fishers support marine parks – pers. comm.
- King George Sound is a protected embayment and has a high abundance of squid; ~95% of the commercial catch of squid along the south coast of WA comes from the Albany region - pers. comm. DPIRD.

Mentions of datasets

- There is ongoing work on kelps off Esperance Town in 20-50 m of water to examine the connectivity between deep water and shallow benthic assemblages - pers comms. Sahira Bell.
- Tangaroa Blue could provide data on rubbish - pers comm. Alma de Rebeira.
- Seadragon Search - seeks to expand understanding of wild seadragon populations through meaningful community involvement - pers. comm. Nerida Wilson
- In absence of published data - the WAM can search their databases for certain locations/coordinates and see what has been deposited by researchers or other groups over the years – pers. comm. Lisa Kirkendale.

- A hybrid Bush Blitz (terrestrial and marine) survey has been approved for the Recherche Archipelago and will hopefully be conducted in 2022-23 – pers. comm. Lisa Kirkendale.
- Data since 2014 on Australian sea lions and small delphinids in Bremer Bay has been collected – pers. comm. Rebecca Wellard.
- Bathymetry data from 1964-2013 is available on SLIP, AusSeabed, National Map, and for 2013-current, data is available upon request to coastaldata@transport.wa.gov.au – pers. comm. Ralph Talbot-Smith.
- CoastRun is conducted every five years where aerial photos are taken of the coastline from Kalbarri to Israelite Bay (1400km). Using photogrammetry a 3D image can be produced. Coastline movements data is available from DoT by emailing CDC@transport.wa.gov.au or viewing on NationalMap under WA -> DoT -> coastal movements. Erosion Hot spots report is available from DoT website Coastal erosion and stability (transport.wa.gov.au) assessment of Coastal Erosion Hotspots in Western Australia. CoastRun has a digital elevation model of 2m resolution and photography at 0.1-0.2m resolution - all available through WALIS Marine Group - pers. comm. Ralph Talbot-Smith.
- Old whaling data was used to help identify suitable port locations along the south coast. One of those potential sites is in the middle of the Recherche - pers. comm. Ralph Talbot-Smith.
- IMOS had a National Reference Station at Esperance between 2008 – 2012/13. Physical and biogeochemical data are available for this site – pers. comm. Paul van Ruth
- PhD student working on developing bathymetry from satellite imagery using algorithms, so could be used to identify any spots where more bathymetry information will be useful – pers. comm. Mick O'Leary.
- Currently research occuring on dolphin population dynamics on the south coast - current research indicates high levels of site fidelity consistent with resident populations of both dolphin species. Photo ID sets and some genetic data is available for dolphins – pers. comm. Kirsty Alexander.
- Some community volunteer long term data available for the Albany area and broader south coast region on habitat use for whales – pers. comm. Kirsty Alexander.
- Whale watch vessel logbooks and DBCA stranding database are useful sources of information – pers. comm. Kirsty Alexander.
- Conducted seagrass diversity study between Albany and Esperance - focus on Posidonia species- pers. comm. Kathryn McMahon.

- Data on fish assemblages can be made available for analyses if required – pers. comm. Euan Harvey.

13. Appendix 2

Appendix 2: EPBC Act 1999 listed species occuring within the Cape Vancouver to Bald Island proposed area as determined from the Protected Matters Search Tool. The lists may include some birds and fishes that are not technically marine species.

NAME	EPBC STATUS	TYPE OF PRESENCE
LISTED THREATENED SPECIES		
BIRDS		
***Atrichornis clamosus,* Noisy Scrub-bird, Tjimiluk [654]**	Endangered	Species or species habitat known to occur within area
***Botaurus poiciloptilus*, Australasian Bittern [1001]**	Endangered	Species or species habitat known to occur within area
***Calidris canutus*, Red Knot, Knot [855]**	Endangered	Species or species habitat likely to occur within area
***Calidris ferruginea*, Curlew Sandpiper [856]**	Critically Endangered	Species or species habitat known to occur within area
***Cereopsis novaehollandiae grisea*, Cape Barren Goose (south-western), Recherche Cape Barren Goose [25978]**	Vulnerable	Breeding known to occur within area
***Dasyornis longirostris*, Western Bristlebird [515]**	Endangered	Species or species habitat known to occur within area
***Diomedea antipodensis*, Antipodean Albatross [64458]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Diomedea dabbenena*, Tristan Albatross [66471]**	Endangered	Species or species habitat known to occur within area
***Diomedea epomophora,* Southern Royal Albatross [89221]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Diomedea exulans,* Wandering Albatross [89223]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Diomedea sanfordi*, Northern Royal Albatross [64456]**	Endangered	Foraging, feeding or related behaviour likely to occur within area
***Falco hypoleucos,* Grey Falcon [929]**	Vulnerable	Species or species habitat known to occur within area
***Halobaena caerulea,* Blue Petrel [1059]**	Vulnerable	Species or species habitat known to occur within area
***Leipoa ocellata,* Malleefowl [934]**	Vulnerable	Species or species habitat known to occur within area
***Limosa lapponica menzbieri,* Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]**	Critically Endangered	Species or species habitat known to occur within area
***Macronectes giganteus,* Southern Giant-Petrel, Southern Giant Petrel [1060]**	Endangered	Species or species habitat known to occur within area
***Macronectes halli,* Northern Giant Petrel [1061]**	Vulnerable	Species or species habitat known to occur within area

NAME	EPBC STATUS	TYPE OF PRESENCE
***Numenius madagascariensis*, Eastern Curlew, Far Eastern Curlew [847]**	Critically Endangered	Species or species habitat known to occur within area
***Pachyptila turtur subantarctica,* Fairy Prion (southern) [64445]**	Vulnerable	Species or species habitat known to occur within area
***Phoebetria fusca,* Sooty Albatross [1075]**	Vulnerable	Species or species habitat known to occur within area
***Psophodes nigrogularis nigrogularis,* Western Heath Whipbird [64449]**	Endangered	Species or species habitat known to occur within area
***Pterodroma mollis,* Soft-plumaged Petrel [1036]**	Vulnerable	Species or species habitat known to occur within area
***Sternula nereis nereis,* Australian Fairy Tern [82950]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Thalassarche carteri*, Indian Yellow-nosed Albatross [64464]**	Vulnerable	Foraging, feeding or related behaviour may occur within area
***Thalassarche cauta*, Shy Albatross [89224]**	Endangered	Foraging, feeding or related behaviour likely to occur within area
***Thalassarche impavida*, Campbell Albatross, Campbell Black-browed Albatross [64459]**	Vulnerable	Species or species habitat may occur within area
***Thalassarche melanophris*, Black-browed Albatross [66472]**	Vulnerable	Species or species habitat may occur within area
***Thalassarche steadi*, White-capped Albatross [64462]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
MAMMALS		
***Balaenoptera borealis*, Sei Whale [34]**	Vulnerable	Species or species habitat may occur within area
***Balaenoptera musculus*, Blue Whale [36]**	Endangered	Species or species habitat likely to occur within area
***Balaenoptera physalus*, Fin Whale [37]**	Vulnerable	Species or species habitat may occur within area
***Eubalaena australis*, Southern Right Whale [40]**	Endangered	Breeding known to occur within area
***Megaptera novaeangliae*, Humpback Whale [38]**	Vulnerable	Species or species habitat likely to occur within area
***Neophoca cinerea*, Australian Sea-lion, Australian Sea Lion [22]**	Endangered	Species or species habitat likely to occur within area
REPTILES		
***Caretta caretta*, Loggerhead Turtle [1763]**	Endangered	Breeding likely to occur within area
***Chelonia mydas*, Green Turtle [1765]**	Vulnerable	Breeding likely to occur within area
***Dermochelys coriacea*, Leatherback Turtle, Leathery Turtle, Luth [1768]**	Endangered	Breeding likely to occur within area
SHARKS		
***Carcharias taurus,* (west coast population),Grey Nurse Shark [68752]**	Vulnerable	Species or species habitat likely to occur within area
***Carcharodon carcharias*, White Shark, Great White Shark [64470]**	Vulnerable	Foraging, feeding or related behaviour known to occur within area
***Rhincodon typus*, Whale Shark [66680]**	Vulnerable	Species or species habitat may occur within area
LISTED MIGRATORY SPECIES		

NAME	EPBC STATUS	TYPE OF PRESENCE
MIGRATORY MARINE BIRDS		
***Apus pacificus*, Fork-tailed Swift [678]**	Threatened	Species or species habitat likely to occur within the area
***Ardenna carneipes*, Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]**	Threatened	Breeding known to occur within area
***Ardenna grisea*, Sooty Shearwater [82651]**	Threatened	Species or species habitat may occur within area
***Diomedea antipodensis*, Antipodean Albatross [64458]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Diomedea dabbenena*, Tristan Albatross [66471]**	Endangered	Species or species habitat may occur within area
***Diomedea epomophora*, Southern Royal Albatross [89221]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Diomedea exulans*, Wandering Albatross [89223]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Diomedea sanfordi,* Northern Royal Albatross [64456]**	Endangered	Foraging, feeding or related behaviour likely to occur within area
***Hydroprogne caspia*, Caspian Tern [808]**	Threatened	Breeding known to occur within area
***Macronectes giganteus*, Southern Giant-Petrel, Southern Giant Petrel [1060]**	Endangered	Species or species habitat may occur within area
***Macronectes halli*, Northern Giant Petrel [1061]**	Vulnerable	Species or species habitat may occur within area
***Onychoprion anaethetus*, Bridled Tern [82845]**	Threatened	Foraging, feeding or related behaviour likely to occur
***Phoebetria fusca*, Sooty Albatross [1075]**	Vulnerable	Species or species habitat may occur within area
***Thalassarche carteri*, Indian Yellow-nosed Albatross [64464]**	Vulnerable	Foraging, feeding or related behaviour may occur within area
***Thalassarche cauta*, Shy Albatross [89224]**	Endangered	Foraging, feeding or related behaviour likely to occur within area
***Thalassarche impavida*, Campbell Albatross, Campbell Black-browed Albatross [64459]**	Threatened	Species or species habitat may occur within area
***Thalassarche melanophris*, Black-browed Albatross [66472]**	Vulnerable	Species or species habitat may occur within area
***Thalassarche steadi*, White-capped Albatross [64462]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
MIGRATORY MARINE SPECIES		
***Eubalaena australis*, Southern Right Whale [75529]**	Endangered	Breeding known to occur within area
***Balaenoptera borealis*, Sei Whale [34]**	Vulnerable	Species or species habitat may occur within area
***Balaenoptera edeni*, Bryde's Whale [35]**	Threatened	Species or species habitat may occur within area
***Balaenoptera musculus*, Blue Whale [36]**	Endangered	Species or species habitat likely to occur within area
***Balaenoptera physalus*, Fin Whale [37]**	Vulnerable	Species or species habitat may occur within area

NAME	EPBC STATUS	TYPE OF PRESENCE
***Caperea marginata*, Pygmy Right Whale [39]**	Threatened	Species or species habitat may occur within area
***Carcharhinus longimanus*, Oceanic Whitetip Shark [84108]**	Threatened	Species or species habitat may occur within area
***Carcharodon carcharias*, White Shark, Great White Shark [64470]**	Vulnerable	Foraging, feeding or related behaviour known to occur within area
***Caretta caretta*, Loggerhead Turtle [1763]**	Endangered	Breeding likely to occur within area
***Chelonia mydas*, Green Turtle [1765]**	Vulnerable	Breeding likely to occur within area
***Dermochelys coriacea*, Leatherback Turtle, Leathery Turtle, Luth [1768]**	Endangered	Breeding likely to occur within area
***Lagenorhynchus obscurus*, Dusky Dolphin [43]**	Threatened	Species or species habitat may occur within area
***Lamna nasus*, Porbeagle, Mackerel Shark [83288]**	Threatened	Species or species habitat may occur within area
***Manta alfredi,* Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]**	Threatened	Species or species habitat known to occur within area
***Manta birostris,* Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]**	Threatened	Species or species habitat known to occur within area
***Megaptera novaeangliae*, Humpback Whale [38]**	Vulnerable	Species or species habitat may occur within area
***Orcinus orca*, Killer Whale, Orca [46]**	Threatened	Species or species habitat may occur within area
***Physeter macrocephalus*, Sperm Whale [59]**	Threatened	Species or species habitat may occur within area
***Rhincodon typus*, Whale Shark [66680]**	Vulnerable	Species or species habitat may occur within area
MIGRATORY WETLANDS SPECIES		
***Actitis hypoleucos*, Common Sandpiper [59309]**	Threatened	Species or species habitat known to occur within area
***Calidris acuminata,* Sharp-tailed Sandpiper [874]**	Threatened	Species or species habitat known to occur within area
***Calidris canutus,* Red Knot, Knot [855]**	Endangered	Species or species habitat likely to occur within area
***Calidris ferruginea,* Curlew Sandpiper [856]**	Critically Endangered	Species or species habitat known to occur within area
***Calidris melanotos,* Pectoral Sandpiper [858]**	Threatened	Species or species habitat may occur within area
***Limosa lapponica,* Bar-tailed Godwit [844]**	Threatened	Species or species habitat known to occur within area
***Numenius madagascariensis,* Eastern Curlew, Far Eastern Curlew [847]**	Critically Endangered	Species or species habitat known to occur within area
***Pandion haliaetus,* Osprey [952]**	Threatened	Species or species habitat known to occur within area
***Tringa nebularia,* Common Greenshank, Greenshank [832]**	Threatened	Species or species habitat known to occur within area
OTHER LISTED MARINE SPECIES		
BIRDS		

