MAY 2019

Assessment of the Values of Victoria's Marine Environment

Atlas

VICTORIA

VEAC
Victorian Environmental Assessment Council

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Victorian Environmental Assessment Council

The Victorian Environmental Assessment Council (VEAC) was established in 2001 under the *Victorian Environmental Assessment Council Act 2001*. It provides the State Government of Victoria with independent advice on protection and management of the environment and natural resources of public land.

The five Council members are:

Ms Janine Haddow (Chairperson)

Ms Joanne Duncan

Ms Anna Kilborn

Dr Charles Meredith

Dr Geoffrey Wescott

Contact details

Victorian Environmental Assessment Council
Level 39, 2 Lonsdale Street
GPO Box 527
Melbourne, Victoria 3001

Phone (03) 9637 9902
or 1800 134 803 (toll free from landline)
Email veac@delwp.vic.gov.au

www.veac.vic.gov.au

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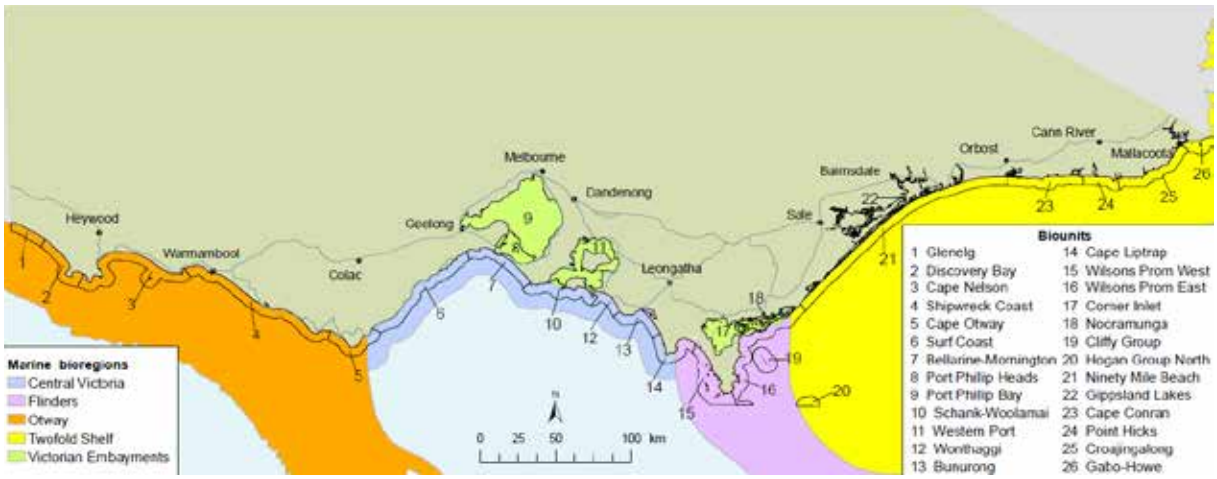
Introduction

1.1 Context

In March 2018, the Victorian Environmental Assessment Council (VEAC) was requested by the Minister for Energy, Environment and Climate Change, to carry out an assessment of the values of Victoria's marine environment.

The assessment outputs include an assessment report and an atlas (this document) that brings together information for the 26 marine bioregional units (biounits) along Victoria's coastline. The boundaries of these biounits, as shown on the map below, have been derived from marine habitat mapping undertaken for the Department of Environment, Land, Water and Planning (DELWP). The 26 marine biounits are a finer-scale breakdown of the marine bioregions established through the national Integrated Marine and Coastal Regionalisation of Australia (IMCRA) program.

The objective of the assessment report and atlas is to improve understanding of marine values, threats to those values and emerging uses. Collectively, this information can be used in the development of a new marine and coastal policy, marine and coastal strategy and a marine spatial planning framework, all of which are requirements of the *Marine and Coastal Act 2018*. This information can also be used to inform the upcoming State of the Marine and Coastal Environment report.



Marine bioregions with finer-scale regional marine biounits defined as part of marine habitat mapping by DELWP

1.2 What information is provided for each biounit?

The atlas contains the same set of spatially relevant information for each marine biounit. A local area map, with the simplified biounit boundary outlined in red, shows relevant spatial features and data layers for the marine values. The physical setting is described, including the extent of marine habitat mapping that has occurred to date. The Traditional Owner groups are identified together with the status of any Sea Country plans. For more detail on Traditional Owner values along the coast, see chapter 7 in the assessment report. Key natural values are listed, often with reference to the DELWP Marine Asset layer. For more detail on natural values, see chapter 6. Social and economic values are described together under five categories that closely align with those used in the report: coastal development (chapter 9), tourism and recreation (chapter 10), commercial fishing and aquaculture (chapter 11), ports and shipping (chapter 12) and energy (chapter 13).

Threats to the natural values within the biounit are described using five categories that align with the way threats are described in the assessment report. For threats specific to individual sectors (e.g. tourism and recreation), see the relevant chapter. Icons have been used to indicate the type of threat:


Climate change


Physical processes


Biological processes


Catchment processes


Pollution

For ease of reading, common names for species have been used and, where relevant, scientific names included in brackets. A list of common and scientific names is provided in appendix 1 at the back of this atlas.

1.3 Where has the information come from?

A range of spatial datasets and reports have been used to compile the atlas entries. These included DELWP corporate spatial data layers, Parks Victoria monitoring programs and management plans, catchment and stream condition assessments, and academic research. A list of references is provided at the back of the report. Some of the main data layers are described below.

Biotope mapping

DELWP has recently undertaken a statewide collation of marine habitat mapping and classification project. This project is based around the Combined Biotope Classification Scheme (CBiCS), which provides a unified way to classify all marine habitats and biotopes from the littoral (intertidal) zone to the deep sea (Edmunds and Flynn 2018).

The biotic (plants and animals) component is the core classification component, and centres around the idea of a biotope; a community of species in a defined habitat. Within the biotic component there are six hierarchical levels: environment, broad habitat, habitat complex, biotope complex, biotope and sub-biotope.

Each atlas entry describes habitat coverage at two levels: broad habitats and biotope complexes. These levels were selected to give suitable detail at a local scale but also for coverage at statewide scale. Broad habitats are defined by substratum (sediment, rock, other hard substrata) and zone. The supralittoral zone is encompassed within the coastal environment. The littoral zone (also referred to as intertidal) is not permanently inundated. The infralittoral zone (nearshore subtidal) is dominated by macroalgae in temperate waters. The circalittoral zone reefs (subtidal reefs beyond the infralittoral zone) are characterised by sessile invertebrates in temperate waters.

Biotope complexes are groups of community-level biotopes with similar physical and biological characteristics that occur in similar settings. They may also be characterised by salinity, tidal and wave exposure regimes and finer-scale depth and height zonation. Visible structural characteristics are emphasised in defining biotope complexes. A list of biotope complexes and descriptions (taken from the CBiCs catalogue available on the CoastKit website) is provided in appendix 2.

The marine habitat mapping is incomplete. Some biounits have yet to be mapped at even the broad habitat level, whereas others have detailed mapping below the biotope complex level. The atlas entries indicate where further survey and mapping work should focus, based on advice from the team that undertook the mapping. For more explanation about biotope mapping, see section 6.1 in the assessment report.

The atlas maps show a simplified biounit boundary (shown in red). The biounit boundary is not shown around islands, coastal lakes and wetlands, or around the landward extent of estuaries that are included within the biounit.

Marine assets

To help inform natural resource management across the state, DELWP developed a system of marine asset identification. Marine assets are biophysical elements of the environment that are valuable for their ecosystem services. The system used specific criteria and advice from scientific experts to identify the assets. Approximately 140 significant marine assets were identified within Victorian waters, many of which were nested within larger assets. Potential threats to each asset have been considered in this assessment and included on the relevant atlas page. Marine assets are indicated by a number (MA 1). For more detail, see section 4.4 in the assessment report.

Key biodiversity areas

Birdlife International has identified 20 key biodiversity areas (KBAs) along the Victorian coast that are globally significant for bird conservation. For an area to be declared a KBA it needs to either have more than half of one per cent of an endangered species population, or at least one per cent of the total population of a species at a critical stage of their life cycle, for example migration stopover. For more detail see section 4.3.

Marine protected areas

Victoria's no-take marine protected areas include 13 marine national parks and 11 marine sanctuaries. These are highly protected areas with no extractive uses allowed and are managed primarily for ecosystem protection, conservation of natural features and recreation. The marine national parks and sanctuaries cover approximately 5.3 per cent of Victorian coastal waters and extend landward to the high-water mark.

Multiple-use marine protected areas consist of two marine parks, one marine reserve and three marine and coastal parks. These areas have a lower level of protection, with recreational and commercial fishing allowed. Unlike the no-take areas, some of these multiple-use areas also include coastal land. There are also three multiple-use Commonwealth marine protected areas adjacent to Victorian coastal waters. For more detail on marine protected areas, see section 4.3.

Terrestrial protected areas

Seven national parks, one state park and five coastal parks extend to the mean low water mark. These parks include the intertidal zone. Where a national park abuts a marine national park (for example, Wilsons Promontory) the intertidal zone is included in the marine national park. Other protected areas along the coast include nature reserves and bushland reserves. For more detail, see section 4.3.

Ramsar sites

The 1971 Ramsar Convention aims to halt the worldwide loss of wetlands and conserve those that remain. There are 12 Ramsar sites in Victoria, five of which are coastal. For more detail see section 4.3.

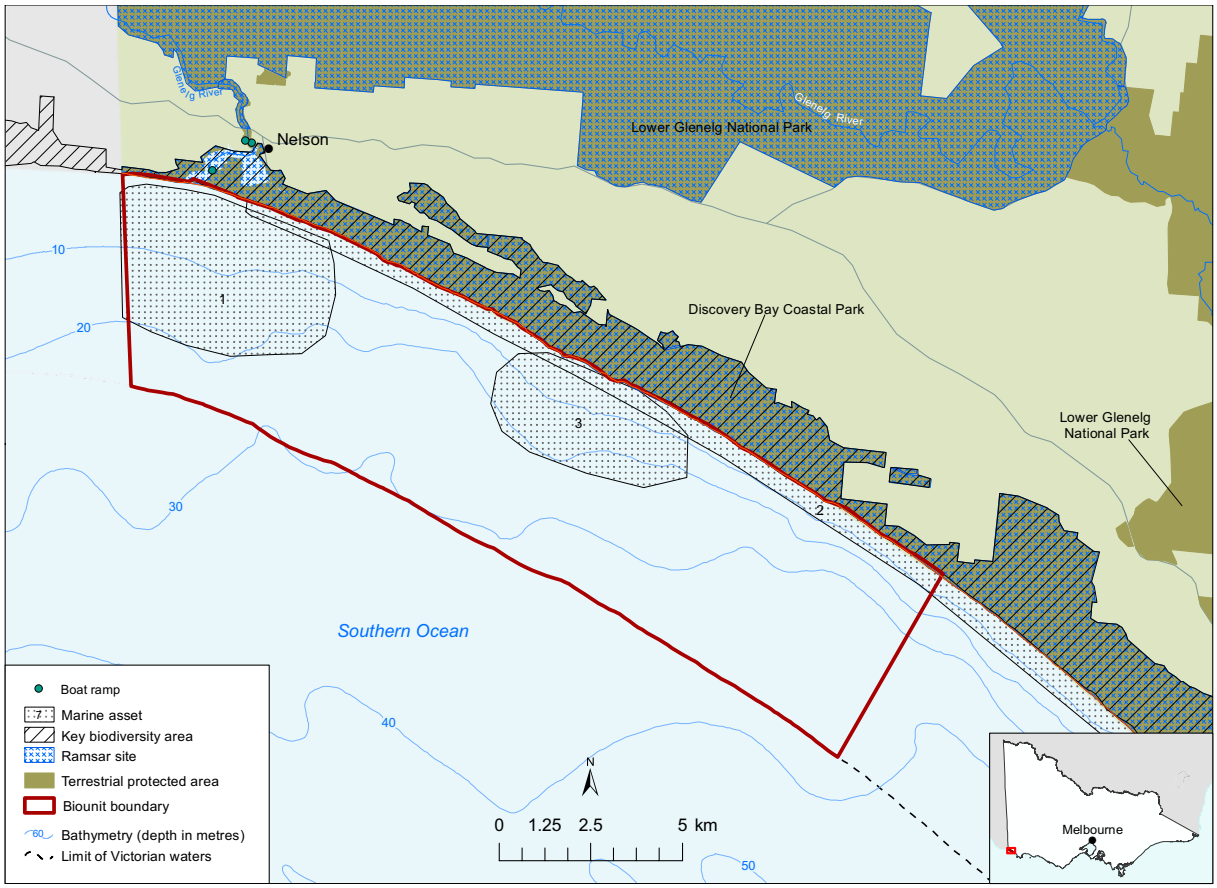
Fisheries reserves (aquaculture)

Crown land has been set aside for aquaculture in twelve designated aquaculture fisheries reserves, of which ten are offshore and two are onshore. For more detail, see section 11.3.

Assessment of the Values of Victoria's Marine Environment

Atlas entries for marine biounits

Biounit 1: Glenelg



Physical setting

The 13,383 hectare Glenelg biounit extends from the border with South Australia into Discovery Bay and includes the Glenelg River estuary and subtidal reef systems (Nelson reefs and Noble Rocks). There are no marine protected areas. The coastline is characterised by extreme exposure to the prevailing weather (including strong winds and swells) and is influenced by the Bonney Upwelling and moderate to strong tidal streams. Habitat types include high-energy, wave-dominated beaches, sublittoral reef and sediments and coastal estuary.

The Glenelg biounit has only been mapped to broad habitat level (59 per cent). At this level, the dominant classes are infralittoral rock and sublittoral sediment. Further mapping within the biounit should prioritise completion of mapping at the broad habitat level so that mapping can begin at the biotope complex level, and understanding giant kelp extent and condition (a unique and rare biotope).

Traditional Owners

- Part of the Sea Country of the Gunditjmara
- Koonang Mirring (Sea Country) plan to be developed by Gunditjmara in 2019

Natural values

- Conservation-listed blue whale feeding area (Bonney Upwelling), one of only 12 sites worldwide
- Extensive hooded plover habitat (MA 2). The Glenelg Estuary and Discovery Bay Ramsar site recognises the importance of shorebird habitat as does the Discovery Bay to Piccaninnie Ponds KBA
- Nelson reefs (MA 1) harbour important giant kelp beds that differ from eastern/central Victoria due to biogeographic affinities of understorey algae and co-occurring communities. Giant kelp decreased across Victoria in last 20 years, likely to be related to increasing water temperature and nutrient levels. Currently no threat from black sea urchin over-grazing
- Noble Rocks (MA 3) unique because of position as only rocky reef in long sandy stretch
- Coastal saltmarsh (Glenelg estuary)
- Conservation-listed communities (e.g. giant kelp marine forest, subtropical and temperate coastal saltmarsh) and species (e.g. pygmy blue whale, hooded plover) particularly vulnerable to environmental change

Social and economic values

European cultural heritage No data

Coastal development Nelson regional town. Coast with very high vulnerability to erosion under climate change

Tourism and recreation Discovery Bay Coastal Park, Great South West Walk. Popular activities include whale watching, bird watching and fishing

Commercial fishing and aquaculture Commercial fisheries licences for western rock lobster zone, western abalone zone, pipis. High rock lobster production. No aquaculture reserves or proposals for aquaculture

Ports and shipping No ports or commercial shipping routes present. Associated marine pollution risk is very low

Energy Otway Basin offshore. Area includes 2018 petroleum acreage release and may be subject to exploration if granted. No proposals for offshore wind, wave or tidal energy projects

Emerging uses

None identified

Threats

- Sea level rise alters frequency of estuary mouth opening (Glenelg river estuary seasonally closed)
- Sea level rise reduces area for saltmarsh where landward migration not possible
- Sea level rise changes coastal features (including inundation of beaches) which may affect shorebird resting/feeding/breeding habitats
- More frequent storm events and nutrient pulses entering estuaries cause algal growth and sedimentation
- Decreased freshwater flows alter frequency of estuary mouth opening/closing and salinity regime. Decreases fish diversity or abundance and connectivity for fish that use fresh and marine waters
- Increased hot, dry weather puts beach nesting birds at risk from fires

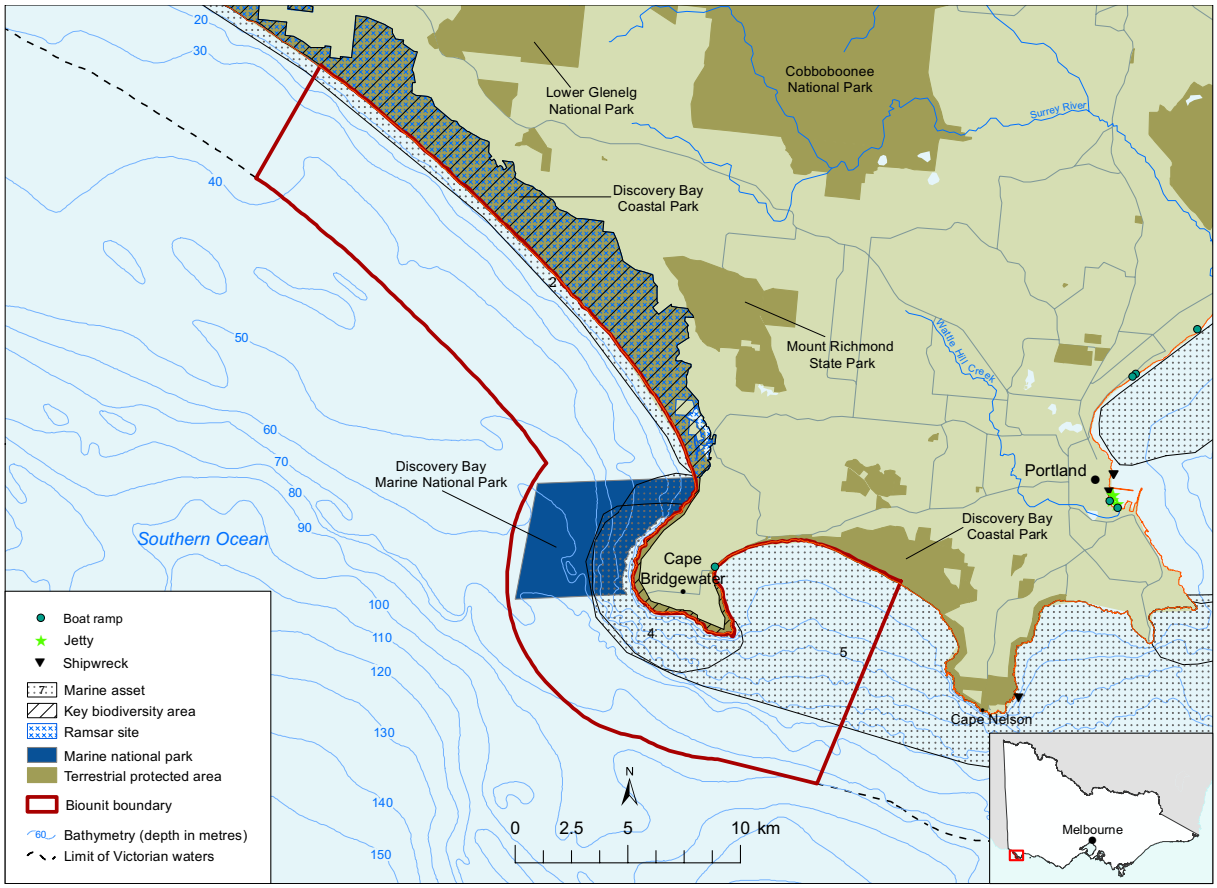
- Coastal saltmarsh vulnerable to trampling, especially during warmer months

- Abalone viral ganglioneuritis recorded in much of Otway bioregion
- Likely pests include green shore crab (intertidal areas), displaces local crabs
- Weeds displace native species in saltmarsh
- Introduced mammals prey on or disturb roosting, feeding and nesting birds and eggs (e.g. hooded plover)
- Greenlip abalone overfished in western zone
- Localised mollusc populations (e.g. pipis) susceptible to over-exploitation
- Disturbance to whales and calves (targeted searching, vessel collision) by whale watchers
- Disturbance to beach nesting birds (e.g. hooded plover), through recreation (e.g. dogs, horses, vehicles, shore-based activities) leads to nesting failure

- Elevated nutrients and sediments (e.g. Glenelg River in moderate condition) cause turbidity, reduce light levels, promote excess growth of algae, epiphytes and phytoplankton, decrease dissolved oxygen. Impacts include decreased fish diversity/abundance (including harvested species), potential seafood contamination

- Marine debris from ocean and litter/other debris from coastal towns (e.g. Nelson) leads to entanglement in and ingestion of thin plastics by marine fauna
- Marine debris more likely source of pollution than catchment-derived litter

Biounit 2: Discovery Bay



Physical setting

The 26,943 hectare Discovery Bay biounit extends from eastern Discovery Bay to Bridgewater Bay east of Cape Bridgewater and includes one marine protected area, the Discovery Bay Marine National Park (MNP). There is extreme exposure to the prevailing weather, including strong winds and swells. The biounit is influenced by the Bonney Upwelling and moderate to strong tidal streams. Habitats include high-energy, wave-dominated beaches and rocky shores, sublittoral reef and sediments, coastal cliffs, dunes and lagoons.

The Discovery Bay biounit has been mapped in some detail: 51 per cent at broad habitat level and 44 per cent at biotope complex level. Within Discovery Bay MNP, over 99 per cent has been mapped at the biotope complex level. The dominant biotope complex, including within Discovery Bay MNP, is infralittoral fine sand. Sandy low profile reef wave surge communities are also important.