NAME	EPBC STATUS	TYPE OF PRESENCE
Actitis hypoleucos, **Common Sandpiper [59309]**	Threatened	Species or species habitat known to occur within area
Apus pacificus, **Fork-tailed Swift [678]**	Threatened	Species or species habitat known to occur within area
Ardea alba, **Great Egret, White Egret [59541]**	Threatened	Species or species habitat known to occur within area
Ardea ibis, **Cattle Egret [59542]**	Threatened	Species or species habitat may occur within area
Calidris acuminata, **Sharp-tailed Sandpiper [874]**	Threatened	Species or species habitat likely to occur within area
Calidris canutus**, Red Knot, Knot [855]**	Endangered	Species or species habitat likely to occur within area
Calidris ferruginea**, Curlew Sandpiper [856]**	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos, **Pectoral Sandpiper [858]**	Threatened	Species or species habitat known to occur within area
Catharacta skua, **Great Skua [59472]**	Threatened	Species or species habitat known to occur within area
Cereopsis novaehollandiae grisea**, Cape Barren Goose (south-western), Recherche Cape Barren Goose [25978]**	Vulnerable	Species or species habitat known to occur within area
Diomedea antipodensis**, Antipodean Albatross [64458]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea dabbenena**, Tristan Albatross [66471]**	Endangered	Species or species habitat may occur within area
Diomedea epomophora**, Southern Royal Albatross [89221]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans**, Wandering Albatross [89223]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi**, Northern Royal Albatross [64456]**	Endangered	Foraging, feeding or related behaviour likely to occur within area
Eudyptula minor**, Little Penguin [1085]**	Threatened	Breeding known to occur within area
Haliaeetus leuc**ogaster,White-bellied Sea-Eagle [943]**	Threatened	Species or species habitat may occur within area
Halobaena caerulea**,Blue Petrel [1059]**	Vulnerable	Species or species habitat may occur within area
Larus novaehollandiae**, Silver Gull [810]**	Threatened	Breeding known to occur within area
Larus pacific*us*, Pacific Gull [811]	Threatened	Breeding known to occur within area
Limosa lapponica menzbieri**, Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]**	Critically Endangered	Species or species habitat known to occur within area
Macronectes giganteus**, Southern Giant-Petrel, Southern Giant Petrel [1060]**	Endangered	Species or species habitat may occur within area
Macronectes halli**, Northern Giant Petrel [1061]**	Vulnerable	Species or species habitat may occur within area
Merops ornatus**, Rainbow Bee-eater [670]**	Threatened	Species or species habitat may occur within area
Motacilla cinerea**, Grey Wagtail [642]**	Threatened	Species or species habitat may occur within area

NAME	EPBC STATUS	TYPE OF PRESENCE
Numenius madagascariensis, **Eastern Curlew, Far Eastern Curlew [847]**	Critically Endangered	Species or species habitat likely to occur within area
Pachyptila turtur subantarctica**, Fairy Prion (southern) [64445]**	Vulnerable	Species or species habitat may occur within area
Pandion haliaetus**,Osprey [952]**	Threatened	Species or species habitat known to occur within area
Pelagodroma marina**,White-faced Storm-Petrel [1016]**	Threatened	Breeding known to occur within area
Phoebetria fusca**, Sooty Albatross [1075]**	Vulnerable	Species or species habitat may occur within area
Pterodroma macroptera**,Great-winged Petrel [1035]**	Threatened	Breeding known to occur within area
Pterodroma mollis**, Soft-plumaged Petrel [1036]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Puffinus assimilis**,Little Shearwater [59363]**	Threatened	Breeding known to occur within area
Puffinus carneipes**,Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]**	Threatened	Breeding known to occur within area
Puffinus griseus**,Sooty Shearwater [1024]**	Threatened	Species or species habitat known to occur within area
Sterna anaethetus**,Bridled Tern [814]**	Threatened	Foraging, feeding or related behaviour likely to occur within area
Sterna caspia**,Caspian Tern [59467]**	Threatened	Breeding known to occur within area
Thalassarche carteri**, Indian Yellow-nosed Albatross [64464]**	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta**, Shy Albatross [89224]**	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida**, Campbell Albatross, Campbell Black-browed Albatross [64459]**	Threatened	Species or species habitat may occur within area
Thalassarche melanophris**, Black-browed Albatross [66472]**	Vulnerable	Species or species habitat may occur within area
Thalassarche st*eadi*, White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thinornis rubricollis**,Hooded Plover [59510]**	Threatened	Species or species habitat may occur within area
Tringa nebularia**, Common Greenshank, Greenshank [832]**	Threatened	Species or species habitat may occur within area
FISH		
Acentronura australe**,Southern Pygmy Pipehorse [66185]**	Threatened	Species or species habitat may occur within area
Campichthys galei**,Gale's Pipefish [66191]**	Threatened	Species or species habitat may occur within area
Heraldia nocturna**,Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]**	Threatened	Species or species habitat may occur within area
Hippocampus breviceps**,Short-head Seahorse, Short-snouted Seahorse [66235]**	Threatened	Species or species habitat may occur within area

NAME	EPBC STATUS	TYPE OF PRESENCE
***Histiogamphelus cristatus*,Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]**	Threatened	Species or species habitat may occur within area
***Leptoichthys fistularius*,Brushtail Pipefish [66248]**	Threatened	Species or species habitat may occur within area
***Lissocampus caudalis*,Australian Smooth Pipefish, Smooth Pipefish [66249]**	Threatened	Species or species habitat may occur within area
***Lissocampus runa*,Javelin Pipefish [66251]**	Threatened	Species or species habitat may occur within area
***Maroubra perserrata*,Sawtooth Pipefish [66252]**	Threatened	Species or species habitat may occur within area
***Nannocampus subosseus*,Bonyhead Pipefish, Bony-headed Pipefish [66264]**	Threatened	Species or species habitat may occur within area
***Notiocampus ruber*,Red Pipefish [66265]**	Threatened	Species or species habitat may occur within area
***Phycodurus eques*,Leafy Seadragon [66267]**	Threatened	Species or species habitat may occur within area
***Phyllopteryx taeniolatus*,Common Seadragon, Weedy Seadragon [66268]**	Threatened	Species or species habitat may occur within area
***Pugnaso curtirostris*, Pugnose Pipefish, Pug-nosed Pipefish [66269]**	Threatened	Species or species habitat may occur within area
***Solegnathus lettiensis*,Gunther's Pipehorse, Indonesian Pipefish [66273]**	Threatened	Species or species habitat may occur within area
***Stigmatopora argus*,Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]**	Threatened	Species or species habitat may occur within area
***Stigmatopora nigra*,Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]**	Threatened	Species or species habitat may occur within area
***Urocampus carinirostris*,Hairy Pipefish [66282]**	Threatened	Species or species habitat may occur within area
***Vanacampus margaritifer*,Mother-of-pearl Pipefish [66283]**	Threatened	Species or species habitat may occur within area
***Vanacampus phillipi*,Port Phillip Pipefish [66284]**	Threatened	Species or species habitat may occur within area
***Vanacampus poecilolaemus*,Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]**	Threatened	Species or species habitat may occur within area
MAMMALS		
***Arctocephalus forsteri*,Long-nosed Fur-seal, New Zealand Fur-seal [20]**	Threatened	Breeding known to occur within area
***Balaenoptera acutorostrata,* Minke Whale [33]**	Threatened	Species or species habitat may occur within area
***Balaenoptera borealis*, Sei Whale [34]**	Vulnerable	Species or species habitat may occur within area
***Balaenoptera edeni*, Bryde's Whale [35]**	Threatened	Species or species habitat may occur within area
***Balaenoptera musculus*, Blue Whale [36]**	Endangered	Species or species habitat likely to occur within area
***Balaenoptera physalus*, Fin Whale [37]**	Vulnerable	Species or species habitat may occur within area
***Berardius arnuxii,*Arnoux's Beaked Whale [70]**	Threatened	Species or species habitat may occur within area
***Caperea marginata,*Pygmy Right Whale [39]**	Threatened	Species or species habitat may occur within area

NAME	EPBC STATUS	TYPE OF PRESENCE
Delphinus delphis, **Common Dophin, Short-beaked Common Dolphin [60]**	Threatened	Species or species habitat may occur within area
Eubalaena australis, **Southern Right Whale [40]**	Endangered	Breeding known to occur within area
Feresa attenuata, **Pygmy Killer Whale [61]**	Threatened	Species or species habitat may occur within area
Globicephala macrorhynchus, **Short-finned Pilot Whale [62]**	Threatened	Species or species habitat may occur within area
Globicephala melas, **Long-finned Pilot Whale [59282]**	Threatened	Species or species habitat may occur within area
Grampus griseus, **Risso's Dolphin, Grampus [64]**	Threatened	Species or species habitat may occur within area
Kogia breviceps, **Pygmy Sperm Whale [57]**	Threatened	Species or species habitat may occur within area
Kogia simus, **Dwarf Sperm Whale [58]**	Threatened	Species or species habitat may occur within area
Lagenorhynchus, **obscurus Dusky Dolphin [43]**	Threatened	Species or species habitat may occur within area
Lissodelphis peronii**,Southern Right Whale Dolphin [44]**	Threatened	Species or species habitat may occur within area
Megaptera novaeangliae, **Humpback Whale [38]**	Vulnerable	Species or species habitat may occur within area
Mesoplodon bowdoini, **Andrew's Beaked Whale [73]**	Threatened	Species or species habitat may occur within area
Mesoplodon densirostris, **Blainville's Beaked Whale, Dense-beaked Whale [74]**	Threatened	Species or species habitat may occur within area
Mesoplodon grayi**, Gray's Beaked Whale, Scamperdown Whale [75]**	Threatened	Species or species habitat may occur within area
Mesoplodon hectori**, Hector's Beaked Whale [76]**	Threatened	Species or species habitat may occur within area
Mesoplodon layardii**, Strap-toothed Beaked Whale, Strap-toothed Whale, Layard's Beaked Whale [25556]**	Threatened	Species or species habitat may occur within area
Mesoplodon mirus**, True's Beaked Whale [54]**	Threatened	Species or species habitat may occur within area
Orcinus orca**, Killer Whale, Orca [46]**	Threatened	Species or species habitat may occur within area
Peponocephala electra**, Melon-headed Whale [47]**	Threatened	Species or species habitat may occur within area
Physeter macrocephalus**, Sperm Whale [59]**	Threatened	Species or species habitat may occur within area
Stenella coeruleoalba**, Striped Dolphin, Euphrosyne Dolphin [52]**	Threatened	Species or species habitat may occur within area
Tursiops aduncus**, Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]**	Threatened	Species or species habitat may occur within area
Tursiops truncatus s. str.**, Bottlenose Dolphin [68417]**	Threatened	Species or species habitat may occur within area
Ziphius cavirostris**, Cuvier's Beaked Whale, Goose-beaked Whale [56]**	Threatened	Species or species habitat may occur within area

14. Appendix 3

Appendix 3: EPBC Act 1999 listed species occuring within the Fitzgerald Biosphere Reserve proposed area as determined from the Protected Matters Search Tool. The lists may include some birds and fishes that are not technically marine species.

NAME	EPBC STATUS	TYPE OF PRESENCE
LISTED THREATENED SPECIES		
BIRDS		
Botaurus poiciloptilus, **Australasian Bittern [1001]**	Endangered	Species or species habitat known to occur within area
Calidris canutus, **Red Knot, Knot [855]**	Endangered	Species or species habitat likely to occur within area
Calidris ferruginea**, Curlew Sandpiper [856]**	Critically Endangered	Species or species habitat known to occur within area
Cereopsis novaehollandiae grisea, **Cape Barren Goose (south-western), Recherche Cape Barren Goose [25978]**	Vulnerable	Breeding known to occur within area
Dasyornis longirostris, **Western Bristlebird [515]**	Endangered	Species or species habitat may occur within area
Diomedea antipodensis, **Antipodean Albatross [64458]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea dabbenena, **Tristan Albatross [66471]**	Endangered	Species or species habitat may occur within area
Diomedea epomophora, **Southern Royal Albatross [89221]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans, **Wandering Albatross [89223]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi, **Northern Royal Albatross [64456]**	Endangered	Foraging, feeding or related behaviour likely to occur within area
Falco hypoleucos, **Grey Falcon [929]**	Vulnerable	Species or species habitat may occur within area
Halobaena caerulea, **Blue Petrel [1059]**	Vulnerable	Species or species habitat may occur within area
Leipoa **ocella*ta,*** **Malleefowl [934]**	Vulnerable	Species or species habitat may occur within area
Limosa lapponica menzbieri, **Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]**	Critically Endangered	Species or species habitat may occur within area
Macronectes giganteus, **Southern Giant-Petrel, Southern Giant Petrel [1060]**	Endangered	Species or species habitat may occur within area
Macronectes halli**, Northern Giant Petrel [1061]**	Vulnerable	Species or species habitat may occur within area
Numenius madagascariensis, **Eastern Curlew, Far Eastern Curlew [847]**	Critically Endangered	Species or species habitat may occur within area
Pachyptila turtur subantarctica, **Fairy Prion (southern) [64445]**	Vulnerable	Species or species habitat may occur within area
Phoebetria fusca, **Sooty Albatross [1075]**	Vulnerable	Species or species habitat may occur within area

NAME	EPBC STATUS	TYPE OF PRESENCE
Pterodroma mollis, **Soft-plumaged Petrel [1036]**	Vulnerable	Species or species habitat may occur within area
Sternula nereis nereis, **Australian Fairy Tern [82950]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche carteri, **Indian Yellow-nosed Albatross [64464]**	Vulnerable	
Thalassarche cauta, **Shy Albatross [89224]**	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida, **Campbell Albatross, Campbell Black-browed Albatross [64459]**	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris, **Black-browed Albatross [66472]**	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi, **White-capped Albatross [64462]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Mammals		
Balaenoptera borealis, **Sei Whale [34]**	Vulnerable	Species or species habitat may occur within area
Balaenoptera musculus, **Blue Whale [36]**	Endangered	Species or species habitat may occur within area
Balaenoptera physalus, **Fin Whale [37]**	Vulnerable	Species or species habitat may occur within area
Eubalaena australis, **Southern Right Whale [40]**	Endangered	Breeding known to occur within area
Megaptera novaeangliae, **Humpback Whale [38]**	Vulnerable	Species or species habitat likely to occur within area
Neophoca cinerea, **Australian Sea-lion, Australian Sea Lion [22]**	Endangered	Breeding known to occur within area
Reptiles		
Caretta caretta, **Loggerhead Turtle [1763]**	Endangered	Foraging, feeding or related behaviour likely to occur within area
Chelonia mydas, **Green Turtle [1765]**	Vulnerable	Breeding known to occur within area
Dermochelys coriacea, **Leatherback Turtle, Leathery Turtle, Luth [1768]**	Endangered	Breeding known to occur within area
Sharks		
Carcharias taurus, **(west coast population) Grey Nurse Shark [68752]**	Vulnerable	Species or species habitat likely to occur within area
Carcharodon carcharias, **White Shark, Great White Shark [64470]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Rhincodon typus, **Whale Shark [66680]**	Vulnerable	Species or species habitat likely to occur within area
LISTED MIGRATORY SPECIES		
MIGRATORY MARINE BIRDS		
Apus pacificus, **Fork-tailed Swift [678]**	Threatened	Species or species habitat likely to occur within the area
Ardenna carneipes, **Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]**	Threatened	Breeding known to occur within area
Ardenna grisea, **Sooty Shearwater [82651]**	Threatened	Species or species habitat likely to occur within the area
Diomedea antipodensis, **Antipodean Albatross [64458]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea dabbenena**, Tristan Albatross [66471]**	Endangered	Species or species habitat may occur within area
Diomedea epomophora**, Southern Royal Albatross [89221]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