Unique or rare biotopes include

- Brown algae: infralittoral bull kelp, high energy common kelp communities
- Sessile invertebrates: circalittoral high diversity sponge-seawhip-sea plume-gorgonian assemblages, low complexity circalittoral rock with non-crowded erect sponges, bushy bryozoan-dominated communities, moderate to high complexity circalittoral rock with covering of small colonies and well-spaced erect sponges

Traditional Owners

- Part of the Sea Country of the Gunditjmara
- Koonang Mirring (Sea Country) plan to be developed by Gunditjmara in 2019
- Sites on Cape Bridgewater provide earliest date for shell midden sites on eastern Australian coastline

Natural values

- Pygmy blue whale feeding area (Bonney Upwelling), one of only 12 sites worldwide
- Records of southern right whale, southern elephant seal
- Cape Bridgewater Australian fur seal haul out/occasional breeding site, long-nosed fur seal also visit
- Extensive hooded plover habitat (MA 2). The Glenelg Estuary and Discovery Bay Ramsar site recognises the importance of shorebird habitat, as does Discovery Bay to Piccaninnie Ponds KBA
- Feeding and roosting habitat for endangered seabirds (southern giant petrel, wandering albatross)
- Great white sharks often observed, habitat for grey nurse shark
- Habitat for southern bluefin tuna
- Portland reefs (MA 5) most productive abalone habitat in Victoria
- Discovery Bay MNP supports high intertidal and shallow subtidal invertebrate diversity

- Deep calcarenite reefs with sessile invertebrates (sponges, ascidians, bryozoans, gorgonians)
- Southern hooded shrimp and sparse seagrass (*Zostera* sp.) in Bridgewater Bay
- Underwater cliffs dominated by dense common kelp to 45 metres - deeper than elsewhere (MA 4)
- Sea caves, blow holes and petrified forest at Cape Duquesne on Cape Bridgewater
- Eight species at distributional limit in Discovery Bay MNP
- Conservation-listed communities and species (e.g. southern giant petrel), endemic or rare species (e.g. southern hooded shrimp) or species at distributional limit particularly vulnerable to environmental change

Social and economic values

European cultural heritage Wrecks of three wooden sailing barques (*Jane, Ann, Marie*) in vicinity of Cape Bridgewater

Coastal development Cape Bridgewater regional town. Coast with very high vulnerability to erosion under climate change

Tourism and recreation Discovery Bay MNP, Great South West walk, blowholes tourist destinations. Popular activities include shore-based recreational fishing (White's beach), bird watching, rock pooling. Southern bluefin tuna recreational fishery. Bridgewater Bay and Discovery Bay popular for surfing and diving

Commercial fishing and aquaculture Bonney Upwelling supports rich and diverse fishery. Commercial fisheries licences for western rock lobster zone, western abalone zone, pipi commercial fisheries. High rock lobster, abalone and pipi production. No aquaculture reserves or proposals for aquaculture

Ports and shipping No ports present but ships visiting Portland may pass through the area close to Cape Bridgewater. Associated marine pollution risk is moderate

Energy Otway Basin offshore. Area includes 2018 petroleum acreage release and may be subject to exploration if granted. No proposals for offshore wind, wave or tidal energy projects

Emerging uses

None identified

Threats

- Alterations in waves and currents reduce seagrass productivity
- Sea level rise reduces area for seagrass where landward migration not possible
- Sea level rise changes coastal features (including inundation of beaches and intertidal areas) which affects shorebird, seabird and seal resting, feeding, and breeding habitats
- Increased hot, dry weather puts beach nesting birds at risk from fires
- Increased ambient temperatures impact bull kelp

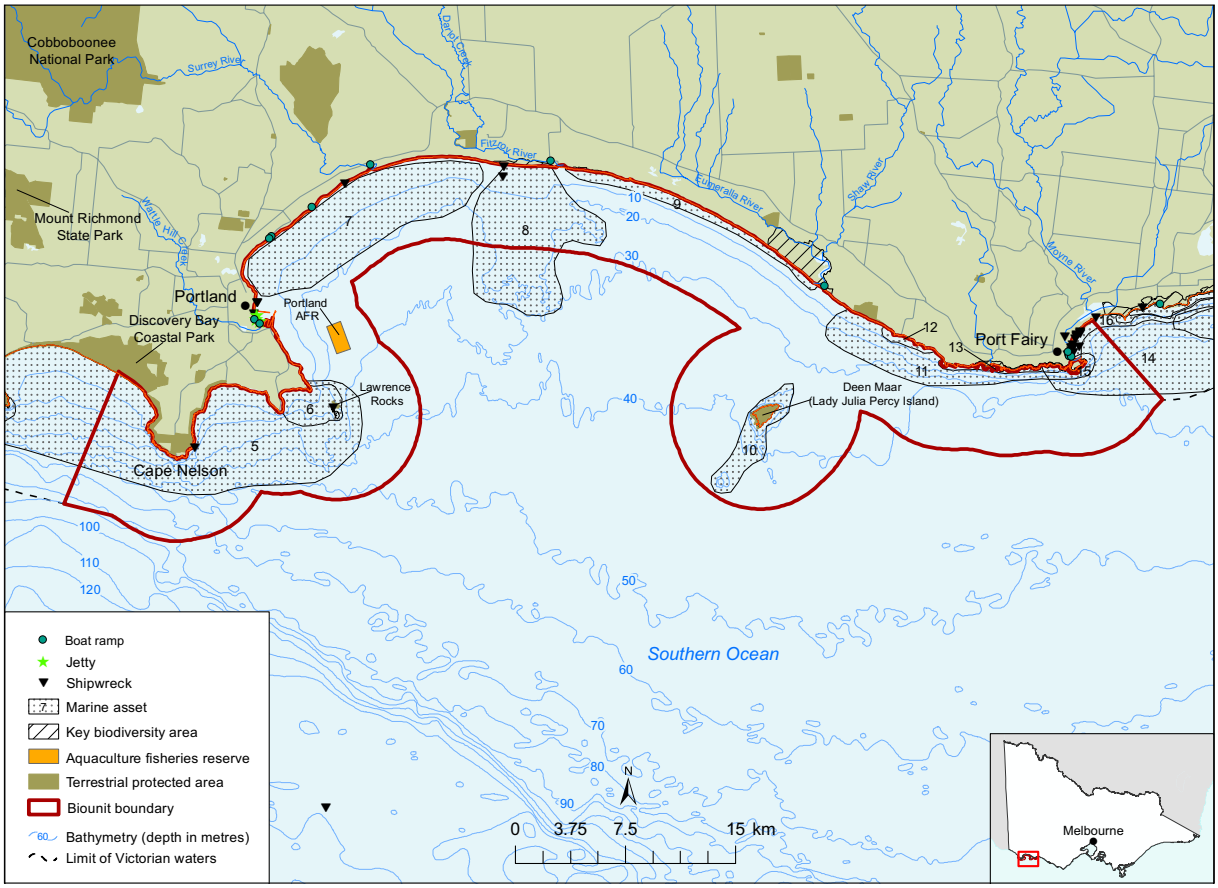
- Coastal saltmarsh and intertidal reef platforms vulnerable to trampling, especially during warmer months

- Abalone viral ganglioneuritis confirmed from Discovery Bay MNP
- Likely pests include green shore crab (intertidal areas), displaces local crabs
- Nine pests recorded in Portland Harbour in 1997: toxic dinoflagellate (*Alexandrium tamarense*), sabellid tube worms (*Euchone* sp.1, *Myxicola infundibulum*), Asian date mussel, Asian semele, bottom-dwelling mollusc (*Corbula gibba*), bryozoans (*Bugula dentata, B. neritina, Watersipora subtorquata*)
- Three invasive algae recorded in Portland Harbour in 2010: broccoli weed, *Grateloupia turuturu, Caulerpa racemosa var. cylindracea*
- Weeds displace native species in saltmarsh
- Introduced mammals prey on and disturb roosting, feeding and nesting birds and eggs (e.g. hooded plover) and intertidal fauna
- Greenlip abalone overfished in western zone
- Localised mollusc populations (e.g. pipis) susceptible to over-exploitation
- Disturbance to whales and calves (targeted searching, vessel collision) by whale watchers
- Disturbance to breeding seals (October to December) leads to crushed or drowned pups, loss of territory by bulls
- Disturbance to beach nesting birds (e.g. hooded plover), through recreation (e.g. dogs, horses, vehicles, shore-based activities) leads to nesting failure

- No data

- Marine debris from ocean and litter/other debris from urban areas (e.g. Cape Bridgewater, Portland) leads to entanglement in and ingestion of thin plastics by marine fauna

Biounit 3: Cape Nelson



Physical setting

The 69,763 hectare Cape Nelson coast biounit extends from western Bridgewater Bay to east of Port Fairy and includes five estuaries (Wattle Hill Creek, Surrey River, Fitzroy River, Lake Yambuk, Moyne River). There are no marine protected areas. The coast features capes, promontories and islands (Deen Maar) with extreme to very high exposure to the prevailing weather, including strong winds and swells. There are also submerged volcanic structures (Lawrence Rocks, Julia Reef) and deep low profile reef systems. Habitats include high-energy, wave-dominated beaches and rocky shores, sublittoral reef and sediments, coastal cliffs and lagoons.

The Cape Nelson biounit has been mapped in some detail: 55 per cent at broad habitat level and 53 per cent at biotope complex level. Of the mapped areas, the dominant biotope complexes are infralittoral fine sand, high energy lower infralittoral zone and high energy common kelp communities.

Unique or rare biotopes include

- Brown algae: high energy common kelp communities
- Red algae: rhodolith beds
- Sessile invertebrates: moderate to high complexity circalittoral rock with covering of small colonies and well spaced erect sponges, high energy circalittoral rock with seabed covering sponges, bushy bryozoan-dominated communities

Traditional Owners

- Part of the Sea Country of the Gunditjmara and Eastern Maar
- Koonang Mirring (Sea Country) plan to be developed by Gunditjmara in 2019. Country Plan that incorporates Eastern Maar Sea Country will be produced in 2019
- Part of Budj Bim National Heritage Landscape
- Deen Maar has particular cultural significance
- Convincing Ground (near Portland) site of first documented Aboriginal massacre in 1833 or 1834
- Increased participation of Traditional Owners in land management and decision making (e.g. Ngootyoong Gunditj Ngootyoong Mara South West Management Plan, Eastern Maar Meerreengeeye Ngakeepoorryeeyt Country Plan)

Natural values

- Southern right whale aggregation area (MA 14)
- Deen Maar supports Australian fur seal breeding colony, long-nosed fur seals, Australian sealions and southern elephant seals also recorded
- Important seabird (common diving-petrel, fairy prion, Caspian tern, little penguin, white-bellied sea eagle, shy albatross) colonies (MA 6, 15), largest Australasian gannet colony occurs at Lawrence Rocks (MA 6). Highest breeding density of hooded plovers (MA 9), and migratory shorebird feeding area (MA 16). Hooded plover sites, orange-bellied parrot part of Yambuk KBA. Great knot at Fitzroy River estuary
- Great white shark occurs near Deen Maar (Lady Julia Percy island MA 10)
- Rocky reefs support diverse fish, invertebrate, and macroalgae communities (MA5, 8, 10, 11, 12)
- Deep reef offshore from Deen Maar
- Seagrass (*Amphibolis antarctica*) beds in Portland bay (MA 7) productive for kingfish, whiting, flathead, mulloway and snapper, also rare brown algae (*Cystophora cymodocea*). *Amphibolis antarctica* relatively long-lived, horizontal recolonisation takes decades
- Dutton Way beach supports rare snapping shrimp (*Alpheus australosulcatus*)
- Rhodolith beds
- Port Fairy boulder shores (MA 13) include basalt boulders with steep drop-off and protected lagoons. Include high biodiversity of micro-habitats, levels of exposure and associated flora and fauna
- Conservation-listed communities and species (e.g. orange-bellied parrot), endemic or rare species particularly vulnerable to environmental change

Social and economic values

European cultural heritage Port Fairy and Portland sites of early sealing and whaling in early 1800s. Shipwrecks. Port of Portland established early on during settlement. Life boats to assist shipwrecks installed at Portland and Port Fairy in 1857

Coastal development Portland, Yambuk and Port Fairy regional towns. Coastline west of Portland has very high vulnerability to erosion under climate change. Portland and Port Fairy have very high vulnerability to inundation under climate change

Tourism and recreation Significant recreational fishery for southern bluefin tuna. Bridgewater Bay, Lawrence Rocks, Deen Maar and Helen's Rock popular for diving. Blacknose Point, Crumpets and Narrawong near Portland and Gabbos, Griffith Island and Eastbay near Port Fairy popular surf spots. Surf life saving club and yacht club at Portland and Port Fairy

Commercial fishing and aquaculture Commercial fisheries licences for western rock lobster zone, western abalone zone, eel. Highly productive abalone sites (MA 5, 7, 8, 11) and rock lobster areas. Offshore fisheries aquaculture reserve off Portland. Onshore abalone aquaculture in Narrawong and Port Fairy

Ports and shipping Port of Portland a commercial deep ocean export port. Port Fairy and Portland Bay local ports with access. Ships visiting Portland pass through the area close to Cape Nelson and Lawrence Rocks. Local port at Port Fairy services fishing and recreational vessels. Associated marine pollution risk is low to moderate

Energy Wave energy converter was trialled at Taylors Bay, six kilometres west of Port Fairy but is decommissioned. No proposals for offshore wind or tidal energy projects. Otway Basin offshore. Area includes 2018 petroleum acreage releases and may be subject to exploration if granted

Emerging uses

Large onshore abalone farm proposed at Portland

Threats

- Alterations in waves or currents reduce seagrass productivity
- Sea level rise alters frequency of estuary mouth opening (Surrey River, Fitzroy River, Lake Yambuk seasonally closed)
- Sea level rise reduces area for seagrass where landward migration not possible
- Sea level rise changes coastal features (including inundation of beaches, intertidal areas and low-lying islands) which affects shorebird and seabird resting, feeding and breeding habitats
- More frequent storm events and nutrient pulses entering estuaries cause algal growth and sedimentation
- Decreased freshwater flows alter frequency of estuary mouth opening and salinity regime. Decreases fish diversity or abundance and connectivity for fish that use fresh and marine waters
- Increased hot, dry weather puts beach nesting birds at risk from fires

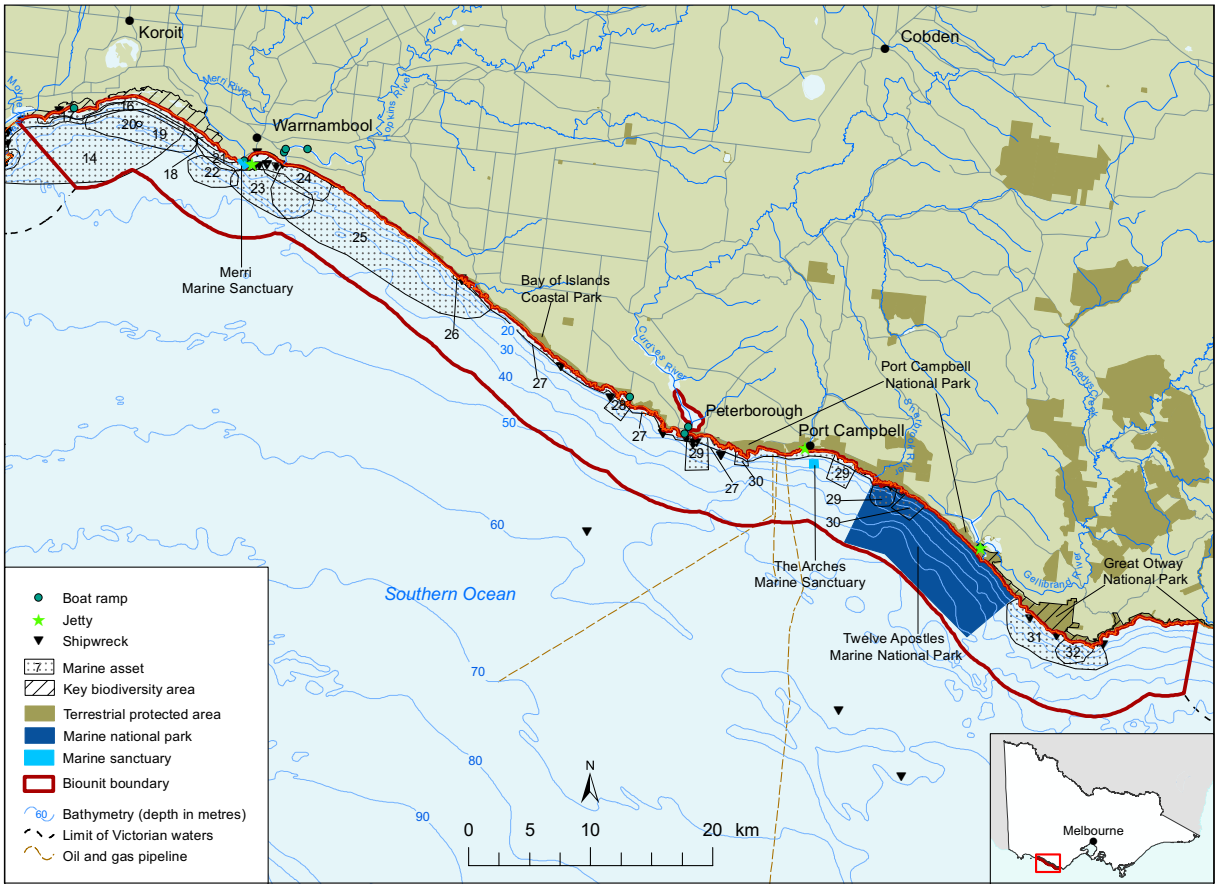
- Artificial estuary opening (e.g. Wattle Hill Creek and Moyne River estuaries modified to remain permanently open to service ports) produces silt plumes, fish kills and sedimentation
- Coastal modifications (e.g. dredging, stormwater disposal, coastal protection structures, beach renourishment, harbours) alter patterns of longshore drift, deposition, erosion. Alters hydrodynamic processes
- Seagrass beds and subtidal reef sensitive to propeller scarring and vessel groundings in shallow water (especially at low tide) and anchor damage

- Abalone viral ganglioneuritis in Portland harbour
- Likely pests include green shore crab (intertidal areas), displaces local crabs
- Known pests include: toxic dinoflagellate (*Alexandrium tamarense*), sabellid tube worms (*Euchone* sp.1, *Myxicola infundibulum*), Asian date mussel, Asian semele, bottom-dwelling mollusc (*Corbula gibba*), bryozoans (*Bugula dentata, B. neritina, Watersipora subtorquata*), algal species (broccoli weed, *Grateloupia turuturu, Caulerpa racemosa var. cylindracea*)
- Introduced mammals prey on and disturb roosting, feeding and nesting birds and eggs (e.g. hooded plover) and intertidal fauna
- Greenlip abalone overfished in western zone
- Disturbance to whales and calves (targeted searching, vessel collision) by whale watchers
- Disturbance to breeding seals (October to December) leads to crushed or drowned pups, loss of territory by bulls
- Disturbance to beach nesting birds (e.g. hooded plover), through recreation (e.g. dogs, horses, vehicles, shore-based activities) leads to nesting failure

- Elevated nutrients and sediments (e.g. Wattle Hill Creek mouth very poor quality; Surrey, Fitzroy, Eumerella and Moyne Rivers in moderate condition) cause turbidity, reduce light levels, promote excess growth of algae, epiphytes and phytoplankton, decrease dissolved oxygen. Impacts include decline in seagrass cover, disturbance and burial of rhodoliths, decreased fish diversity/abundance (including harvested species), potential seafood contamination
- Sedimentation problematic in winter when south-west currents push sediments towards Logan's Beach

- Underwater seismic surveys for oil and gas disturb large (e.g. cetaceans) and small (e.g. zooplankton, scallops) marine organisms
- Port of Portland, proximity to shipping lanes, use by recreational boats increases vulnerability to oil or chemical spills
- Marine debris from ocean and litter/other debris from urban areas (e.g. Portland, Port Fairy) leads to entanglement in and ingestion of thin plastics by marine fauna

Biounit 4: Shipwreck Coast



Physical setting

The 64,466 hectare Shipwreck Coast biounit extends from east of Port Fairy to west of Cape Otway and includes three marine protected areas: Merri and The Arches marine sanctuaries (MS), Twelve Apostles Marine National Park (MNP). The predominantly cliffed coast has stacks (Twelve Apostles), islands (Middle Island, Helen Rock), small bays and estuaries (Merri River, Hopkins River, Curdies River, Port Campbell Creek, Sherbrook River, Gelibrand River). There is extreme to very high exposure to the prevailing weather with strong winds and swells. Habitats include high-energy, wave-dominated beaches and rocky cliffs, sublittoral reefs and sediments (deep reefs with terraces, scarps and pinnacles as well as low complexity and veneer reef systems), coastal cliffs and lagoons.

The Shipwreck coast biounit has been mapped in some detail: 63 per cent at broad habitat level and 42 per cent at biotope complex level. In mapped areas across the biounit infralittoral fine sand and circalittoral fine sand dominate. Merri MS has been mapped to biotope complex level (91 per cent) and is dominated by high-energy cray weed communities (76 per cent) and infralittoral fine sand (15 per cent). The Arches MS has been mapped only at broad habitat level and consists of sublittoral sediment (84 per cent) and infralittoral rock (16 per cent). Twelve Apostles MNP has been mapped to biotope complex level (97 per cent) and is predominantly circalittoral fine sand (37 per cent) and infralittoral fine sand (28 per cent).