NAME	EPBC STATUS	TYPE OF PRESENCE
***Diomedea exulans*, Wandering Albatross [89223]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Diomedea sanfordi*, Northern Royal Albatross [64456]**	Endangered	Foraging, feeding or related behaviour likely to occur within area
***Hydroprogne caspia*, Caspian Tern [808]**	Threatened	Breeding known to occur within area
***Macronectes giganteus*, Southern Giant-Petrel, Southern Giant Petrel [1060]**	Endangered	Species or species habitat may occur within area
***Macronectes halli*, Northern Giant Petrel [1061]**	Vulnerable	Species or species habitat may occur within area
***Onychoprion anaethetus*, Bridled Tern [82845]**	Threatened	Foraging, feeding or related behaviour likely to occur
***Phoebetria fusca*, Sooty Albatross [1075]**	Vulnerable	Species or species habitat may occur within area
***Thalassarche carteri*, Indian Yellow-nosed Albatross [64464]**	Vulnerable	Foraging, feeding or related behaviour may occur within area
***Thalassarche cauta*, Shy Albatross [89224]**	Endangered	Foraging, feeding or related behaviour likely to occur within area
***Thalassarche impavida*, Campbell Albatross, Campbell Black-browed Albatross [64459]**	Vulnerable	Species or species habitat may occur within area
***Thalassarche melanophris*, Black-browed Albatross [66472]**	Vulnerable	Species or species habitat may occur within area
***Thalassarche steadi*, White-capped Albatross [64462]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
MIGRATORY MARINE SPECIES		
***Eubalaena australis*, Southern Right Whale [75529]**	Endangered	Breeding known to occur within area
***Balaenoptera borealis*, Sei Whale [34]**	Vulnerable	Species or species habitat may occur within area
***Balaenoptera edeni*, Bryde's Whale [35]**	Threatened	Species or species habitat may occur within area
***Balaenoptera musculus*, Blue Whale [36]**	Endangered	Species or species habitat likely to occur within area
***Balaenoptera physalus*, Fin Whale [37]**	Vulnerable	Species or species habitat may occur within area
***Caperea marginata*, Pygmy Right Whale [39]**	Threatened	Species or species habitat may occur within area
***Carcharodon carcharias*, White Shark, Great White Shark [64470]**	Vulnerable	Foraging, feeding or related behaviour known to occur within area
***Caretta caretta*, Loggerhead Turtle [1763]**	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia *mydas*, Green Turtle [1765]	Vulnerable	Breeding likely to occur within area
***Dermochelys coriacea*, Leatherback Turtle, Leathery Turtle, Luth [1768]**	Endangered	Breeding likely to occur within area
***Isurus oxyrinchus*, Shortfin Mako, Mako Shark [79073]**	Threatened	Species or species habitat known to occur within area
***Lagenorhynchus obscurus*, Dusky Dolphin [43]**	Threatened	Species or species habitat known to occur within area
***Lamna nasus Porbeagle*, Mackerel Shark [83288]**	Threatened	Species or species habitat known to occur within area
***Megaptera novaeangliae*, Humpback Whale [38]**	Vulnerable	Species or species habitat known to occur within area
***Orcinus orca*, Killer Whale, Orca [46]**	Threatened	Species or species habitat known to occur within area

NAME	EPBC STATUS	TYPE OF PRESENCE
***Physeter macrocephalus,* Sperm Whale [59]**	Threatened	Species or species habitat known to occur within area
***Rhincodon typus,* Whale Shark [66680]**	Vulnerable	Species or species habitat known to occur within area
MIGRATORY WETLANDS SPECIES		
***Actitis hypoleucos,* Common Sandpiper [59309]**		Species or species habitat known to occur within area
***Calidris acuminata,* Sharp-tailed Sandpiper [874]**		Species or species habitat known to occur within area
***Calidris canutus,* Red Knot, Knot [855]**	Endangered	Species or species habitat known to occur within area
***Calidris ferruginea,* Curlew Sandpiper [856]**	Critically Endangered	Species or species habitat known to occur within area
***Calidris melanotos,* Pectoral Sandpiper [858]**	Threatened	Species or species habitat known to occur within area
***Calidris ruficollis,* Red-necked Stint [860]**	Threatened	Foraging, feeding or related behaviour known to occur within area
***Limosa lapponica,* Bar-tailed Godwit [844]**	Threatened	Species or species habitat known to occur within area
***Numenius madagascariensis,* Eastern Curlew, Far Eastern Curlew [847]**	Critically Endangered	Species or species habitat known to occur within area
***Pandion haliaetus,* Osprey [952]**	Threatened	Species or species habitat known to occur within area
***Tringa nebularia,* Common Greenshank, Greenshank [832]**	Threatened	Species or species habitat known to occur within area
OTHER LISTED MARINE SPECIES		
BIRDS		
***Actitis hypoleucos*, Common Sandpiper [59309]**	Threatened	Species or species habitat known to occur within area
***Apus pacificus,* Fork-tailed Swift [678]**	Threatened	Species or species habitat known to occur within area
***Ardea alba,* Great Egret, White Egret [59541]**	Threatened	Species or species habitat known to occur within area
***Ardea ibis,* Cattle Egret [59542]**	Threatened	Species or species habitat may occur within area
***Calidris acuminata,* Sharp-tailed Sandpiper [874]**	Threatened	Species or species habitat likely to occur within area
***Calidris canutus*, Red Knot, Knot [855]**	Endangered	Species or species habitat likely to occur within area
***Calidris ferruginea*, Curlew Sandpiper [856]**	Critically Endangered	Species or species habitat known to occur within area
***Calidris melanotos,* Pectoral Sandpiper [858]**	Threatened	Species or species habitat known to occur within area
***Calidris ruficollis*, Red-necked Stint [860]**	Threatened	Species or species habitat known to occur within area
***Catharacta skua,* Great Skua [59472]**	Threatened	Species or species habitat known to occur within area
***Cereopsis novaehollandiae grisea,* Cape Barren Goose (south-western), Recherche Cape Barren Goose [25978]**	Vulnerable	Species or species habitat known to occur within area
***Charadrius ruficapillus,* Red-capped Plover [881]**	Vulnerable	Species or species habitat known to occur within area

NAME	EPBC STATUS	TYPE OF PRESENCE
***Diomedea antipodensis*, Antipodean Albatross [64458]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Diomedea dabbenena*, Tristan Albatross [66471]**	Endangered	Species or species habitat may occur within area
***Diomedea epomophora*, Southern Royal Albatross [89221]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Diomedea exulans*, Wandering Albatross [89223]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Diomedea sanfordi*, Northern Royal Albatross [64456]**	Endangered	Foraging, feeding or related behaviour likely to occur within area
***Eudyptula minor,* Little Penguin [1085]**	Threatened	Breeding known to occur within area
***Haliaeetus leucogaster,* White-bellied Sea-Eagle [943]**	Threatened	Species or species habitat may occur within area
***Halobaena caerulea,* Blue Petrel [1059]**	Vulnerable	Species or species habitat may occur within area
***Larus dominicanus,* Kelp Gull [809]**	Threatened	Breeding known to occur within area
***Larus pacificus,* Pacific Gull [811]**	Threatened	Breeding known to occur within area
***Limosa lapponica menzbieri*, Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]**	Critically Endangered	Species or species habitat known to occur within area
***Macronectes giganteus*, Southern Giant-Petrel, Southern Giant Petrel [1060]**	Endangered	Species or species habitat may occur within area
***Macronectes halli*, Northern Giant Petrel [1061]**	Vulnerable	Species or species habitat may occur within area
***Merops ornatus*, Rainbow Bee-eater [670]**	Threatened	Species or species habitat may occur within area
***Motacilla cinerea,* Grey Wagtail [642]**	Threatened	Species or species habitat may occur within area
***Numenius madagascariensis*, Eastern Curlew, Far Eastern Curlew [847]**	Critically Endangered	Species or species habitat likely to occur within area
***Pachyptila turtur subantarctica*, Fairy Prion (southern) [64445]**	Vulnerable	Species or species habitat may occur within area
***Pandion haliaetus,* Osprey [952]**	Threatened	Species or species habitat known to occur within area
***Phoebetria fusca*, Sooty Albatross [1075]**	Vulnerable	Species or species habitat may occur within area
***Pterodroma mollis*, Soft-plumaged Petrel [1036]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Puffinus assimilis*, Little Shearwater [59363]**	Threatened	Breeding known to occur within area
***Puffinus carneipes*, Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]**	Threatened	Breeding known to occur within area
***Puffinus griseus*, Sooty Shearwater [1024]**	Threatened	Species or species habitat known to occur within area
***Recurvirostra novaehollandiae*, Red-necked Avocet [871]**	Threatened	Species or species habitat known to occur within area
***Sterna anaethetus*, Bridled Tern [814]**	Threatened	Foraging, feeding or related behaviour likely to occur within area
***Sterna caspia*, Caspian Tern [59467]**	Threatened	Breeding known to occur within area
***Thalassarche carteri*, Indian Yellow-nosed Albatross [64464]**	Vulnerable	Foraging, feeding or related behaviour may occur within area
***Thalassarche cauta*, Shy Albatross [89224]**	Endangered	Foraging, feeding or related behaviour likely to occur within area

NAME	EPBC STATUS	TYPE OF PRESENCE
***Thalassarche impavida*, Campbell Albatross, Campbell Black-browed Albatross [64459]**	Threatened	Species or species habitat may occur within area
***Thalassarche melanophris*, Black-browed Albatross [66472]**	Vulnerable	Species or species habitat may occur within area
***Thalassarche steadi*, White-capped Albatross [64462]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Thinornis rubricollis*, Hooded Plover [59510]**	Threatened	Species or species habitat may occur within area
***Tringa nebularia*, Common Greenshank, Greenshank [832]**	Threatened	Species or species habitat may occur within area
FISH		
***Acentronura australe*, Southern Pygmy Pipehorse [66185]**	Threatened	Species or species habitat may occur within area
***Campichthys galei*, Gale's Pipefish [66191]**	Threatened	Species or species habitat may occur within area
***Heraldia nocturna*, Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]**	Threatened	Species or species habitat may occur within area
***Hippocampus breviceps*, Short-head Seahorse, Short-snouted Seahorse [66235]**	Threatened	Species or species habitat may occur within area
***Histiogamphelus cristatus*, Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]**	Threatened	Species or species habitat may occur within area
***Leptoichthys fistularius*, Brushtail Pipefish [66248]**	Threatened	Species or species habitat may occur within area
***Lissocampus caudalis*, Australian Smooth Pipefish, Smooth Pipefish [66249]**	Threatened	Species or species habitat may occur within area
***Lissocampus runa*, Javelin Pipefish [66251]**	Threatened	Species or species habitat may occur within area
***Maroubra perserrata*, Sawtooth Pipefish [66252]**	Threatened	Species or species habitat may occur within area
***Nannocampus subosseus*, Bonyhead Pipefish, Bony-headed Pipefish [66264]**	Threatened	Species or species habitat may occur within area
***Notiocampus ruber*, Red Pipefish [66265]**	Threatened	Species or species habitat may occur within area
***Phycodurus eques*, Leafy Seadragon [66267]**	Threatened	Species or species habitat may occur within area
***Phyllopteryx taeniolatus*, Common Seadragon, Weedy Seadragon [66268]**	Threatened	Species or species habitat may occur within area
***Pugnaso curtirostris*, *Pugnose Pipefish*, Pug-nosed Pipefish [66269]**	Threatened	Species or species habitat may occur within area
***Solegnathus lettiensis*, Gunther's Pipehorse, Indonesian Pipefish [66273]**	Threatened	Species or species habitat may occur within area
***Stigmatopora argus*, Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]**	Threatened	Species or species habitat may occur within area
***Stigmatopora nigra*, Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]**	Threatened	Species or species habitat may occur within area
***Urocampus carinirostris*, Hairy Pipefish [66282]**	Threatened	Species or species habitat may occur within area
***Vanacampus margaritifer*, Mother-of-pearl Pipefish [66283]**	Threatened	Species or species habitat may occur within area

NAME	EPBC STATUS	TYPE OF PRESENCE
***Vanacampus phillipi,* Port Phillip Pipefish [66284]**	Threatened	Species or species habitat may occur within area
***Vanacampus poecilolaemus,* Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]**	Threatened	Species or species habitat may occur within area
MAMMALS		
***Arctocephalus forsteri,* Long-nosed Fur-seal, New Zealand Fur-seal [20]**	Threatened	Breeding known to occur within area
***Balaenoptera acutorostrata,* Minke Whale [33]**	Threatened	Species or species habitat may occur within area
***Balaenoptera borealis*, Sei Whale [34]**	Vulnerable	Species or species habitat may occur within area
***Balaenoptera edeni*, Bryde's Whale [35]**	Threatened	Species or species habitat may occur within area
***Balaenoptera musculus*, Blue Whale [36]**	Endangered	Species or species habitat likely to occur within area
***Balaenoptera physalus*, Fin Whale [37]**	Vulnerable	Species or species habitat may occur within area
***Berardius arnuxii*, Arnoux's Beaked Whale [70]**	Threatened	Species or species habitat may occur within area
***Caperea marginata*, Pygmy Right Whale [39]**	Threatened	Species or species habitat may occur within area
***Delphinus delphis*, Common Dolphin, Short-beaked Common Dolphin [60]**	Threatened	Species or species habitat may occur within area
***Eubalaena australis*, Southern Right Whale [40]**	Endangered	Breeding known to occur within area
***Feresa attenuata*, Pygmy Killer Whale [61]**	Threatened	Species or species habitat may occur within area
***Globicephala macrorhynchus*, Short-finned Pilot Whale [62]**	Threatened	Species or species habitat may occur within area
***Globicephala melas*, Long-finned Pilot Whale [59282]**	Threatened	Species or species habitat may occur within area
***Grampus griseus*, Risso's Dolphin, Grampus [64]**	Threatened	Species or species habitat may occur within area
***Kogia breviceps*, Pygmy Sperm Whale [57]**	Threatened	Species or species habitat may occur within area
***Kogia simus*, Dwarf Sperm Whale [58]**	Threatened	Species or species habitat may occur within area
***Lagenorhynchus*, obscurus Dusky Dolphin [43]**	Threatened	Species or species habitat may occur within area
***Lissodelphis peronii*, Southern Right Whale Dolphin [44]**	Threatened	Species or species habitat may occur within area
***Megaptera novaeangliae*, Humpback Whale [38]**	Vulnerable	Species or species habitat may occur within area
***Mesoplodon bowdoini*, Andrew's Beaked Whale [73]**	Threatened	Species or species habitat may occur within area
***Mesoplodon densirostris*, Blainville's Beaked Whale, Dense-beaked Whale [74]**	Threatened	Species or species habitat may occur within area
***Mesoplodon layardii*, Strap-toothed Beaked Whale, Strap-toothed Whale, Layard's Beaked Whale [25556]**	Threatened	Species or species habitat may occur within area
***Mesoplodon mirus*, True's Beaked Whale [54]**	Threatened	Species or species habitat may occur within area
***Orcinus orca*, Killer Whale, Orca [46]**	Threatened	Species or species habitat may occur within area
***Peponocephala electra*, Melon-headed Whale [47]**	Threatened	Species or species habitat may occur within area
***Physeter macrocephalus*, Sperm Whale [59]**	Threatened	Species or species habitat may occur within area
***Pseudorca crassidens*, False Killer Whale [48]**	Threatened	Species or species habitat may occur within area

NAME	EPBC STATUS	TYPE OF PRESENCE
***Tursiops aduncus*, Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]**	Threatened	Species or species habitat may occur within area
***Tursiops truncatus s. str*., Bottlenose Dolphin [68417]**	Threatened	Species or species habitat may occur within area
***Ziphius cavirostris*, Cuvier's Beaked Whale, Goose-beaked Whale [56]**	Threatened	Species or species habitat may occur within area

15. Appendix 4

Appendix 4: EPBC Act 1999 listed species occuring within the Stokes Inlet proposed area as determined from the Protected Matters Search Tool. The lists may include some birds and fishes that are not technically marine species.

NAME	EPBC STATUS	TYPE OF PRESENCE
LISTED THREATENED SPECIES		
BIRDS		
***Botaurus poiciloptilus,* Australasian Bittern [1001]**	Endangered	Species or species habitat known to occur within area
***Calidris canutus,* Red Knot, Knot [855]**	Endangered	Species or species habitat likely to occur within area
***Calidris ferruginea*, Curlew Sandpiper [856]**	Critically Endangered	Species or species habitat known to occur within area
***Cereopsis novaehollandiae grisea,* Cape Barren Goose (south-western), Recherche Cape Barren Goose [25978]**	Vulnerable	Breeding known to occur within area
***Diomedea antipodensis,* Antipodean Albatross [64458]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Diomedea dabbenena,* Tristan Albatross [66471]**	Endangered	Species or species habitat may occur within area
***Diomedea epomophora,* Southern Royal Albatross [89221]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Diomedea exulans,* Wandering Albatross [89223]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Diomedea sanfordi,* Northern Royal Albatross [64456]**	Endangered	Foraging, feeding or related behaviour likely to occur within area
***Falco hypoleucos,* Grey Falcon [929]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Halobaena caerulea,* Blue Petrel [1059]**	Vulnerable	Species or species habitat may occur within area
***Limosa lapponica menzbieri,* Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]**	Critically Endangered	Species or species habitat may occur within area
***Macronectes giganteus,* Southern Giant-Petrel, Southern Giant Petrel [1060]**	Endangered	Species or species habitat may occur within area
***Macronectes halli*, Northern Giant Petrel [1061]**	Vulnerable	Species or species habitat may occur within area
***Numenius madagascariensis,* Eastern Curlew, Far Eastern Curlew [847]**	Critically Endangered	Species or species habitat may occur within area
***Pachyptila turtur subantarctica,* Fairy Prion (southern) [64445]**	Vulnerable	Species or species habitat may occur within area
***Phoebetria fusca,* Sooty Albatross [1075]**	Vulnerable	Species or species habitat may occur within area

NAME	EPBC STATUS	TYPE OF PRESENCE
Pterodroma mollis, **Soft-plumaged Petrel [1036]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Sternula nereis nereis, **Australian Fairy Tern [82950]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche carteri, **Indian Yellow-nosed Albatross [64464]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta, **Shy Albatross [89224]**	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida, **Campbell Albatross, Campbell Black-browed Albatross [64459]**	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris, **Black-browed Albatross [66472]**	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi, **White-capped Albatross [64462]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
MAMMALS		
Balaenoptera borealis, **Sei Whale [34]**	Vulnerable	Species or species habitat may occur within area
Balaenoptera musculus, **Blue Whale [36]**	Endangered	Species or species habitat may occur within area
Balaenoptera physalus, **Fin Whale [37]**	Vulnerable	Species or species habitat may occur within area
Eubalaena australis, **Southern Right Whale [40]**	Endangered	Breeding known to occur within area
Megaptera novaeangliae **Humpback Whale [38]**	Vulnerable	Species or species habitat likely to occur within area
Neophoca cinerea **Australian Sea-lion, Australian Sea Lion [22]**	Endangered	Breeding known to occur within area
REPTILES		
Caretta caretta, **Loggerhead Turtle [1763]**	Endangered	Breeding likely to occur within area
Chelonia mydas, **Green Turtle [1765]**	Vulnerable	Breeding likely to occur within area
Dermochelys coriacea, **Leatherback Turtle, Leathery Turtle, Luth [1768]**	Endangered	Breeding likely to occur within area
SHARKS		
Carcharias taurus, **(west coast population) Grey Nurse Shark [68752]**	Vulnerable	Species or species habitat likely to occur within area
Carcharodon carcharias, **White Shark, Great White Shark [64470]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Rhincodon typus, **Whale Shark [66680]**	Vulnerable	Species or species habitat likely to occur within area
LISTED MIGRATORY SPECIES		
MIGRATORY MARINE BIRDS		
Apus pacificus, **Fork-tailed Swift [678]**	Threatened	Species or species habitat likely to occur within the area
Ardenna carneipes, **Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]**	Threatened	Breeding known to occur within area
Ardenna grisea, **Sooty Shearwater [82651]**	Threatened	Species or species habitat likely to occur within the area
Diomedea **an*tipodensis,*** **Antipodean Albatross [64458]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea dabbenena**, Tristan Albatross [66471]**	Endangered	Species or species habitat may occur within area

NAME	EPBC STATUS	TYPE OF PRESENCE
***Diomedea epomophora*, Southern Royal Albatross [89221]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Diomedea exulans*, Wandering Albatross [89223]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Diomedea sanfordi*, Northern Royal Albatross [64456]**	Endangered	Foraging, feeding or related behaviour likely to occur within area
***Hydroprogne caspia*, Caspian Tern [808]**	Threatened	Breeding known to occur within area
***Macronectes giganteus*, Southern Giant-Petrel, Southern Giant Petrel [1060]**	Endangered	Species or species habitat may occur within area
***Macronectes halli*, Northern Giant Petrel [1061]**	Vulnerable	Species or species habitat may occur within area
***Onychoprion anaethetus*, Bridled Tern [82845]**	Threatened	Foraging, feeding or related behaviour likely to occur
***Phoebetria fusca*, Sooty Albatross [1075]**	Vulnerable	Species or species habitat may occur within area
***Thalassarche carteri*, Indian Yellow-nosed Albatross [64464]**	Vulnerable	Foraging, feeding or related behaviour may occur within area
***Thalassarche cauta*, Shy Albatross [89224]**	Endangered	Foraging, feeding or related behaviour likely to occur within area
***Thalassarche impavida*, Campbell Albatross, Campbell Black-browed Albatross [64459]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Thalassarche melanophris*, Black-browed Albatross [66472]**	Vulnerable	Species or species habitat may occur within area
***Thalassarche steadi*, White-capped Albatross [64462]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
MIGRATORY MARINE SPECIES		
***Eubalaena australis*, Southern Right Whale [75529]**	Endangered	Breeding known to occur within area
***Balaenoptera borealis*, Sei Whale [34]**	Vulnerable	Species or species habitat may occur within area
***Balaenoptera edeni*, Bryde's Whale [35]**	Threatened	Species or species habitat may occur within area
***Balaenoptera musculus*, Blue Whale [36]**	Endangered	Species or species habitat likely to occur within area
***Balaenoptera physalus*, Fin Whale [37]**	Vulnerable	Species or species habitat may occur within area
***Caperea marginata*, Pygmy Right Whale [39]**	Threatened	Species or species habitat may occur within area
***Carcharodon carcharias*, White Shark, Great White Shark [64470]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Caretta caretta*, Loggerhead Turtle [1763]**	Endangered	Breeding likely to occur within area
***Chelonia mydas*, Green Turtle [1765]**	Vulnerable	Breeding likely to occur within area
***Dermochelys coriacea*, Leatherback Turtle, Leathery Turtle, Luth [1768]**	Endangered	Breeding likely to occur within area
***Lagenorhynchus obscurus*, Dusky Dolphin [43]**	Threatened	Species or species habitat may occur within area
***Lamna nasus*, Porbeagle, Mackerel Shark [83288]**	Threatened	Species or species habitat may occur within area
***Megaptera novaeangliae*, Humpback Whale [38]**	Vulnerable	Species or species habitat may occur within area
***Orcinus orca*, Killer Whale, Orca [46]**	Threatened	Species or species habitat may occur within area
***Rhincodon typus*, Whale Shark [66680]**	Vulnerable	Species or species habitat may occur within area

NAME	EPBC STATUS	TYPE OF PRESENCE
MIGRATORY WETLANDS SPECIES		
***Actitis hypoleucos,* Common Sandpiper [59309]**	Threatened	Species or species habitat may occur within area
***Calidris acuminata,* Sharp-tailed Sandpiper [874]**	Threatened	Species or species habitat may occur within area
***Calidris canutus,* Red Knot, Knot [855]**	Endangered	Species or species habitat may occur within area
***Calidris ferruginea,* Curlew Sandpiper [856]**	Critically Endangered	Species or species habitat may occur within area
***Calidris melanotos,* Pectoral Sandpiper [858]**	Threatened	Species or species habitat may occur within area
***Calidris ruficollis,* Red-necked Stint [860]**	Threatened	Foraging, feeding or related behaviour known to occur within area
***Limosa lapponica,* Bar-tailed Godwit [844]**	Threatened	Species or species habitat may occur within area
***Numenius madagascariensis,* Eastern Curlew, Far Eastern Curlew [847]**	Critically Endangered	Species or species habitat may occur within area
***Pandion haliaetus,* Osprey [952]**	Threatened	Species or species habitat may occur within area
***Tringa nebularia,* Common Greenshank, Greenshank [832]**	Threatened	Species or species habitat known to occur within area
***Tringa stagnatilis,* Marsh Sandpiper, Little Greenshank [833]**	Threatened	Species or species habitat known to occur within area
OTHER LISTED MARINE SPECIES		
BIRDS		
***Actitis hypoleucos,* Common Sandpiper [59309]**	Threatened	Species or species habitat known to occur within area
***Apus pacificus,* Fork-tailed Swift [678]**	Threatened	Species or species habitat known to occur within area
***Ardea alba,* Great Egret, White Egret [59541]**	Threatened	Species or species habitat known to occur within area
***Ardea ibis,* Cattle Egret [59542]**	Threatened	Species or species habitat may occur within area
***Calidris acuminata,* Sharp-tailed Sandpiper [874]**	Threatened	Species or species habitat likely to occur within area
***Calidris canutus*, Red Knot, Knot [855]**	Endangered	Species or species habitat likely to occur within area
***Calidris ferruginea*, Curlew Sandpiper [856]**	Critically Endangered	Species or species habitat known to occur within area
***Calidris melanotos,* Pectoral Sandpiper [858]**	Threatened	Species or species habitat known to occur within area
***Calidris ruficollis*, Red-necked Stint [860]**	Threatened	Species or species habitat known to occur within area
***Catharacta skua,* Great Skua [59472]**	Threatened	Species or species habitat known to occur within area
***Cereopsis novaehollandiae grisea,* Cape Barren Goose (south-western), Recherche Cape Barren Goose [25978]**	Vulnerable	Species or species habitat known to occur within area
***Charadrius ruficapillus,* Red-capped Plover [881]**	Vulnerable	Species or species habitat known to occur within area
***Diomedea antipodensis*, Antipodean Albatross [64458]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Diomedea dabbenena*, Tristan Albatross [66471]**	Endangered	Species or species habitat may occur within area

NAME	EPBC STATUS	TYPE OF PRESENCE
***Diomedea epomophora*, Southern Royal Albatross [89221]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Diomedea exulans*, Wandering Albatross [89223]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Haliaeetus leucogaster*, White-bellied Sea-Eagle [943]**	Threatened	Species or species habitat may occur within area
***Halobaena caerulea*, Blue Petrel [1059]**	Vulnerable	Species or species habitat may occur within area
***Larus pacificus*, Pacific Gull [811]**	Threatened	Breeding known to occur within area
***Limosa lapponica menzbieri*, Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]**	Critically Endangered	Species or species habitat known to occur within area
***Macronectes giganteus*, Southern Giant-Petrel, Southern Giant Petrel [1060]**	Endangered	Species or species habitat may occur within area
***Macronectes halli*, Northern Giant Petrel [1061]**	Vulnerable	Species or species habitat may occur within area
***Merops ornatus*, Rainbow Bee-eater [670]**	Threatened	Species or species habitat may occur within area
***Motacilla cinerea*, Grey Wagtail [642]**	Threatened	Species or species habitat may occur within area
***Numenius madagascariensis*, Eastern Curlew, Far Eastern Curlew [847]**	Critically Endangered	Species or species habitat likely to occur within area
***Pachyptila turtur subantarctica*, Fairy Prion (southern) [64445]**	Vulnerable	Species or species habitat may occur within area
Pandion haliaetus, Osprey [952]	Threatened	Species or species habitat known to occur within area
***Phalacrocorax fuscescens*, Black-faced Cormorant [59660]**	Threatened	Foraging, feeding or related behaviour likely to occur within area
***Phoebetria fusca*, Sooty Albatross [1075]**	Vulnerable	Species or species habitat may occur within area
***Pterodroma mollis*, Soft-plumaged Petrel [1036]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Puffinus assimilis*, Little Shearwater [59363]**	Threatened	Breeding known to occur within area
***Puffinus carneipes*, Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]**	Threatened	Breeding known to occur within area
***Puffinus griseus*, Sooty Shearwater [1024]**	Threatened	Species or species habitat known to occur within area
***Recurvirostra novaehollandiae*, Red-necked Avocet [871]**	Threatened	Species or species habitat known to occur within area
***Sterna anaethetus*, Bridled Tern [814]**	Threatened	Foraging, feeding or related behaviour likely to occur within area
***Sterna caspia*, Caspian Tern [59467]**	Threatened	Breeding known to occur within area
***Thalassarche carteri*, Indian Yellow-nosed Albatross [64464]**	Vulnerable	Foraging, feeding or related behaviour may occur within area
***Thalassarche cauta*, Shy Albatross [89224]**	Endangered	Foraging, feeding or related behaviour likely to occur within area
***Thalassarche impavida*, Campbell Albatross, Campbell Black-browed Albatross [64459]**	Threatened	Species or species habitat may occur within area
***Thalassarche melanophris*, Black-browed Albatross [66472]**	Vulnerable	Species or species habitat may occur within area
***Thalassarche steadi*, White-capped Albatross [64462]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