Unique or rare biotopes include

- Seagrass: *Zostera* spp. and *Ruppia* spp. beds
- Red algae: lower infralittoral red algae, rhodolith beds in subtidal clean gravel or sand on open coasts
- Brown algae: moderately exposed mixed brown seaweed communities, high energy common kelp communities, high energy bull kelp communities
- Sessile invertebrates: moderate to high complexity circalittoral rock with prominent sea plumes, sea tulips and hydroid fans, erect octocorals on sediment
- Twelve Apostles circalittoral reef

Traditional Owners

- Part of the Sea Country of Eastern Maar
- Country Plan that incorporates Eastern Maar Sea Country will be produced in 2019
- Camp sites in Thunder Point Coastal Reserve adjacent Merri MS, shell middens along coast east of Gellibrand River
- ‘Merri’ local Aboriginal word meaning ‘stony water’

Natural values

- Seasonal aggregation (MA 14) and calving areas (MA 24 Logan's beach) for southern right whales. Records of blue and humpback whales
- Australian fur seal colony at Moonlight Head (MA 32). Records of long-nosed fur seals, southern elephant and leopard seals, Australian sealion
- Migratory shorebird feeding areas and colonies (hooded plover, sanderlings) (MA 16, 18, 27), seabird colonies (black-faced cormorants, little penguins, short-tailed shearwaters) (MA 21, 28, 29, 30) and orange-bellied parrots. Port Fairy to Warrnambool KBA and Otway Range KBA recognise importance of these sites. Black swan hot spot near Bay of Islands
- Habitat for southern bluefin tuna, grey nurse shark, great white shark
- Rocky canyon between Merri and Middle islands supports variety of fish (parrotfish, blue-throated wrasse, bastard trumpeters, magpie perch, dusky and banded morwong). Dusky morwong thought to be declining due to spearfishing and gill netting outside marine protected areas
- Highest diversity of intertidal/shallow subtidal invertebrates on limestone reef in Victoria in MNP
- Diverse invertebrate communities around complex rocky reefs (Killarney basalt reefs MA 17, Childers Cove reefs MA 26, the Paddock MA 31) and rock pinnacle (Helen Rock MA 20)
- The Arches MS provides habitat for marine invertebrates more common in deeper Bass Strait waters
- Seagrass beds (Thunder Point MA 22)
- Giant and bull kelp forests at Hopkins bank (MA 23). Giant kelp decreased across Victoria in last 20 years, likely related to increasing water temperature and nutrient levels. Provides vertical structure to reef habitats, loss may influence water currents/wave action
- Over 30 distinct sponge morphotypes observed in Twelve Apostles MNP
- Brittle star (*Ophiacantha heterotyla*) at western distributional limit in Twelve Apostles MNP, 8 algal species at distribution limit in Merri MS
- The Arches regionally unique geoform
- Rock stacks of the Twelve Apostles of national geological significance
- Conservation-listed communities and species (e.g. orange-bellied parrot) or species at distributional limit particularly vulnerable to environmental change

Social and economic values

European cultural heritage Numerous exposed and submerged shipwrecks lend their name to the area. Life boat to assist shipwrecks installed at Warrnambool in 1857. *Loch Ard* wrecked in 1878, now a popular dive site

Coastal development City of Warrnambool, Peterborough and Port Campbell regional towns. Warrnambool wastewater outfall. Wastewater discharge at Twelve Apostles Visitor Centre

Tourism and recreation Twelve Apostles MNP, Great Ocean Walk, Great Ocean Road tourist destinations. Popular activities include shore-based recreational fishing, whale watching, dive charters, swimming (e.g. Stingray Bay), rock pools (Merri MS). Recreational activities in Twelve Apostles MNP include surfing, scenic tours, bird watching and scuba diving. Diving is the primary recreational activity at The Arches MS. Popular dive spots include around Warrnambool, Eagle Rock in the west to Breakwater Pier in the east; shipwrecks in the Bay of Islands area; sites in the Twelve Apostles MNP; and shipwrecks near Moonlight Head. Numerous popular surf spots between Warrnambool and Johanna including Elevators, The Well, Easter Reef, Harbour Point, Gibson's Steps, Princetown. Hopkins River a popular fishing spot. Warrnambool and Port Campbell have surf life saving clubs

Commercial fishing and aquaculture Commercial fisheries licences for western rock lobster zone, western and central abalone zones, eel. East Killarney reefs (MA 19) support greenlip abalone, Warrnambool reefs (MA 25) support blacklip abalone. High rock lobster production. No aquaculture reserves or proposals for aquaculture

Ports and shipping Local ports at Warrnambool and Port Campbell are used by fishing and recreational vessels. Marine pollution risks range from low for Bay of Islands and Childers Cove to high for the area near Johanna

Energy No proposals for offshore wind or tidal energy projects. Potential for wave energy identified along this coast. Significant gas resources onshore and offshore in Commonwealth waters in this area (Otway Basin gas field). Area includes 2018 petroleum acreage releases and may be subject to exploration if granted. Several gas pipelines between fields further offshore and processing plant near Port Campbell. Gas pipelines on the seafloor west of The Arches MS

Emerging uses

Offshore gas exploration expansion – likely to be further offshore but new pipelines may be required

Threats

- Alterations in waves and currents reduce seagrass productivity
- Sea level rise alters frequency of estuary mouth opening (e.g. Curdies River, Port Campbell Creek, Sherbrook River seasonally closed)
- Sea level rise reduces area for seagrass where landward migration not possible
- Sea level rise changes coastal features (including inundation of beaches, intertidal reefs, low-lying reefs and islands) which affects shorebird, seabird and seal resting, feeding and breeding habitats
- More frequent storm events and nutrient pulses entering estuaries causes algal growth and sedimentation threatening seagrass
- Decreased freshwater flows alter frequency of estuary mouth opening and salinity regime. Decreases fish diversity or abundance and connectivity for fish that use fresh and marine waters
- Increased hot, dry weather puts beach nesting birds at risk from fires
- Temperatures above 35°C detrimental to penguins on land and in burrows. Prolonged exposure causes heat stress and mortality
- Increased ambient temperatures impact bull kelp

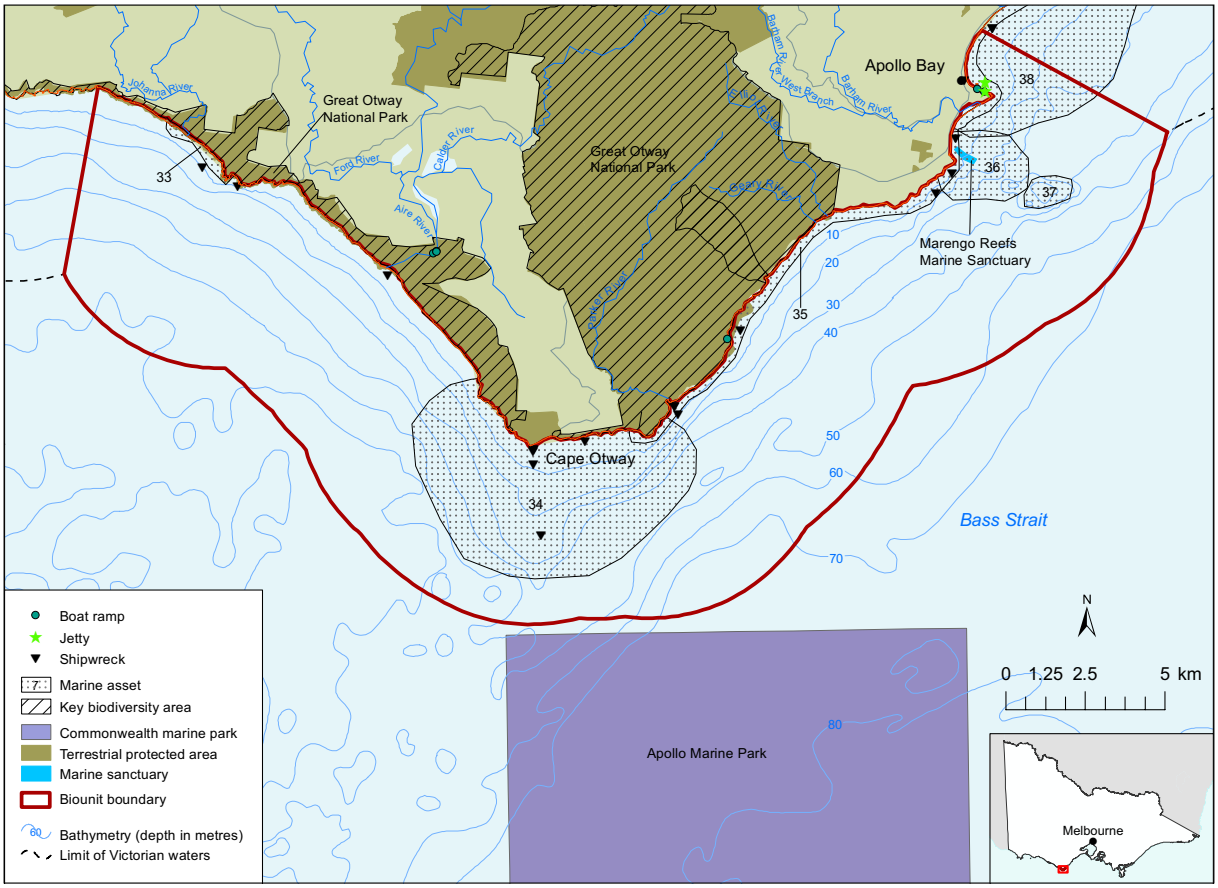
- Artificial estuary opening (e.g. Merri River mouth constructed and permanently open) produces silt plumes, fish kills and sedimentation
- Coastal modifications (e.g. breakwater near Merri MS) alter patterns of longshore drift, deposition, erosion. Physical damage to sea caves and blowholes, altered hydrodynamic processes
- Intertidal reef platforms vulnerable to trampling, especially during warmer months
- Intensive use of intertidal areas (e.g. Merri MS) for education threatens biota through trampling and disturbance
- Seagrass beds and subtidal reef sensitive to propeller scarring and vessel groundings in shallow water (especially at low tide) and anchor damage

- Abalone viral ganglioneuritis confirmed from MNP and MS
- Likely pests include green shore crab (intertidal areas), displaces local crabs
- Concern about spread of introduced algae *Grateloupia turuturu*, *Caulerpa racemosa* var. *cylindracea* and broccoli weed (Portland Harbour), Japanese kelp (Apollo Bay)
- Introduced mammals prey on and disturb roosting, feeding and nesting birds and eggs (e.g. little penguins, short-tailed shearwater, black-faced cormorants on Middle and Merri islands)
- Greenlip abalone overfished in western zone
- Disturbance to whales and calves (targeted searching, vessel collision) by whale watchers
- Disturbance to breeding seals (October to December) leads to crushed or drowned pups, loss of territory by bulls
- Disturbance to beach nesting birds (e.g. hooded plover), through recreation (e.g. dogs, horses, vehicles, shore-based activities) leads to nesting failure

- Elevated nutrients and sediments (e.g. Merri and Curdies river estuaries very poor condition, Hopkins and Gellibrand rivers in poor condition, Warrnambool wastewater outfall) cause turbidity, reduce light levels, excess growth of algae, epiphytes and phytoplankton, decrease dissolved oxygen). Impacts include high levels of zinc and lead, decline in seagrass cover, disturbance and burial of rhodoliths, decreased fish diversity/abundance (including harvested species), potential seafood contamination

- Light pollution (e.g. development on foreshore) affects birds (e.g. short-tailed shearwater fledglings)
- Underwater seismic surveys for oil and gas disturb large (e.g. cetaceans) and small (e.g. zooplankton, scallops) marine organisms
- Ports, offshore oil and gas production pipelines increase vulnerability to oil or chemical spills. Impacts include oiling of seabirds, oil accumulation over intertidal areas, loss of recreation
- Marine debris from ocean and litter/other debris from urban areas (e.g. Warrnambool, Port Campbell) leads to entanglement in and ingestion of thin plastics by marine fauna

Biounit 5: Cape Otway



Physical setting

The 25,188 hectare Cape Otway biounit extends from east of Cape Otway to west of Apollo Bay. It includes one marine protected area - Marengo Reefs Marine Sanctuary (MS) - and one Commonwealth marine protected area (Apollo Marine Park) in Commonwealth waters to the south. The rocky cape has extreme exposure on the western side and high exposure on the eastern side. Strong tidal currents at the southern tip interact with high geoform complexity. There are four estuaries (Aire River, Elliot River, Anderson Creek, Barham River). Habitats include high-energy, wave-dominated beaches and rocky headlands, sublittoral reef and sediments, coastal lagoons. Cape Otway reef (MA 34) forms a biogeographic boundary, with different species and genetic stocks on either side. Nine species are presumed to be at their distributional limit in the biounit.