NAME	EPBC STATUS	TYPE OF PRESENCE
Thinornis rubricollis, **Hooded Plover [59510]**	Threatened	Species or species habitat may occur within area
Tringa nebularia**, Common Greenshank, Greenshank [832]**	Threatened	Species or species habitat may occur within area
Tringa stagnatilis, **Marsh Sandpiper, Little Greenshank [833]**	Threatened	Species or species habitat may occur within area
FISH		
Acentronura australe, **Southern Pygmy Pipehorse [66185]**	Threatened	Species or species habitat may occur within area
Campichthys galei, **Gale's Pipefish [66191]**	Threatened	Species or species habitat may occur within area
Heraldia nocturna, **Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]**	Threatened	Species or species habitat may occur within area
Hippocampus breviceps, **Short-head Seahorse, Short-snouted Seahorse [66235]**	Threatened	Species or species habitat may occur within area
Histiogamphelus cristatus, **Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]**	Threatened	Species or species habitat may occur within area
Leptoichthys fistularius, **Brushtail Pipefish [66248]**	Threatened	Species or species habitat may occur within area
Lissocampus caudalis, **Australian Smooth Pipefish, Smooth Pipefish [66249]**	Threatened	Species or species habitat may occur within area
Lissocampus runa, **Javelin Pipefish [66251]**	Threatened	Species or species habitat may occur within area
Maroubra perserrata, **Sawtooth Pipefish [66252]**	Threatened	Species or species habitat may occur within area
Nannocampus subosseus, **Bonyhead Pipefish, Bony-headed Pipefish [66264]**	Threatened	Species or species habitat may occur within area
Notiocampus ruber, **Red Pipefish [66265]**	Threatened	Species or species habitat may occur within area
Phycodurus eques, **Leafy Seadragon [66267]**	Threatened	Species or species habitat may occur within area
Phyllopteryx taeniolatus, **Common Seadragon, Weedy Seadragon [66268]**	Threatened	Species or species habitat may occur within area
Pugnaso curtirostris, ***Pugnose Pipefish*****, Pug-nosed Pipefish [66269]**	Threatened	Species or species habitat may occur within area
Solegnathus lettiensis, **Gunther's Pipehorse, Indonesian Pipefish [66273]**	Threatened	Species or species habitat may occur within area
Stigmatopora argus, **Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]**	Threatened	Species or species habitat may occur within area
Stigmatopora nigra, **Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]**	Threatened	Species or species habitat may occur within area
Urocampus carinirostris, **Hairy Pipefish [66282]**	Threatened	Species or species habitat may occur within area
Vanacampus margaritifer, **Mother-of-pearl Pipefish [66283]**	Threatened	Species or species habitat may occur within area
Vanacampus phillipi, **Port Phillip Pipefish [66284]**	Threatened	Species or species habitat may occur within area
Vanacampus poecilolaemus, **Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]**	Threatened	Species or species habitat may occur within area

NAME	EPBC STATUS	TYPE OF PRESENCE
MAMMALS		
***Arctocephalus forsteri,* Long-nosed Fur-seal, New Zealand Fur-seal [20]**	Threatened	Breeding known to occur within area
***Balaenoptera acutorostrata,* Minke Whale [33]**	Threatened	Species or species habitat may occur within area
***Balaenoptera borealis*, Sei Whale [34]**	Vulnerable	Species or species habitat may occur within area
***Balaenoptera edeni*, Bryde's Whale [35]**	Threatened	Species or species habitat may occur within area
***Balaenoptera musculus*, Blue Whale [36]**	Endangered	Species or species habitat likely to occur within area
***Balaenoptera physalus*, Fin Whale [37]**	Vulnerable	Species or species habitat may occur within area
***Caperea marginata,* Pygmy Right Whale [39]**	Threatened	Species or species habitat may occur within area
***Delphinus delphis,* Common Dolphin, Short-beaked Common Dolphin [60]**	Threatened	Species or species habitat may occur within area
***Eubalaena australis,* Southern Right Whale [40]**	Endangered	Breeding known to occur within area
***Grampus griseus,* Risso's Dolphin, Grampus [64]**	Threatened	Species or species habitat may occur within area
***Lagenorhynchus obscurus,* Dusky Dolphin [43]**	Threatened	Species or species habitat may occur within area
***Megaptera novaeangliae,* Humpback Whale [38]**	Vulnerable	Species or species habitat may occur within area
***Orcinus orca*, Killer Whale, Orca [46]**	Threatened	Species or species habitat may occur within area
***Tursiops aduncus*, Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]**	Threatened	Species or species habitat may occur within area
***Tursiops truncatus s. str.*, Bottlenose Dolphin [68417]**	Threatened	Species or species habitat may occur within area

16. Appendix 5

Appendix 5: EPBC Act 1999 listed species occuring within the Recherche Archipelago proposed area as determined from the Protected Matters Search Tool. The lists may include some birds and fishes that are not technically marine species.

NAME	EPBC STATUS	TYPE OF PRESENCE
LISTED THREATENED SPECIES		
BIRDS		
***Botaurus poiciloptilus*, Australasian Bittern [1001]**	Endangered	Species or species habitat known to occur within area
***Calidris canutus*, Red Knot, Knot [855]**	Endangered	Species or species habitat likely to occur within area
***Calidris ferruginea*, Curlew Sandpiper [856]**	Critically Endangered	Species or species habitat known to occur within area
***Cereopsis novaehollandiae grisea*, Cape Barren Goose (south-western), Recherche Cape Barren Goose [25978]**	Vulnerable	Breeding known to occur within area
***Diomedea antipodensis*, Antipodean Albatross [64458]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Diomedea dabbenena*, Tristan Albatross [66471]**	Endangered	Species or species habitat may occur within area
***Diomedea epomophora*, Southern Royal Albatross [89221]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Diomedea exulans*, Wandering Albatross [89223]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Diomedea sanfordi*, Northern Royal Albatross [64456]**	Endangered	Foraging, feeding or related behaviour likely to occur within area
***Falco hypoleucos*, Grey Falcon [929]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Halobaena caerulea*, Blue Petrel [1059]**	Vulnerable	Species or species habitat may occur within area
***Limosa lapponica menzbieri*, Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]**	Critically Endangered	Species or species habitat may occur within area
***Macronectes giganteus*, Southern Giant-Petrel, Southern Giant Petrel [1060]**	Endangered	Species or species habitat may occur within area
***Macronectes halli*, Northern Giant Petrel [1061]**	Vulnerable	Species or species habitat may occur within area
***Numenius madagascariensis*, Eastern Curlew, Far Eastern Curlew [847]**	Critically Endangered	Species or species habitat may occur within area
***Pachyptila turtur subantarctica*, Fairy Prion (southern) [64445]**	Vulnerable	Species or species habitat may occur within area
***Phoebetria fusca*, Sooty Albatross [1075]**	Vulnerable	Species or species habitat may occur within area
***Pterodroma mollis*, Soft-plumaged Petrel [1036]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Sternula nereis nereis*, Australian Fairy Tern [82950]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Thalassarche carteri*, Indian Yellow-nosed Albatross [64464]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

NAME	EPBC STATUS	TYPE OF PRESENCE
***Thalassarche cauta*, Shy Albatross [89224]**	Endangered	Foraging, feeding or related behaviour likely to occur within area
***Thalassarche impavida*, Campbell Albatross, Campbell Black-browed Albatross [64459]**	Vulnerable	Species or species habitat may occur within area
***Thalassarche melanophris*, Black-browed Albatross [66472]**	Vulnerable	Species or species habitat may occur within area
***Thalassarche steadi*, White-capped Albatross [64462]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
MAMMALS		
***Balaenoptera borealis*, Sei Whale [34]**	Vulnerable	Species or species habitat may occur within area
***Balaenoptera musculus*, Blue Whale [36]**	Endangered	Species or species habitat may occur within area
***Balaenoptera physalus*, Fin Whale [37]**	Vulnerable	Species or species habitat may occur within area
***Eubalaena australis*, Southern Right Whale [40]**	Endangered	Breeding known to occur within area
***Megaptera novaeangliae*, Humpback Whale [38]**	Vulnerable	Species or species habitat likely to occur within area
***Neophoca cinerea*, Australian Sea-lion, Australian Sea Lion [22]**	Endangered	Breeding known to occur within area
REPTILES		
***Caretta caretta*, Loggerhead Turtle [1763]**	Endangered	Breeding likely to occur within area
***Chelonia mydas*, Green Turtle [1765]**	Vulnerable	Breeding likely to occur within area
***Dermochelys coriacea*, Leatherback Turtle, Leathery Turtle, Luth [1768]**	Endangered	Breeding likely to occur within area
SHARKS		
***Carcharias taurus*, (west coast population) Grey Nurse Shark [68752]**	Vulnerable	Species or species habitat likely to occur within area
***Carcharodon carcharias*, White Shark, Great White Shark [64470]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Rhincodon typus*, Whale Shark [66680]**	Vulnerable	Species or species habitat likely to occur within area
LISTED MIGRATORY SPECIES		
MIGRATORY MARINE BIRDS		
***Apus pacificus*, Fork-tailed Swift [678]**	Threatened	Species or species habitat likely to occur within the area
***Ardenna carneipes*, Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]**	Threatened	Breeding known to occur within area
***Ardenna grisea*, Sooty Shearwater [82651]**	Threatened	Species or species habitat likely to occur within the area
***Diomedea antipodensis*, Antipodean Albatross [64458]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Diomedea dabbenena*, Tristan Albatross [66471]**	Endangered	Species or species habitat may occur within area
***Diomedea epomophora*, Southern Royal Albatross [89221]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Diomedea exulans*, Wandering Albatross [89223]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Diomedea sanfordi*, Northern Royal Albatross [64456]**	Endangered	Foraging, feeding or related behaviour likely to occur within area
***Hydroprogne caspia*, Caspian Tern [808]**	Threatened	Breeding known to occur within area

NAME	EPBC STATUS	TYPE OF PRESENCE
***Macronectes giganteus*, Southern Giant-Petrel, Southern Giant Petrel [1060]**	Endangered	Species or species habitat may occur within area
***Macronectes halli*, Northern Giant Petrel [1061]**	Vulnerable	Species or species habitat may occur within area
***Onychoprion anaethetus*, Bridled Tern [82845]**	Threatened	Foraging, feeding or related behaviour likely to occur
***Phoebetria fusca*, Sooty Albatross [1075]**	Vulnerable	Species or species habitat may occur within area
***Thalassarche carteri*, Indian Yellow-nosed Albatross [64464]**	Vulnerable	Foraging, feeding or related behaviour may occur within area
***Thalassarche cauta*, Shy Albatross [89224]**	Endangered	Foraging, feeding or related behaviour likely to occur within area
***Thalassarche impavida*, Campbell Albatross, Campbell Black-browed Albatross [64459]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Thalassarche melanophris*, Black-browed Albatross [66472]**	Vulnerable	Species or species habitat may occur within area
***Thalassarche steadi*, White-capped Albatross [64462]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
MIGRATORY MARINE SPECIES		
***Eubalaena australis*, Southern Right Whale [75529]**	Endangered	Breeding known to occur within area
***Balaenoptera borealis*, Sei Whale [34]**	Vulnerable	Species or species habitat may occur within area
***Balaenoptera edeni*, Bryde's Whale [35]**	Threatened	Species or species habitat may occur within area
***Balaenoptera musculus*, Blue Whale [36]**	Endangered	Species or species habitat likely to occur within area
***Balaenoptera physalus*, Fin Whale [37]**	Vulnerable	Species or species habitat may occur within area
***Caperea marginate*, Pygmy Right Whale [39]**	Threatened	Species or species habitat may occur within area
***Carcharodon carcharias*, White Shark, Great White Shark [64470]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Caretta caretta*, Loggerhead Turtle [1763]**	Endangered	Breeding likely to occur within area
***Chelonia mydas*, Green Turtle [1765]**	Vulnerable	Breeding likely to occur within area
***Dermochelys coriacea*, Leatherback Turtle, Leathery Turtle, Luth [1768]**	Endangered	Breeding likely to occur within area
***Lagenorhynchus obscurus*, Dusky Dolphin [43]**	Threatened	Species or species habitat may occur within area
***Lamna nasus* Porbeagle, Mackerel Shark [83288]**	Threatened	Species or species habitat may occur within area
***Megaptera novaeangliae*, Humpback Whale [38]**	Vulnerable	Species or species habitat may occur within area
***Orcinus orca*, Killer Whale, Orca [46]**	Threatened	Species or species habitat may occur within area
***Rhincodon typus*, Whale Shark [66680]**	Vulnerable	Species or species habitat may occur within area
MIGRATORY WETLANDS SPECIES		
***Actitis hypoleucos*, Common Sandpiper [59309]**	Threatened	Species or species habitat may occur within area
***Calidris acuminata*, Sharp-tailed Sandpiper [874]**	Threatened	Species or species habitat may occur within area
***Calidris canutus*, Red Knot, Knot [855]**	Endangered	Species or species habitat may occur within area

NAME	EPBC STATUS	TYPE OF PRESENCE
***Calidris ferruginea*, Curlew Sandpiper [856]**	Critically Endangered	Species or species habitat may occur within area
***Calidris melanotos*, Pectoral Sandpiper [858]**	Threatened	Species or species habitat may occur within area
***Calidris ruficollis*, Red-necked Stint [860]**	Threatened	Foraging, feeding or related behaviour known to occur within area
***Limosa lapponica*, Bar-tailed Godwit [844]**	Threatened	Species or species habitat may occur within area
***Numenius madagascariensis*, Eastern Curlew, Far Eastern Curlew [847]**	Critically Endangered	Species or species habitat may occur within area
***Pandion haliaetus*, Osprey [952]**	Threatened	Species or species habitat may occur within area
***Tringa nebularia*, Common Greenshank, Greenshank [832]**	Threatened	Species or species habitat known to occur within area
***Tringa stagnatilis*, Marsh Sandpiper, Little Greenshank [833]**	Threatened	Species or species habitat known to occur within area
OTHER LISTED MARINE SPECIES		
BIRDS		
***Actitis hypoleucos*, Common Sandpiper [59309]**	Threatened	Species or species habitat known to occur within area
***Apus pacificus*, Fork-tailed Swift [678]**	Threatened	Species or species habitat known to occur within area
***Ardea alba*, Great Egret, White Egret [59541]**	Threatened	Species or species habitat known to occur within area
***Ardea ibis*, Cattle Egret [59542]**	Threatened	Species or species habitat may occur within area
***Calidris acuminata*, Sharp-tailed Sandpiper [874]**	Threatened	Species or species habitat likely to occur within area
***Calidris canutus*, Red Knot, Knot [855]**	Endangered	Species or species habitat likely to occur within area
***Calidris ferruginea*, Curlew Sandpiper [856]**	Critically Endangered	Species or species habitat known to occur within area
***Calidris melanotos*, Pectoral Sandpiper [858]**	Threatened	Species or species habitat known to occur within area
***Calidris ruficollis*, Red-necked Stint [860]**	Threatened	Species or species habitat known to occur within area
***Catharacta skua,* Great Skua [59472]**	Threatened	Species or species habitat known to occur within area
***Cereopsis novaehollandiae grisea*, Cape Barren Goose (south-western), Recherche Cape Barren Goose [25978]**	Vulnerable	Species or species habitat known to occur within area
***Charadrius ruficapillus*, Red-capped Plover [881]**	Vulnerable	Species or species habitat known to occur within area
***Diomedea antipodensis*, Antipodean Albatross [64458]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Diomedea dabbenena*, Tristan Albatross [66471]**	Endangered	Species or species habitat may occur within area
***Diomedea epomophora*, Southern Royal Albatross [89221]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Diomedea exulans*, Wandering Albatross [89223]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Haliaeetus leucogaster*, White-bellied Sea-Eagle [943]**	Threatened	Species or species habitat may occur within area
***Halobaena caerulea*, Blue Petrel [1059]**	Vulnerable	Species or species habitat may occur within area

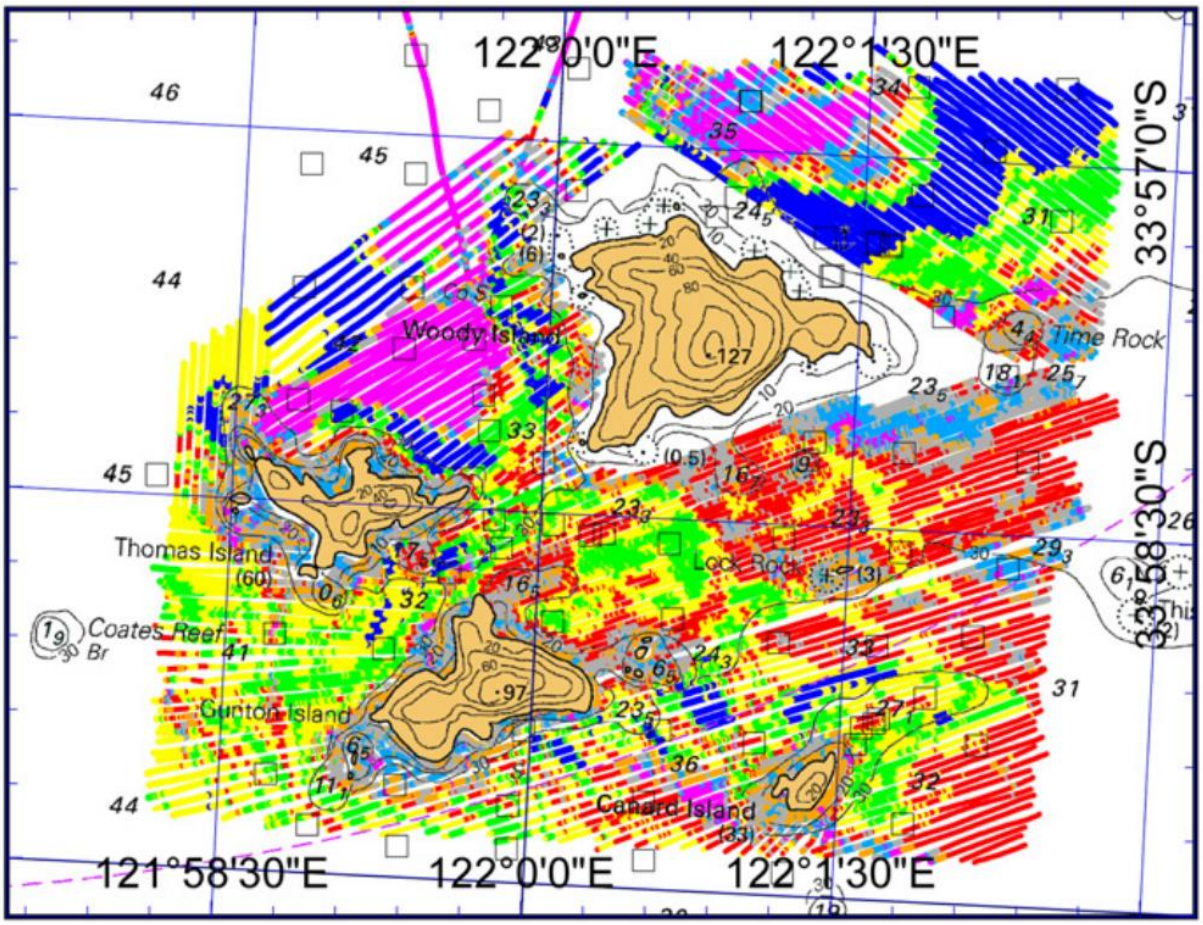
NAME	EPBC STATUS	TYPE OF PRESENCE
***Larus pacificus*, Pacific Gull [811]**	Threatened	Breeding known to occur within area
***Limosa lapponica menzbieri*, Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]**	Critically Endangered	Species or species habitat known to occur within area
***Macronectes giganteus*, Southern Giant-Petrel, Southern Giant Petrel [1060]**	Endangered	Species or species habitat may occur within area
***Macronectes halli*, Northern Giant Petrel [1061]**	Vulnerable	Species or species habitat may occur within area
***Merops ornatus*, Rainbow Bee-eater [670]**	Threatened	Species or species habitat may occur within area
***Motacilla cinerea*, Grey Wagtail [642]**	Threatened	Species or species habitat may occur within area
***Numenius madagascariensis*, Eastern Curlew, Far Eastern Curlew [847]**	Critically Endangered	Species or species habitat likely to occur within area
***Pachyptila turtur subantarctica*, Fairy Prion (southern) [64445]**	Vulnerable	Species or species habitat may occur within area
***Pandion haliaetus*, Osprey [952]**	Threatened	Species or species habitat known to occur within area
***Phalacrocorax fuscescens*, Black-faced Cormorant [59660]**	Threatened	Foraging, feeding or related behaviour likely to occur within area
***Phoebetria fusca*, Sooty Albatross [1075]**	Vulnerable	Species or species habitat may occur within area
***Pterodroma mollis*, Soft-plumaged Petrel [1036]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Puffinus assimilis* Little Shearwater [59363]**	Threatened	Breeding known to occur within area
***Puffinus carneipes*, Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]**	Threatened	Breeding known to occur within area
***Puffinus griseus,* Sooty Shearwater [1024]**	Threatened	Species or species habitat known to occur within area
Recurvirostra novaehollandiae, Red-necked Avocet [871]	Threatened	Species or species habitat known to occur within area
***Sterna anaethetus*, Bridled Tern [814]**	Threatened	Foraging, feeding or related behaviour likely to occur within area
***Sterna caspia*, Caspian Tern [59467]**	Threatened	Breeding known to occur within area
***Thalassarche carteri*, Indian Yellow-nosed Albatross [64464]**	Vulnerable	Foraging, feeding or related behaviour may occur within area
***Thalassarche cauta*, Shy Albatross [89224]**	Endangered	Foraging, feeding or related behaviour likely to occur within area
***Thalassarche impavida*, Campbell Albatross, Campbell Black-browed Albatross [64459]**	Threatened	Species or species habitat may occur within area
***Thalassarche melanophris*, Black-browed Albatross [66472]**	Vulnerable	Species or species habitat may occur within area
***Thalassarche steadi*, White-capped Albatross [64462]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Thinornis rubricollis*, Hooded Plover [59510]**	Threatened	Species or species habitat may occur within area
***Tringa nebularia*, Common Greenshank, Greenshank [832]**	Threatened	Species or species habitat may occur within area
***Tringa stagnatilis*, Marsh Sandpiper, Little Greenshank [833]**	Threatened	Species or species habitat may occur within area
FISH		

NAME	EPBC STATUS	TYPE OF PRESENCE
***Acentronura australe*, Southern Pygmy Pipehorse [66185]**	Threatened	Species or species habitat may occur within area
***Campichthys galei*, Gale's Pipefish [66191]**	Threatened	Species or species habitat may occur within area
***Heraldia nocturna*, Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]**	Threatened	Species or species habitat may occur within area
***Hippocampus breviceps*, Short-head Seahorse, Short-snouted Seahorse [66235]**	Threatened	Species or species habitat may occur within area
***Histiogamphelus cristatus*, Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]**	Threatened	Species or species habitat may occur within area
***Leptoichthys fistularius*, Brushtail Pipefish [66248]**	Threatened	Species or species habitat may occur within area
***Lissocampus caudalis*, Australian Smooth Pipefish, Smooth Pipefish [66249]**	Threatened	Species or species habitat may occur within area
***Lissocampus runa*, Javelin Pipefish [66251]**	Threatened	Species or species habitat may occur within area
***Maroubra perserrata*, Sawtooth Pipefish [66252]**	Threatened	Species or species habitat may occur within area
***Nannocampus subosseus*, Bonyhead Pipefish, Bony-headed Pipefish [66264]**	Threatened	Species or species habitat may occur within area
***Notiocampus ruber*, Red Pipefish [66265]**	Threatened	Species or species habitat may occur within area
***Phycodurus eques*, Leafy Seadragon [66267]**	Threatened	Species or species habitat may occur within area
***Phyllopteryx taeniolatus*, Common Seadragon, Weedy Seadragon [66268]**	Threatened	Species or species habitat may occur within area
***Pugnaso curtirostris*, Pugnose Pipefish, Pug-nosed Pipefish [66269]**	Threatened	Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]	Threatened	Species or species habitat may occur within area
***Stigmatopora argus*, Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]**	Threatened	Species or species habitat may occur within area
***Stigmatopora nigra*, Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]**	Threatened	Species or species habitat may occur within area
***Urocampus carinirostris*, Hairy Pipefish [66282]**	Threatened	Species or species habitat may occur within area
***Vanacampus margaritifer*, Mother-of-pearl Pipefish [66283]**	Threatened	Species or species habitat may occur within area
***Vanacampus phillipi*, Port Phillip Pipefish [66284]**	Threatened	Species or species habitat may occur within area
***Vanacampus poecilolaemus*, Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]**	Threatened	Species or species habitat may occur within area
MAMMALS		
***Arctocephalus forsteri*, Long-nosed Fur-seal, New Zealand Fur-seal [20]**	Threatened	Breeding known to occur within area
***Balaenoptera acutorostrata*, Minke Whale [33]**	Threatened	Species or species habitat may occur within area
***Balaenoptera borealis*, Sei Whale [34]**	Vulnerable	Species or species habitat may occur within area
***Balaenoptera edeni*, Bryde's Whale [35]**	Threatened	Species or species habitat may occur within area

NAME	EPBC STATUS	TYPE OF PRESENCE
***Balaenoptera musculus*, Blue Whale [36]**	Endangered	Species or species habitat likely to occur within area
***Balaenoptera physalus*, Fin Whale [37]**	Vulnerable	Species or species habitat may occur within area
***Caperea marginate*, Pygmy Right Whale [39]**	Threatened	Species or species habitat may occur within area
***Delphinus delphis*, Common Dolphin, Short-beaked Common Dolphin [60]**	Threatened	Species or species habitat may occur within area
***Eubalaena australis*, Southern Right Whale [40]**	Endangered	Breeding known to occur within area
***Grampus griseus*, Risso's Dolphin, Grampus [64]**	Threatened	Species or species habitat may occur within area
***Lagenorhynchus obscurus,* Dusky Dolphin [43]**	Threatened	Species or species habitat may occur within area
***Megaptera novaeangliae*, Humpback Whale [38]**	Vulnerable	Species or species habitat may occur within area
***Orcinus orca*, Killer Whale, Orca [46]**	Threatened	Species or species habitat may occur within area
***Tursiops aduncus*, Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]**	Threatened	Species or species habitat may occur within area
***Tursiops truncatus* s. str., Bottlenose Dolphin [68417]**	Threatened	Species or species habitat may occur within area

17. Appendix 6

Appendix 6: Benthic habitats around Woody, Thomas, Gunton and Canard Islands of Esperance Bay, as determined from multibeam sonar backscatter data. Taken from Hamilton and Parnum (2011). Mauve is rhodolith, light blue is high profile reef or rhodolith, dark blue is sand, green and yellow are seagrass, red is low profile reef, grey is high profile reef (for interpretation of the references to colour in this figure legend, the reader is referred to the web version of the article).



18. Appendix 7

Appendix 7: EPBC Act 1999 listed species occuring within the Twilight Cove proposed area as determined from the Protected Matters Search Tool. The lists may include some birds and fishes that are not technically marine species.