The Cape Otway biounit has been extensively mapped. Almost 99 per cent has been mapped at the broad habitat level and over 97 per cent has been mapped at the biotope complex level. In mapped areas circalittoral fine sand and infralittoral fine sand dominate. Within Marengo Reefs MS 60 per cent has been mapped at the biotope complex level. Here high energy cray weed communities (31 per cent) and seagrass beds (17 per cent) dominate. Further mapping within the biounit should prioritise infralittoral biotopes and circalittoral biotopes (including sponge morphospecies).

Unique or rare biotopes include:

- Seagrass: *Zostera* spp. and *Ruppia* spp. beds
- Brown algae: infralittoral bull kelp, high energy common kelp communities
- Sessile invertebrates: high diversity sponge assemblages, non-reef forming epibiota assemblages dominated by sponge mounds, moderate to high complexity circalittoral rock with prominent sea plumes- sea tulips- hydroid fans, erect octocorals on sediment
- High-relief geoforms

Traditional Owners

- Country Plan that incorporates Eastern Maar Sea Country will be produced in 2019
- Short-finned eel particularly important
- Middens near Marengo Reefs MS contain turban shells and abalone

Natural values

- Conservation-listed southern right whale habitat (MA 38), records of southern elephant seal MS
- Australian fur seal colony on outer reef (Marengo reef MA 36)
- Hooded plover nesting habitat (MA 33, 35). The importance of this habitat is recognised in the Otway Range KBA
- Six rare fish (including harvested species: barracuda, common gurnard perch, dusky morwong)
- Henty Reef (MA 37) supports high invertebrate diversity
- Dinosaur Cove provides unique habitats and has high reef biodiversity, internationally recognised fossil dinosaur locality

- Dense bull kelp stands on reefs with other seaweeds and invertebrates (MA 36)
- Conservation-listed communities and species (e.g. southern right whale), endemic or rare species (e.g. dusky morwong) or species at distributional limit particularly vulnerable to environmental change
- Dusky morwong thought to be declining due to spearfishing and gill netting outside marine protected areas

Social and economic values

European cultural heritage shipwrecks of the *Grange* (1858) wooden hull visible from Great Ocean Road, the *Woolomai* (1923), *SS Casino*, anchors from several shipwrecks. Cape Otway Cemetery with graves of shipwreck victims. Cape Otway lighthouse completed in 1848 in response to numerous shipwrecks and increased shipping in Bass Strait

Coastal development Apollo Bay township. Marengo wastewater outfall. Coastal roads require protection works

Tourism and recreation Marengo Reefs MS, Great Otway National Park, Great Ocean Walk, Great Ocean Road tourist destinations. Popular activities include shore-based angling, boat-based fishing, snorkelling/scuba diving rock pooling, seal watching, sea kayaking. Johanna, Cape Otway and Apollo Bay popular surf spots. Apollo Bay sailing and surf life saving clubs

Commercial fishing and aquaculture Commercial fisheries licences for western and eastern rock lobster zones, central abalone zone, eel. Cape Otway reef (MA 34) supports abalone. High abalone and rock lobster production. Henty Reef (MA 37) supports high abundance of snapper, King George whiting, Australian salmon, silver trevally, gummy shark.

Ports and shipping Apollo Bay local port and access area. Heavy shipping routes pass by tip of Cape Otway. Associated marine pollution risk is high

Energy No current proposals for wave, tidal, or wind energy projects. Otway Basin offshore

Emerging uses

None identified

Threats

- Sea level rise alters frequency of estuary mouth opening (e.g. Johanna, Aire, Barham rivers seasonally closed)
- Sea level rise changes coastal features (including inundation of beaches, intertidal reefs and low-lying reefs) which affects shorebird, seabird and seal resting, feeding and breeding habitats
- More frequent storm events and nutrient pulses entering estuaries causes algal growth and sedimentation
- Decreased freshwater flows alter frequency of estuary mouth opening and salinity regime. Decreases fish diversity or abundance and connectivity for fish that use fresh and marine waters
- Increased hot, dry weather puts beach nesting birds at risk from fires
- Temperatures above 35°C detrimental to penguins on land and in burrows. Prolonged exposure causes heat stress and mortality
- Increased ambient temperatures impact bull kelp

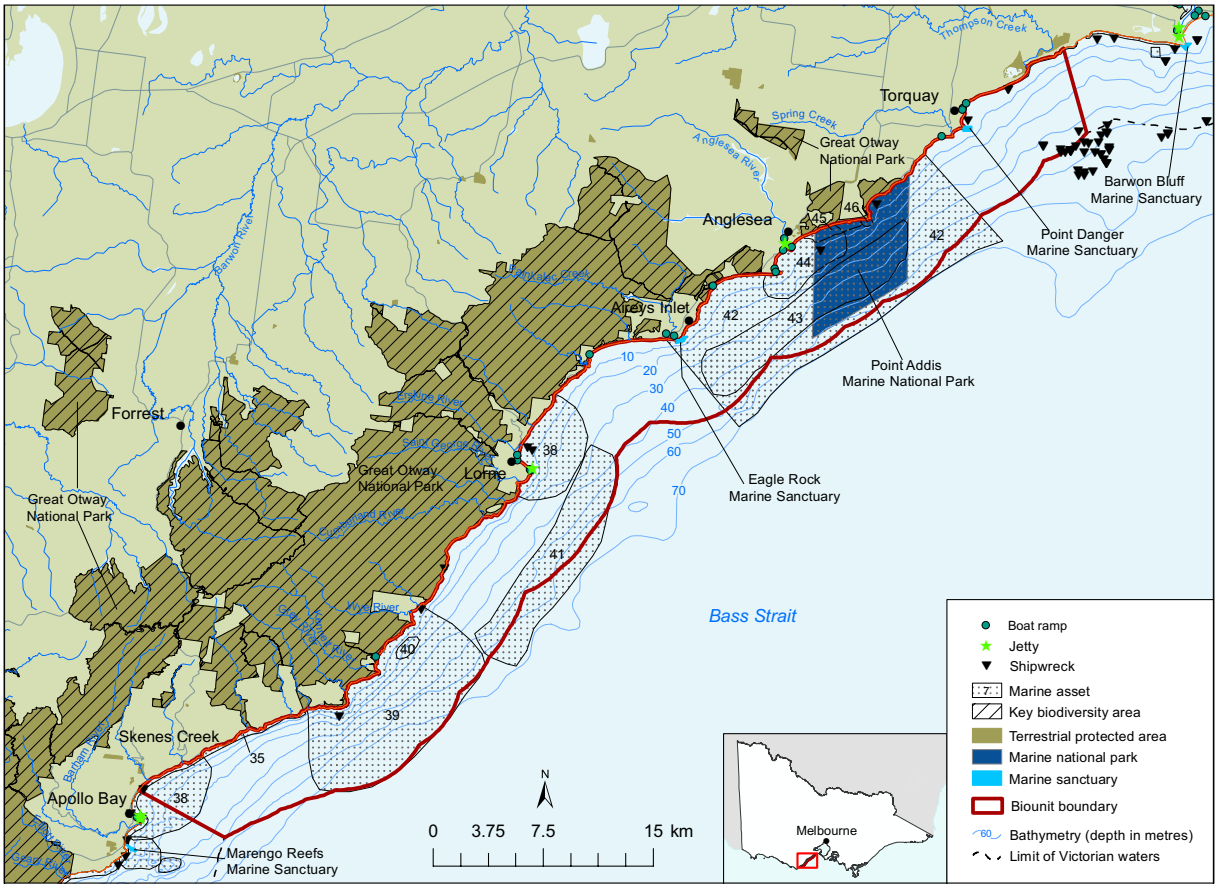
- Coastal modifications (e.g. dredging, stormwater disposal, coastal protection structures, beach renourishment, harbours) alter patterns of longshore drift, deposition, erosion. Alters hydrodynamic processes
- Intertidal reef platforms vulnerable to trampling, especially during warmer months

- Abalone viral ganglioneuritis recorded in much of Otway bioregion
- Likely pests include green shore crab (intertidal areas), displaces local crabs
- Concern about spread of introduced algae *Grateloupia turuturu*, *Caulerpa racemosa* var. *cylindracea* and broccoli weed (Portland Harbour), Japanese kelp (Apollo Bay). Other marine pests of concern include European fan worm
- Introduced mammals prey on and disturb roosting, feeding and nesting birds and eggs (e.g. hooded plover)
- Disturbance to whales and calves (targeted searching, vessel collision) by whale watchers
- Disturbance to breeding seals (October to December) leads to crushed or drowned pups, loss of territory by bulls
- Disturbance to beach nesting birds (e.g. hooded plover), through recreation (e.g. dogs, horses, vehicles, shore-based activities) leads to nesting failure

- Elevated nutrients and sediments (e.g. Barham River in poor condition, Aire River in moderate condition, Marengo wastewater outfall) cause turbidity, reduce light levels, promote excess growth of algae, epiphytes and phytoplankton, decrease dissolved oxygen). Decreased fish diversity and abundance (including harvested species), potential seafood contamination

- Underwater seismic surveys for oil and gas disturb large (e.g. cetaceans) and small (e.g. zooplankton, scallops) marine organisms
- Ports, offshore oil and gas production pipelines increase vulnerability to oil or chemical spills. Impacts include oiling of seabirds, oil accumulation over intertidal areas, loss of recreation
- Marine debris from ocean and litter/other debris from urban areas (e.g. Apollo Bay) leads to entanglement in and ingestion of thin plastics by marine fauna

Biounit 6: Surf Coast



Physical setting

The 49,009 hectare Surf Coast biounit extends from north of Apollo Bay to south of Barwon Heads, and includes Aireys Inlet. The coastline is characterised by small points and promontories and is sheltered from prevailing weather but exposed to easterly swells and to westerly swells diffracted around Cape Otway. The steep hinterland of the Otway Ranges continues offshore to a depth of about 70 metres on the seaward boundary (MA 42). The many creeks along the coast have relatively small estuaries which are seasonally closed. The biounit includes three marine protected areas: Eagle Rock Marine Sanctuary (MS), Point Addis Marine National Park (MNP), Point Danger MS. Habitats include high-energy, wave-dominated beaches and rocky headlands, sublittoral reef and sediments, rhodolith beds and coastal lagoons. Up to eleven species are presumed to be at their distributional limit in the biounit.