NAME	EPBC STATUS	TYPE OF PRESENCE
LISTED THREATENED SPECIES		
BIRDS		
***Calidris canutus*, Red Knot, Knot [855]**	Endangered	Species or species habitat likely to occur within area
***Calidris ferruginea*, Curlew Sandpiper [856]**	Critically Endangered	Species or species habitat known to occur within area
***Calidris tenuirostris*, Great Knot [862]**	Critically Endangered	Foraging, feeding or related behaviour known to occur within area
***Charadrius leschenaultii*, Greater Sand Plover, Large Sand Plover [877]**	Vulnerable	Species or species habitat known to occur within area
***Charadrius mongolus*, Lesser Sand Plover, Mongolian Plover [879]**	Endangered	Species or species habitat known to occur within area
***Diomedea antipodensis*, Antipodean Albatross [64458]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Diomedea dabbenena*, Tristan Albatross [66471]**	Endangered	Species or species habitat may occur within area
***Diomedea epomophora*, Southern Royal Albatross [89221]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Diomedea exulans*, Wandering Albatross [89223]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Diomedea sanfordi*, Northern Royal Albatross [64456]**	Endangered	Foraging, feeding or related behaviour likely to occur within area
***Falco hypoleucos*, Grey Falcon [929]**	Vulnerable	Species or species habitat known to occur within area
***Halobaena caerulea*, Blue Petrel [1059]**	Vulnerable	Species or species habitat may occur within area
***Leipoa ocellata*, Malleefowl [934]**	Vulnerable	Species or species habitat likely to occur within area
***Limosa lapponica menzbieri*, Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (Menzbieri) [86432]**	Critically Endangered	Species or species habitat likely to occur within area
***Macronectes giganteus*, Southern Giant-Petrel, Southern Giant Petrel [1060]**	Endangered	Species or species habitat may occur within area
***Macronectes halli*, Northern Giant Petrel [1061]**	Vulnerable	Species or species habitat may occur within area

NAME	EPBC STATUS	TYPE OF PRESENCE
***Numenius madagascariensis*, Eastern Curlew, Far Eastern Curlew [847]**	Critically Endangered	Species or species habitat may occur within area
***Pachyptila turtur subantarctica*, Fairy Prion (southern) [64445]**	Vulnerable	Species or species habitat may occur within area
***Phoebetria fusca*, Sooty Albatross [1075]**	Vulnerable	Species or species habitat may occur within area
***Pterodroma mollis*, Soft-plumaged Petrel [1036]**	Vulnerable	Species or species habitat may occur within area
***Sternula nereis nereis*, Australian Fairy Tern [82950]**	Vulnerable	Species or species habitat may occur within area
***Thalassarche carteri*, Indian Yellow-nosed Albatross [64464]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Thalassarche cauta*, Shy Albatross [89224]**	Endangered	Foraging, feeding or related behaviour likely to occur within area
***Thalassarche impavida*, Campbell Albatross, Campbell Black-browed Albatross [64459]**	Vulnerable	Species or species habitat may occur within area
***Thalassarche melanophris*, Black-browed Albatross [66472]**	Vulnerable	Species or species habitat may occur within area
***Thalassarche steadi*, White-capped Albatross [64462]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
MAMMALS		
***Balaenoptera musculus*, Blue Whale [36]**	Endangered	Species or species habitat likely to occur within area
***Eubalaena australis*, Southern Right Whale [40]**	Endangered	Breeding known to occur within area
***Megaptera novaeangliae*, Humpback Whale [38]**	Vulnerable	Species or species habitat likely to occur within area
***Neophoca cinerea*, Australian Sea-lion, Australian Sea Lion [22]**	Endangered	Breeding known to occur within area
REPTILES		
***Caretta caretta*, Loggerhead Turtle [1763]**	Endangered	Breeding likely to occur within area
***Chelonia mydas*, Green Turtle [1765]**	Vulnerable	Breeding likely to occur within area
***Dermochelys coriacea*, Leatherback Turtle, Leathery Turtle, Luth [1768]**	Endangered	Breeding likely to occur within area
SHARKS		
***Carcharodon carcharias*, White Shark, Great White Shark [64470]**	Vulnerable	Foraging, feeding or related behaviour known to occur within area
LISTED MIGRATORY SPECIES		
MIGRATORY MARINE BIRDS		
***Apus pacificus*, Fork-tailed Swift [678]**	Threatened	Species or species habitat likely to occur within the area
***Ardenna carneipes*, Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]**	Threatened	Breeding known to occur within area
***Ardenna grisea*, Sooty Shearwater [82651]**	Threatened	Species or species habitat may occur within area

NAME	EPBC STATUS	TYPE OF PRESENCE
***Diomedea antipodensis*, Antipodean Albatross [64458]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Diomedea dabbenena*, Tristan Albatross [66471]**	Endangered	Species or species habitat may occur within area
***Diomedea epomophora*, Southern Royal Albatross [89221]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Diomedea exulans*, Wandering Albatross [89223]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Diomedea sanfordi*, Northern Royal Albatross [64456]**	Endangered	Foraging, feeding or related behaviour likely to occur within area
***Hydroprogne caspia*, Caspian Tern [808]**	Threatened	Breeding known to occur within area
***Macronectes giganteus*, Southern Giant-Petrel, Southern Giant Petrel [1060]**	Endangered	Species or species habitat may occur within area
***Macronectes halli*, Northern Giant Petrel [1061]**	Vulnerable	Species or species habitat may occur within area
***Phoebetria fusca*, Sooty Albatross [1075]**	Vulnerable	Species or species habitat may occur within area
***Thalassarche carteri*, Indian Yellow-nosed Albatross [64464]**	Vulnerable	Foraging, feeding or related behaviour may occur within area
***Thalassarche cauta*, Shy Albatross [89224]**	Endangered	Foraging, feeding or related behaviour likely to occur within area
***Thalassarche impavida*, Campbell Albatross, Campbell Black-browed Albatross [64459]**	Vulnerable	Species or species habitat may occur within area
***Thalassarche melanophris*, Black-browed Albatross [66472]**	Vulnerable	Species or species habitat may occur within area
***Thalassarche steadi*, White-capped Albatross [64462]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
MIGRATORY MARINE SPECIES		
***Eubalaena australis*, Southern Right Whale [75529]**	Endangered	Breeding known to occur within area
***Balaenoptera edeni*, Bryde's Whale [35]**	Threatened	Species or species habitat likely to occur within area
***Balaenoptera musculus*, Blue Whale [36]**	Endangered	Species or species habitat likely to occur within area
***Caperea marginate*, Pygmy Right Whale [39]**	Threatened	Species or species habitat likely to occur within area
***Carcharhinus longimanus*, Oceanic Whitetip Shark [84108]**	Threatened	Species or species habitat may occur within area
***Carcharodon carcharias*, White Shark, Great White Shark [64470]**	Vulnerable	Foraging, feeding or related behaviour known to occur within area
***Caretta caretta*, Loggerhead Turtle [1763]**	Endangered	Breeding likely to occur within area
***Chelonia mydas*, Green Turtle [1765]**	Vulnerable	Breeding likely to occur within area
***Dermochelys coriacea*, Leatherback Turtle, Leathery Turtle, Luth [1768]**	Endangered	Breeding likely to occur within area

NAME	EPBC STATUS	TYPE OF PRESENCE
***Isurus oxyrinchus*, Shortfin Mako, Mako Shark [79073]**	Threatened	Species or species habitat may occur within area
***Lagenorhynchus obscurus*, Dusky Dolphin [43]**	Threatened	Species or species habitat may occur within area
***Lamna nasus* Porbeagle, Mackerel Shark [83288]**	Threatened	Species or species habitat may occur within area
***Megaptera novaeangliae*, Humpback Whale [38]**	Vulnerable	Species or species habitat may occur within area
***Orcinus orca*, Killer Whale, Orca [46]**	Threatened	Species or species habitat may occur within area
MIGRATORY WETLANDS SPECIES		
***Actitis hypoleucos*, Common Sandpiper [59309]**	Threatened	Species or species habitat may occur within area
***Arenaria interpres*, Ruddy Turnstone [872]**	Threatened	Species or species habitat may occur within area
***Calidris acuminata*, Sharp-tailed Sandpiper [874]**	Threatened	Species or species habitat may occur within area
***Calidris alba*, Sanderling [875]**	Threatened	Species or species habitat may occur within area
***Calidris canutus*, Red Knot, Knot [855]**	Endangered	Species or species habitat may occur within area
***Calidris ferruginea*, Curlew Sandpiper [856]**	Critically Endangered	Species or species habitat may occur within area
***Calidris melanotos*, Pectoral Sandpiper [858]**	Threatened	Species or species habitat may occur within area
***Calidris ruficollis*, Red-necked Stint [860]**	Threatened	Species or species habitat may occur within area
***Calidris tenuirostris*, Great Knot [862]**	Critically Endangered	Species or species habitat may occur within area
***Charadrius bicinctus*, Double-banded Plover [895]**	Threatened	Species or species habitat may occur within area
***Charadrius leschenaultii*, Greater Sand Plover, Large Sand Plover [877]**	Vulnerable	Species or species habitat may occur within area
***Charadrius mongolus*, Lesser Sand Plover, Mongolian Plover [879]**	Endangered	Species or species habitat may occur within area
***Charadrius veredus*, Oriental Plover, Oriental Dotterel [882]**	Threatened	Species or species habitat may occur within area
***Limicola falcinellus*, Broad-billed Sandpiper [842]**	Threatened	Species or species habitat may occur within area
***Limosa lapponica*, Bar-tailed Godwit [844]**	Threatened	Species or species habitat may occur within area
***Limosa limosa*, Black-tailed Godwit [845]**	Threatened	Species or species habitat may occur within area
***Numenius madagascariensis*, Eastern Curlew, Far Eastern Curlew [847]**	Critically Endangered	Species or species habitat may occur within area
***Pandion haliaetus*, Osprey [952]**	Threatened	Species or species habitat may occur within area
***Phalaropus lobatus*, Red-necked Phalarope [838]**	Threatened	Species or species habitat may occur within area
***Pluvialis fulva*, Pacific Golden Plover [25545]**	Threatened	Species or species habitat may occur within area
***Pluvialis squatarola*, Grey Plover [865]**	Threatened	Species or species habitat may occur within area
***Tringa brevipes*, Grey-tailed Tattler [851]**	Threatened	Species or species habitat may occur within area
***Tringa nebularia*, Common Greenshank, Greenshank [832]**	Threatened	Species or species habitat known to occur within area

NAME	EPBC STATUS	TYPE OF PRESENCE
***Tringa stagnatilis*, Marsh Sandpiper, Little Greenshank [833]**	Threatened	Species or species habitat known to occur within area
***Xenus cinereus*, Terek Sandpiper [59300]**	Threatened	Species or species habitat known to occur within area
OTHER LISTED MARINE SPECIES		
BIRDS		
***Actitis hypoleucos*, Common Sandpiper [59309]**	Threatened	Species or species habitat known to occur within area
***Apus pacificus*, Fork-tailed Swift [678]**	Threatened	Species or species habitat known to occur within area
***Ardea alba*, Great Egret, White Egret [59541]**	Threatened	Species or species habitat known to occur within area
***Ardea ibis*, Cattle Egret [59542]**	Threatened	Species or species habitat may occur within area
***Arenaria interpres*, Ruddy Turnstone [872]**	Threatened	Species or species habitat may occur within area
***Calidris acuminata*, Sharp-tailed Sandpiper [874]**	Threatened	Species or species habitat likely to occur within area
***Calidris alba*, Sanderling [875]**	Threatened	Species or species habitat likely to occur within area
***Calidris canutus*, Red Knot, Knot [855]**	Endangered	Species or species habitat likely to occur within area
***Calidris ferruginea*, Curlew Sandpiper [856]**	Critically Endangered	Species or species habitat known to occur within area
***Calidris melanotos*, Pectoral Sandpiper [858]**	Threatened	Species or species habitat known to occur within area
***Calidris ruficollis*, Red-necked Stint [860]**	Threatened	Species or species habitat known to occur within area
***Calidris tenuirostris*, Great Knot [862]**	Critically Endangered	Species or species habitat known to occur within area
***Catharacta skua*, Great Skua [59472]**	Threatened	Species or species habitat known to occur within area
***Charadrius bicinctus*, Double-banded Plover [895]**	Threatened	Species or species habitat known to occur within area
***Charadrius leschenaultii*, Greater Sand Plover, Large Sand Plover [877]**	Vulnerable	Species or species habitat known to occur within area
***Charadrius mongolus*, Lesser Sand Plover, Mongolian Plover [879]**	Endangered	Species or species habitat likely to occur within area
***Charadrius ruficapillus*, Red-capped Plover [881]**	Vulnerable	Species or species habitat known to occur within area
***Charadrius veredus*, Oriental Plover, Oriental Dotterel [882]**	Threatened	Species or species habitat known to occur within area
***Chrysococcyx osculans*, Black-eared Cuckoo [705]**	Threatened	Species or species habitat known to occur within area
***Diomedea antipodensis*, Antipodean Albatross [64458]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Diomedea dabbenena*, Tristan Albatross [66471]**	Endangered	Species or species habitat may occur within area
***Diomedea epomophora*, Southern Royal Albatross [89221]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Diomedea exulans*, Wandering Albatross [89223]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Diomedea sanfordi*, Northern Royal Albatross [64456]**	Endangered	Foraging, feeding or related behaviour likely to occur within area

NAME	EPBC STATUS	TYPE OF PRESENCE
***Haliaeetus leucogaster*, White-bellied Sea-Eagle [943]**	Threatened	Species or species habitat may occur within area
***Halobaena caerulea*, Blue Petrel [1059]**	Vulnerable	Species or species habitat may occur within area
***Heteroscelus brevipes*, Grey-tailed Tattler [59311]**	Threatened	Species or species habitat may occur within area
***Himantopus himantopus*, Pied Stilt, Black-winged Stilt [870]**	Threatened	Species or species habitat may occur within area
***Larus pacificus*, Pacific Gull [811]**	Threatened	Breeding known to occur within area
***Limicola falcinellus*, Broad-billed Sandpiper [842]**	Threatened	Breeding known to occur within area
***Limosa lapponica menzbieri*, Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]**	Critically Endangered	Species or species habitat known to occur within area
***Limosa limosa*, Black-tailed Godwit [845]**	Threatened	Species or species habitat may occur within area
***Macronectes giganteus*, Southern Giant-Petrel, Southern Giant Petrel [1060]**	Endangered	Species or species habitat may occur within area
***Macronectes halli*, Northern Giant Petrel [1061]**	Vulnerable	Species or species habitat may occur within area
***Merops ornatus*, Rainbow Bee-eater [670]**	Threatened	Species or species habitat may occur within area
***Motacilla cinerea*, Grey Wagtail [642]**	Threatened	Species or species habitat may occur within area
***Numenius madagascariensis*, Eastern Curlew, Far Eastern Curlew [847]**	Critically Endangered	Species or species habitat likely to occur within area
***Pachyptila turtur subantarctica*, Fairy Prion (southern) [64445]**	Vulnerable	Species or species habitat may occur within area
***Pandion haliaetus*, Osprey [952]**	Threatened	Species or species habitat known to occur within area
***Phalaropus lobatus*, Red-necked Phalarope [838]**	Threatened	Species or species habitat known to occur within area
***Phoebetria fusca*, Sooty Albatross [1075]**	Vulnerable	Species or species habitat may occur within area
***Pluvialis fulva*, Pacific Golden Plover [25545]**	Threatened	Species or species habitat known to occur within area
***Pluvialis squatarola*, Grey Plover [865]**	Threatened	Species or species habitat known to occur within area
***Pterodroma mollis*, Soft-plumaged Petrel [1036]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Puffinus assimilis*, Little Shearwater [59363]**	Threatened	Breeding known to occur within area
***Puffinus carneipes*, Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]**	Threatened	Breeding known to occur within area
***Puffinus griseus*, Sooty Shearwater [1024]**	Threatened	Species or species habitat known to occur within area
***Recurvirostra novaehollandiae*, Red-necked Avocet [871]**	Threatened	Species or species habitat known to occur within area
***Sterna caspia*, Caspian Tern [59467]**	Threatened	Breeding known to occur within area
***Thalassarche carteri*, Indian Yellow-nosed Albatross [64464]**	Vulnerable	Foraging, feeding or related behaviour may occur within area

NAME	EPBC STATUS	TYPE OF PRESENCE
***Thalassarche cauta*, Shy Albatross [89224]**	Endangered	Foraging, feeding or related behaviour likely to occur within area
***Thalassarche impavida*, Campbell Albatross, Campbell Black-browed Albatross [64459]**	Threatened	Species or species habitat may occur within area
***Thalassarche melanophris*, Black-browed Albatross [66472]**	Vulnerable	Species or species habitat may occur within area
***Thalassarche steadi*, White-capped Albatross [64462]**	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
***Thinornis rubricollis*, Hooded Plover [59510]**	Threatened	Species or species habitat may occur within area
***Tringa nebularia*, Common Greenshank, Greenshank [832]**	Threatened	Species or species habitat may occur within area
***Tringa stagnatilis*, Marsh Sandpiper, Little Greenshank [833]**	Threatened	Species or species habitat may occur within area
***Xenus cinereus*, Terek Sandpiper [59300]**	Threatened	Species or species habitat may occur within area
FISH		
***Acentronura australe*, Southern Pygmy Pipehorse [66185]**	Threatened	Species or species habitat may occur within area
***Campichthys galei*, Gale's Pipefish [66191]**	Threatened	Species or species habitat may occur within area
***Heraldia nocturna*, Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]**	Threatened	Species or species habitat may occur within area
***Hippocampus breviceps*, Short-head Seahorse, Short-snouted Seahorse [66235]**	Threatened	Species or species habitat may occur within area
***Histiogamphelus cristatus*, Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]**	Threatened	Species or species habitat may occur within area
***Leptoichthys fistularius*, Brushtail Pipefish [66248]**	Threatened	Species or species habitat may occur within area
***Lissocampus caudalis*, Australian Smooth Pipefish, Smooth Pipefish [66249]**	Threatened	Species or species habitat may occur within area
***Lissocampus runa*, Javelin Pipefish [66251]**	Threatened	Species or species habitat may occur within area
***Maroubra perserrata*, Sawtooth Pipefish [66252]**	Threatened	Species or species habitat may occur within area
***Nannocampus subosseus*, Bonyhead Pipefish, Bony-headed Pipefish [66264]**	Threatened	Species or species habitat may occur within area
***Notiocampus ruber*, Red Pipefish [66265]**	Threatened	Species or species habitat may occur within area
***Phycodurus eques*, Leafy Seadragon [66267]**	Threatened	Species or species habitat may occur within area
***Phyllopteryx taeniolatus*, Common Seadragon, Weedy Seadragon [66268]**	Threatened	Species or species habitat may occur within area
***Pugnaso curtirostris*, Pugnose Pipefish, Pug-nosed Pipefish [66269]**	Threatened	Species or species habitat may occur within area
***Stigmatopora argus*, Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]**	Threatened	Species or species habitat may occur within area

NAME	EPBC STATUS	TYPE OF PRESENCE
***Stigmatopora nigra*, Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]**	Threatened	Species or species habitat may occur within area
***Urocampus carinirostris*, Hairy Pipefish [66282]**	Threatened	Species or species habitat may occur within area
***Vanacampus margaritifer*, Mother-of-pearl Pipefish [66283]**	Threatened	Species or species habitat may occur within area
***Vanacampus phillipi*, Port Phillip Pipefish [66284]**	Threatened	Species or species habitat may occur within area
***Vanacampus poecilolaemus*, Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]**	Threatened	Species or species habitat may occur within area
MAMMALS		
***Arctocephalus forsteri*, Long-nosed Fur-seal, New Zealand Fur-seal [20]**	Threatened	Breeding known to occur within area
***Balaenoptera acutorostrata*, Minke Whale [33]**	Threatened	Species or species habitat may occur within area
***Balaenoptera edeni*, Bryde's Whale [35]**	Threatened	Species or species habitat may occur within area
***Balaenoptera musculus*, Blue Whale [36]**	Endangered	Species or species habitat likely to occur within area
***Caperea marginate*, Pygmy Right Whale [39]**	Threatened	Species or species habitat may occur within area
***Delphinus delphis*, Common Dolphin, Short-beaked Common Dolphin [60]**	Threatened	Species or species habitat may occur within area
***Eubalaena australis*, Southern Right Whale [40]**	Endangered	Breeding known to occur within area
***Grampus griseus*, Risso's Dolphin, Grampus [64]**	Threatened	Species or species habitat may occur within area
***Lagenorhynchus obscurus*, Dusky Dolphin [43]**	Threatened	Species or species habitat may occur within area
***Megaptera novaeangliae*, Humpback Whale [38]**	Vulnerable	Species or species habitat may occur within area
***Orcinus orca*, Killer Whale, Orca [46]**	Threatened	Species or species habitat may occur within area
***Pseudorca crassidens*, False Killer Whale [48]**	Threatened	Species or species habitat may occur within area
***Tursiops aduncus*, Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]**	Threatened	Species or species habitat may occur within area
***Tursiops truncatus* s. str., Bottlenose Dolphin [68417]**	Threatened	Species or species habitat may occur within area

19. Appendix 8

Appendix 8: Justifications and scoring of ecological criteria for each of the five proposed areas for marine reservation based on CALM (n.d.).

Wilson report recommended area	CALM original score	This report	Justification
E1: Ecological value			
CV-BI	4	4	*Pictilabrus brauni* wrasse has not been found anywhere else apart from Cheynes Beach and King George Sound. This is one example of endemism along the south coast. Seagrass meadows in Two Peoples Bay may be providing nursery habitat for key species, though not confirmed. Diverse range of habitat including sand, reef, gravel which is largely covered in sessile invertebrates and algae communities. Southern right whales are listed as Endangered under the EPBC Act and use Two Peoples Bay (this may be for nursing and calving like other locations along the south coast), and Australian sea lions are listed as 'vulnerable' and Bald Island and Coffin Island are breeding/haul out locations. Proximity to Albany could elevate vulnerability as human population increase.
FBR	4	5	Has a range of benthic habitats that are likely linked to the differences in substrate (e.g., silicate sands vs limestone). Obvious break in benthic habitat occurs around Red Island – extensive seagrass meadows and reefs throughout boundary area. Biophysical differences exist between Bremer and Hopetoun which influences different compositions of species e.g., leafy sea dragons and *Cystophora*. Potential foraging area for Australian sea lions. Breeding colonies of Australian sea lion and long-nosed fur seal on Doubtful Islands and Australian sea lion on Red Islands/Islet. Doubtful Bay is a recognised as a large established aggregation area for southern right whales, and Point Charles Bay is also regularly used by whales.
SI	3	4	Likely that the three parallel limestone reefs occurring across a 1km stretch are diverse in invertebrates and fishes, which is a unique feature. Extensive seagrass meadows occur within boundary, likely *Posidonia* and *Amphibolis*. Low- and high-profile reef is present, some bare and some covered in algae. The endangered southern right whale is known to frequent the coastal waters within the boundary, and mothers use coastal spots along south coast for calving, nursing and resting. Stokes Inlet is a location visited by the hooded plover – a priority species that is considered to be Australia's most endangered resident shorebird (Taylor, 2013).
RA	4	5	Most biodiversity research has focused on the Recherche Archipelago. There is a variety of habitats, including seagrass meadows, reef, sand, sponges and macroalgae beds, and different geomorphological features, that support a diverse flora and fauna community. The region supports over 300 sponge species and ~260 fish species, plus a diverse molluscs and crustacean community. An obvious presence of K-selected demersal species (long-lived, slow growing) was an important feature of assemblages in the region, e.g., western blue groper and foxfish wrasse. A faunal break in fish assemblages was also noted around Cape Le Grand, warranting further investigation. The first live records of the ruby seadragon (*Phyllopteryx dewysea*) were collected from the Recherche Archipelago at ~50 m depth. Many islands are used for breeding and hauls outs by Australian sea lions and long-nosed fur seals. Southern right whales aggregate around Cape Arid, which is a recognised area by the Commonwealth.

Wilson report recommended area	CALM original score	This report	Justification
TC	3	3	Lower diversity of fishes and habitats than other locations along south coast. Four species of shorebird (60 individuals) counted along Kanidal Beach, which was lower than other locations along the south coast. The Baxter Cliffs at Twilight Cove is noted as a haul out and breeding colony for Australian sea lions and is the only record of breeding on the mainland as opposed to islands. Recognised as an emerging aggregation area for endangered southern right whales, which use the south coast for calving, nursing and resting.
E2: Comprehensiveness			
CV-BI	5	5	The Walpole and Nornalup Inlets Marine Park is the only marine park in state waters along the south coast, but the boundaries do not extend into coastal waters. The south coast is underrepresented in the WA network of marine parks and reserves, so including a south coast park would increase comprehensiveness.
FBR	5	5	The Walpole and Nornalup Inlets Marine Park is the only marine park in state waters along the south coast, but the boundaries do not extend into coastal waters. The south coast is underrepresented in the WA network of marine parks and reserves, so including a south coast park would increase comprehensiveness.
SI	5	5	The Walpole and Nornalup Inlets Marine Park is the only marine park in state waters along the south coast, but the boundaries do not extend into coastal waters. The south coast is underrepresented in the WA network of marine parks and reserves, so including a south coast park would increase comprehensiveness.
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TC	5	5	The Walpole and Nornalup Inlets Marine Park is the only marine park in state waters along the south coast, but the boundaries do not extend into coastal waters. The south coast is underrepresented in the WA network of marine parks and reserves, so including a south coast park would increase comprehensiveness.
E3: Bioregional representation			
CV-BI	2	2	Boundaries have not changed and IMCRA regions haven't changed. Increasing the boundary area will increase the score.
FBR	3	3	Boundaries have not changed and IMCRA regions haven't changed. Increasing the boundary area will increase the score.
SI	1	1	Boundaries have not changed and IMCRA regions haven't changed. Increasing the boundary area will increase the score.
RA	4	4	Boundaries have not changed and IMCRA regions haven't changed. Increasing the boundary area will increase the score.
TC	1	1	Boundaries have not changed and IMCRA regions haven't changed. Increasing the boundary area will increase the score.
E4: Level of existing and/or potential threats			
CV-BI	2	3	Uncertainty of the extent of port impacts on proposed marine reservation area – potential port expansion impacts to consider? Proximity to Albany could increase future threats from vessel use, fishing activity, pollution as human population increase. Risk of oil spills and other contaminants impacting marine life and habitats. Risk of introduced marine pests was low for the port of Albany (McDonald 2008). Whale watching activities are projected to increases due to increased visitation of whales and increased visitation of tourists. Cumulative impacts need to be considered and incorporate climate change pressures. Slow growing, long-lived demersal fish species are a feature of south coast

Wilson report recommended area	CALM original score	This report	Justification
			assemblages, and they are inherently vulnerable to disturbance and overfishing. Minimal run off from land so agricultural impacts are not a major concern at present. Anecdotal evidence that recreational fishers have been catching less and smaller fish.
FBR	1	3	Increased visitation in the area due to thriving Bremer Canyon whale watching businesses. Tourism has boomed in the past 5yrs. Potential oil and gas exploration opportunities and upgrading the Bremer Bay marina will increase anthropogenic activity in the area and potentially have flow on effects to the proposed area (Economic growth project plan 2016-2021 – Shire of Jerramungup). Development of Bremer Bay airport to facilitate increased visitation is a consideration. If boundaries were extended to Cape Knob, then the score would increase. Cumulative impacts need to be considered and incorporate climate change pressures. Slow growing, long-lived demersal fish species are a feature of south coast assemblages, and they are inherently vulnerable to disturbance and overfishing.
SI	3	3	Original scoring also considered the estuary component of Stokes Inlet, which was not considered in this scope of works. Based on this, keep score as is. Cumulative impacts need to be considered and incorporate climate change pressures. K selected fish species are a feature of south coast assemblages, and they are more vulnerable to disturbance and overfishing.
RA	2	3	An assessment of potential future port/and or expansion has been conducted around the south-west and south coast by DoT and WAM, whereby old whaling data was used to help identify suitable port locations – one of those potential sites is in the middle of the proposed Recherche Archipelago boundary. $10.2mil has been allocated towards projects at Esperance Port for expansion and safety – *2020 Gov of WA media statement*. Cumulative impacts need to be considered and incorporate climate change pressures. Slow growing, long-lived demersal fish species are a feature of south coast assemblages, and they are inherently vulnerable to disturbance and overfishing. Esperance Port received a low likelihood for marine pest introductions (McDonald 2008). Fishing is a pressure.
TC	1	2	A comment from Eyre Bird Observatory expert said that there has been an increase in 4WD activity along the beaches in recent years. Cumulative impacts need to be considered and incorporate climate change pressures. K selected fish species are a feature of south coast assemblages, and they are more vulnerable to disturbance and overfishing, though the diversity of fishes at Twilight Cove is lower than other locations, possibly due to the less diverse habitat.
E5: Functional integrity			
CV-BI	2	2	Extensive seagrass meadows of Cheynes and Hassell Beach is missed and if included would increase the functional integrity. Lack of research on functional integrity.
FBR	3	3	Functional integrity could be improved by encompassing a greater proportion of habitats east and west of the recommended boundary. Bremer Canyon connectivity with coastal waters likely to significantly influence functional integrity, which could be more encompassed by expanding the boundary west to Cape Knob. Lack of research on functional integrity.
SI	2	2	Functional integrity could be improved by encompassing a greater proportion of habitats east and west of the recommended boundary. Lack of research on functional integrity.

Wilson report recommended area	CALM original score	This report	Justification
RA	5	5	Inclusive of all islands and waters around islands, range of depths and habitats, so would be inclusive of key ecosystem processes related to the islands and region.
TC	2	2	More surveys needed to determine the extent of biodiversity and habitats. Lack of research on functional integrity.
E6: Integration of terrestrial and marine management			
CV-BI	4	5	Two Peoples Bay Nature Reserve, Waychinicup National Park, Mt Manypeaks Nature Reserve, Bald Island Nature Reserve
FBR	5	5	Fitzgerald River National Park, Doubtful Island Nature Reserve, Glasse Island Nature Reserve, Rocky Islets Nature Reserve
SI	4	5	Stokes National Park
RA	4	5	Woody Island Nature Reserve, Recherche Archipelago Nature Reserve, Nuytsland Nature Reserve, Cape Arid National Park, Cape Le Grand National Park
TC	5	5	Nuytsland Nature Reserve