The Surf Coast biounit has been widely mapped. Over 88 per cent has been mapped at the broad habitat level and over 86 per cent at the biotope complex level. In mapped areas, infralittoral and circalittoral fine sand dominate. Over 80 per cent of Eagle Rock MS has been mapped to biotope complex. Seagrass on moderate energy rock with sandy veneer dominates (46 per cent) followed by infralittoral fine sand (16 per cent). Only 48 per cent of Point Addis MNP has been mapped to biotope complex. Infralittoral fine sand (15 per cent) and high energy common kelp communities (9 per cent) dominate. Some 64 per cent of Point Danger MS has been mapped to biotope complex. Seagrass stands on high energy rock is the dominant biotope (50 per cent), followed by high energy sub-canopy brown seaweed communities (11 per cent).

Unique or rare biotopes include:

- Seagrass: *Zostera* spp. and *Ruppia* spp. beds, *Amphibolis antarctica* on moderate energy rock with sandy veneer
- Brown algae: high energy common kelp communities, high energy bull kelp communities
- Red algae: Point Grey rhodoliths, lower infralittoral *Caulerpa* spp. on rhodolith, rhodolith beds in subtidal clean gravel or sand on open coasts, foliose red seaweeds on upper infralittoral rock
- Sessile invertebrates: non-reef forming epibiota assemblages dominated by sponge mounds, Kennett River diverse sponge-sea plume- sea whip assemblages, moderate to high complexity circalittoral rock with prominent sea plumes- sea tulips-hydroid fans, erect octocorals on sediment

Traditional Owners

- Part of the Sea Country of the Eastern Maar and Wathaurung
- Country Plans that incorporate Eastern Maar and Wathaurung Sea Country interests will be produced in 2019
- Middens along shoreline near Eagle Rock MS and Point Addis MNP
- Point Addis a likely burial site. Painkalac Creek area highly significant, also possible burial site

Natural values

- Habitat for southern right whales (MA 38), records of blue, killer and long-finned pilot whales, bottlenose dolphin, leopard seal
- Eagle Rock MS intertidal reef occasional haul out for Australian fur seal
- Shorebird feeding areas and colonies (hooded plover) (MA 35, 46), importance recognised in the Otway Range KBA. Seabird foraging areas off Kennett and Wye River (MA 39) and Anglesea (MA 44) (e.g. Caspian tern, shy albatross)
- Ingoldsby reef (Point Addis MNP) supports leafy sea dragon, molluscs, echinoderms, sea stars, sea urchins, 114 species of algae
- Diverse sessile invertebrate communities including Eagle Rock MS, Point Danger MS, sea pens (MA 40) and deep reefs (MA 41)
- Five regionally uncommon intertidal species in Eagle Rock MS: smooth shore crab, spider crab (*Notomithrax* sp.), red swimmer crab, flame limpet, green algae (*Codium pomoides*)
- At least 96 species of opisthobranchs recorded at Point Danger MS, conservation-listed sea cucumber (*Apsolidium densum*) (Skenes Creek)
- Important estuaries and saltmarsh habitat including Painkalac Creek and Thompson Creek.
- *Amphibolis antarctica* seagrass off Point Addis, Point Danger. *A. antarctica* relatively long-lived, horizontal recolonisation takes decades
- Rhodolith beds (MA 43) provide biogenic habitat
- Conservation-listed communities and species (e.g. southern right whale), endemic or rare species (e.g. sea cucumber) or species at distributional limit particularly vulnerable to environmental change

Social and economic values

European cultural heritage Historic shipwreck discovery trail. Wreck of *Joseph H. Scammell* (1891), *Inverlochy* (1902). Split Point lighthouse adjacent Eagle Rock MS. Numerous ships scuttled offshore from Torquay

Coastal development Kennett River, Wye River, Lorne, Aireys Inlet, Anglesea and Torquay coastal towns. Anglesea sewage outfall

Tourism and recreation Great Otway National Park, marine protected areas, Great Ocean Road popular tourist destinations. Summer holiday towns and surf beaches e.g. Bells Beach, Kennett River, Wye River, Lorne, Anglesea, Aireys Inlet. Artificial reef with fish aggregating devices off Torquay for recreational fishers. Surf life saving clubs at Kennett River, Wye River, Lorne, Fairhaven, Anglesea, Jan Juc, Torquay. Anglesea motor yacht club. Bells Beach Reserve an international icon of Australian surfing culture

Commercial fishing and aquaculture Commercial fisheries licences for eastern rock lobster zone and central abalone zone. No aquaculture reserves or proposals for aquaculture

Ports and shipping Lorne local port, numerous boat ramps at other coastal towns for trailerable vessels. Associated marine pollution risk is high (Cape Patton to Lorne) to very high (Anglesea to Torquay). Ships anchor offshore while waiting for entrance to Port Phillip Bay

Energy Exploration of Otway Basin gas field (Anglesea/Torquay sub basin) has not identified opportunities for development

Emerging uses

- Use of wildlife protection dogs (e.g. Australasian gannets at Point Danger)
- High population growth in ‘sea change’ areas (e.g. Torquay)

Threats

- Alterations in waves or currents affect seagrass productivity
- Sea level rise alters frequency of estuary mouth opening (e.g. 10 creeks and rivers seasonally closed)
- Sea level rise reduces area for seagrass and saltmarsh where landward migration not possible
- Sea level rise changes coastal features (including inundation of beaches and intertidal reefs) which affects shorebird, seabird and seal resting, feeding and breeding habitats
- More frequent storm events and nutrient pulses in estuaries causes algal growth and sedimentation
- Decreased freshwater flows alter frequency of estuary mouth opening and salinity regime. Decreases fish diversity or abundance and connectivity for fish that use fresh and marine waters
- Increased hot, dry weather puts beach nesting birds at risk from fires
- Increased ambient temperatures impact bull kelp

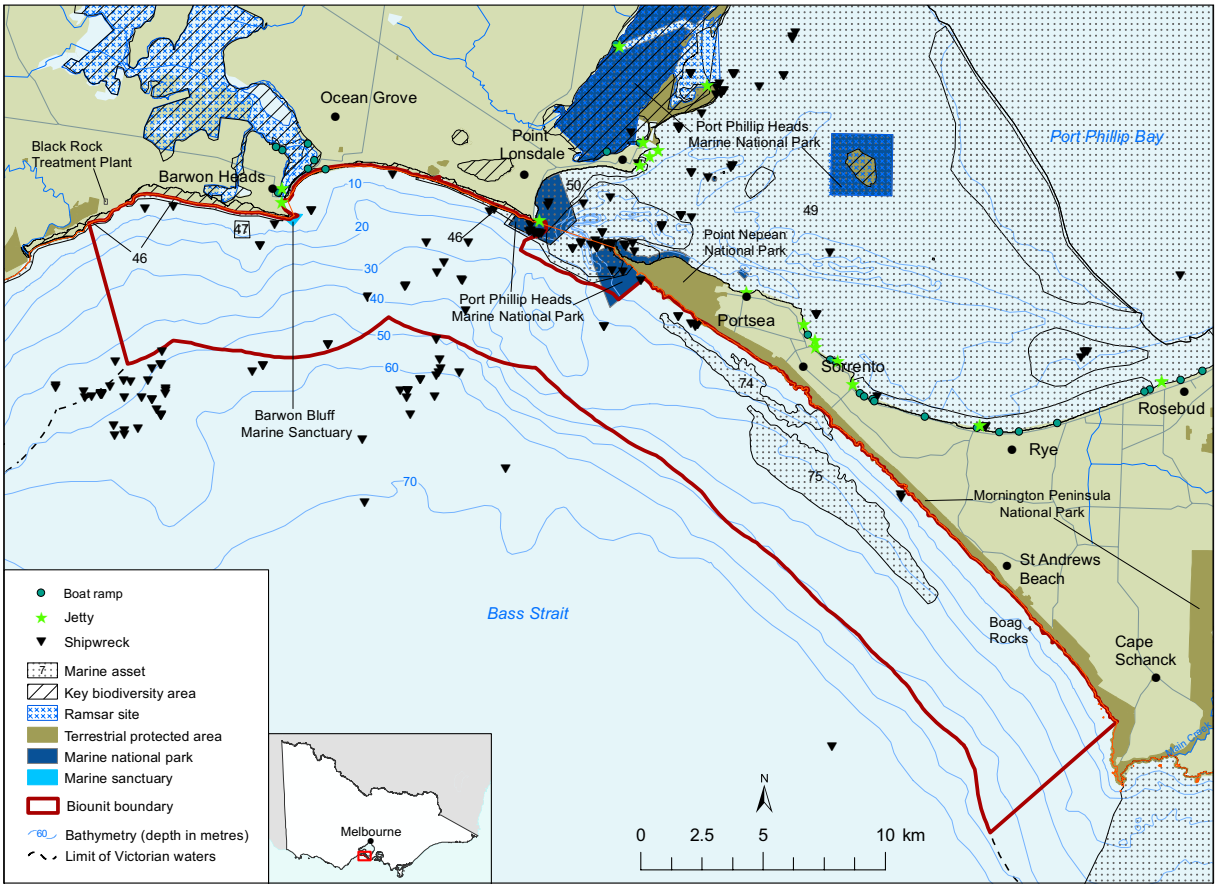
- Removal of beach wrack (kelp and invertebrates) affects ecological processes and biodiversity
- Inappropriate shore-based development (especially around holiday towns) impacts on biota (e.g. disturbance, reduced water quality)
- Coastal modifications (e.g. dredging, stormwater disposal, coastal protection structures, beach renourishment, harbours) alter patterns of longshore drift, deposition, erosion. Alters hydrodynamic processes
- Coastal saltmarsh and intertidal reef platforms vulnerable to trampling, especially during warmer months
- Seagrass beds and subtidal reef sensitive to propeller scarring and vessel groundings in shallow water (especially at low tide) and anchor damage (e.g. incident where ship anchored in Point Addis MNP)

- Abalone viral ganglioneuritis recorded in much of Otway bioregion
- Likely pests include green shore crab (intertidal areas), displaces local crabs
- Concern about spread of introduced algae Japanese kelp (Apollo Bay). Concern about spread of many pests from Geelong Harbour and Port Phillip Bay including northern Pacific seastar, European fan worm and broccoli weed
- Introduced mammals prey on and disturb roosting, feeding and nesting birds and eggs (e.g. hooded plover)
- Disturbance to whales and calves (targeted searching, vessel collision) by whale watchers
- Disturbance to breeding seals (October to December) leads to crushed or drowned pups, loss of territory by bulls
- Disturbance to beach nesting birds (e.g. hooded plover), through recreation (e.g. dogs, horses, vehicles, shore-based activities) leads to nesting failure

- Elevated nutrients and sediments (e.g. coastal development in Torquay; Painkalac and Thompson creeks in poor condition; Wild Dog, Skenes and Spring creeks and Saint George River in moderate condition; Anglesea sewage outfall) cause turbidity, reduce light levels, excess growth of algae, epiphytes and phytoplankton, decrease dissolved oxygen). Impacts include decline in seagrass cover, disturbance and burial of rhodoliths, decreased fish diversity and abundance (including harvested species), potential seafood contamination

- Urban areas covered by impervious surfaces, high stormwater runoff
- Growing urban areas (e.g. Torquay) deliver excess freshwater and pollutants
- Marine debris from ocean and litter/other debris from urban areas (e.g. Kennett River, Wye River, Lorne, Aireys Inlet, Anglesea, Torquay) leads to entanglement in and ingestion of thin plastics by marine fauna

Biounit 7: Bellarine – Mornington



Physical setting

The 27,448 hectare Bellarine-Mornington biounit extends along the open coast from south of Barwon Heads to west of Cape Schanck including the Barwon River estuary. There are two marine protected areas: Barwon Bluff Marine Sanctuary (MS) and part of the Port Phillip Heads Marine National Park (MNP). The coast is partly sheltered from the prevailing weather, but is exposed to easterly swells and westerly swells diffracted up the coast. Habitats include high-energy, wave-dominated beaches and rocky headlands, extensive intertidal platforms, sublittoral reef and sediments and coastal inlet.

The Bellarine-Mornington biounit has been mapped in some detail: 51 per cent at broad habitat level and 48 per cent at biotope complex level. Of the mapped areas, dominant biotope complexes are infralittoral fine sand and a number of high energy, kelp-dominated communities. The Barwon Bluff MS has been mapped to biotope complex (78 per cent). High energy sandy veneer and scour turf communities (31 per cent) and high energy bull kelp communities (20 per cent) dominate. Most of the Port Phillip Heads MNP occurs within the Port Phillip Heads biounit, so this protected area is discussed in that biounit.

Unique or rare biotopes include:

- Seagrass: *Zostera* spp. and *Ruppia* spp. beds, *Amphibolis antarctica* on moderate energy rock with sandy veneer
- Brown algae: high energy common kelp communities, high energy bull kelp communities
- Moderate to high complexity circalittoral rock with prominent sea plumes, sea tulips and hydroid fans

Traditional Owners

- Part of the sea country of the Wathaurung/Wadawurrung (west of the entrance) and Bunurong/Boon Wurrung (east of the entrance)
- Country Plans that incorporate Wathaurung/Wadawurrung and Bunurong/Boon Wurrung Sea Country will be produced in 2019
- Middens along shore near Barwon Bluff MS and Point Nepean

Natural values

- Migratory shorebird feeding areas and colonies (hooded plover) (MA 46). Bellarine Wetlands KBA and Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site recognise importance of sites for other species including orange-bellied parrot, chestnut teal, banded stilt, sharp-tailed sandpiper, red-necked stint. Shy albatross feeding offshore from Mornington Peninsula
- Mangroves and saltmarsh (Barwon estuary), western extent of mangroves in Victoria
- Charlemont reef (MA 47) shallow subtidal bommie complex supports high biodiversity, as does Graveyard deep reef
- Mornington Peninsula nearshore calcarenite reef (MA 74) and offshore reefs (MA 75) include beds of common kelp, thallose red algae, carpeting green *Caulerpa*, high abundances of ascidians and sessile biota in crevices
- Intertidal platforms with mixed brown algae (including *Hormosira banksii*) and seagrass (*Amphibolis antarctica*). *A. antarctica* relatively long-lived, horizontal recolonisation takes decades
- Sub-canopy brown seaweed beds (giant and bull kelps). Giant kelp decreased across Victoria in last 20 years, likely related to increasing water temperature and nutrient levels. Provides vertical structure to reef habitats, loss may influence water currents/wave action
- Conservation-listed communities (e.g. giant kelp marine forest) and species (e.g. orange-bellied parrot) particularly vulnerable to environmental change

Social and economic values

European cultural heritage Shipwrecks include *Earl of Charlemont* (1853), *South Milton* (1886) and *SS Orungal* (1940). Ship 'graveyard' at the head of Port Phillip Bay contains a number of scuttled ships, including *Hygeia*, *Julia Percy*, *Lady Loch*. Shipwreck Protection Zone around *SS Alert* (1893) in Commonwealth waters

Coastal development Barwon Heads, Ocean Grove, Point Lonsdale townships. Black Rock outfall and Boags Rock outfall. Barwon Heads very high vulnerability to inundation under climate change

Tourism and recreation Bellarine and Mornington peninsulas popular holiday destinations. Recreational activities include swimming, rock pooling, snorkelling, diving. Shore platforms and shallow reefs of Barwon Bluff MS used for marine education. Surf locations include Ocean Grove, Barwon Heads, Point Lonsdale, Portsea, Rye Back Beach, St Andrews, Gunnamatta. Dive spots at Chimney Rock, Nepean Wall, Back Beaches. Surf life saving clubs at Bancoora, Barwon Heads, Ocean Grove, Portsea, Sorrento, Gunnamatta

Commercial fishing and aquaculture Commercial fisheries licences for eastern rock lobster zone, central abalone zone, eel. No aquaculture reserves or proposals for aquaculture

Ports and shipping Port of Melbourne at entrance to Port Phillip Bay. Barwon Heads local port. Associated marine pollution risk is high (Mornington Peninsula) to very high (Port Phillip Heads)

Energy Otway Basin offshore. Entrance to bay has potential for tidal energy but no current proposals

Emerging uses

High population growth in sea change areas (e.g. Ocean Grove-Barwon Heads) and increased use of ocean beaches on Mornington Peninsula

Threats

- Alterations in waves or currents affect seagrass productivity
- Sea level rise reduces area for seagrass, mangroves and saltmarsh where landward migration not possible
- Sea level rise changes coastal features (including inundation of beaches and intertidal reefs) which affects shorebird and seabird resting, feeding and breeding habitats
- More frequent storm events and nutrient pulses entering estuaries causes algal growth and sedimentation, threatening seagrass
- Increased hot, dry weather puts beach nesting birds at risk from fires
- Increased ambient temperatures impact bull kelp

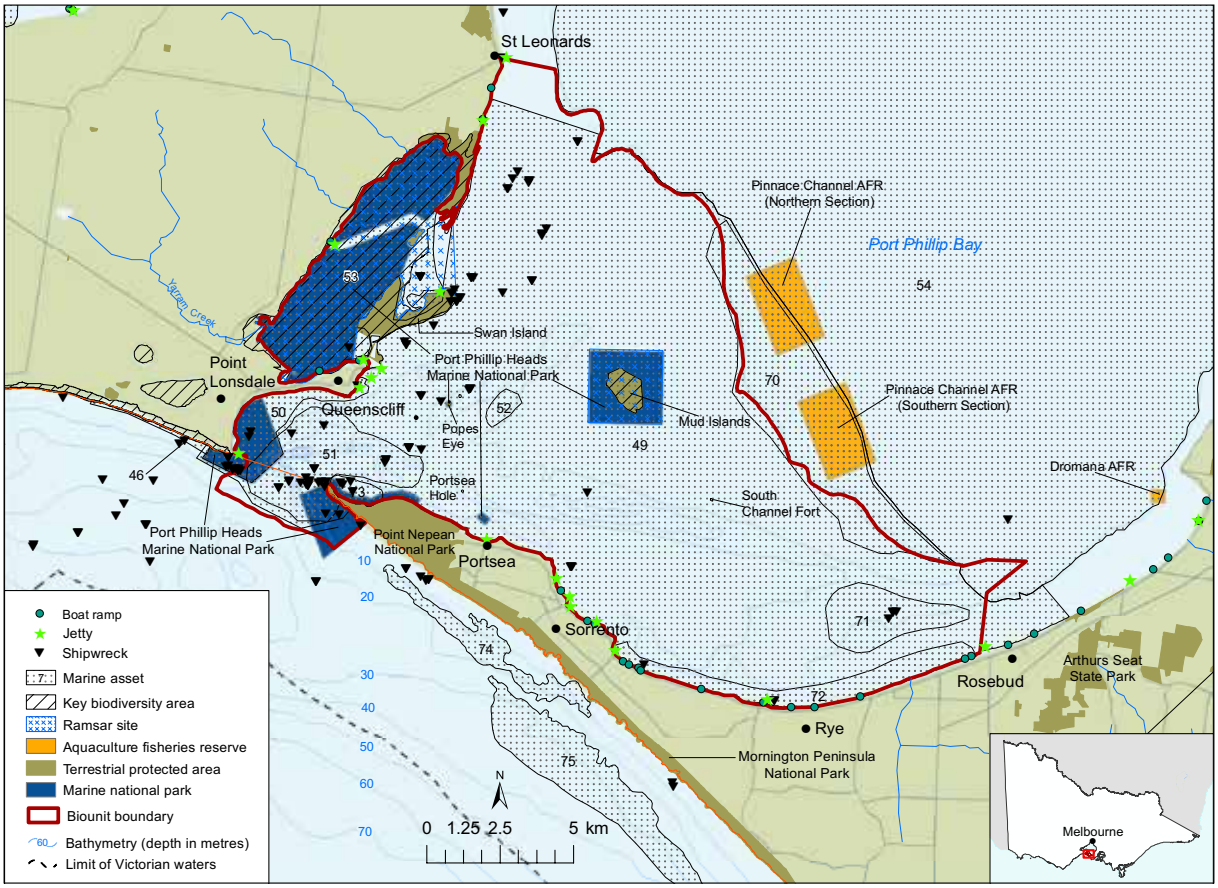
- Removal of beach wrack (kelp and invertebrates) affects ecological processes and biodiversity
- Inappropriate shore-based development (especially around holiday towns) impacts on biota (e.g. disturbance, reduced water quality)
- Coastal modifications (e.g. river retaining walls at base of dunes north of Barwon Bluff MS) alter patterns of longshore drift, deposition, erosion. Impacts include physical damage to Entrance canyon geoforms, altered hydrodynamic processes
- Dredging to allow passage of more or larger ships causes turbidity, sedimentation, reduces light penetration, alters wave patterns, mobilises toxins from polluted sediments. Impacts include smothered seagrass and sponges (e.g. sediments, rock falls), decreased sessile invertebrate feeding efficiency, impaired function of infauna communities
- Coastal saltmarsh, mangroves and intertidal reef platforms vulnerable to trampling, especially during warmer months
- Intensive use of intertidal areas for education threatens biota through trampling and disturbance
- Seagrass beds, mudflats and subtidal reef sensitive to propeller scarring and vessel groundings in shallow water (especially at low tide) and anchor damage

- Likely pests include green shore crab (intertidal areas), displaces local crabs
- Concern about spread of many pests from Port Phillip Bay including northern Pacific seastar, European fan worm, broccoli weed and Japanese kelp
- Introduced mammals prey on and disturb roosting, feeding and nesting birds and eggs (e.g. hooded plover)
- Cord grass invades saltmarsh, mangroves and mudflats binding sediments and altering mud habitats
- Disturbance to beach nesting birds (e.g. hooded plover), through recreation (e.g. dogs, horses, vehicles, shore-based activities) leads to nesting failure

- Elevated nutrients and sediments (e.g. coastal development; Barwon River in very poor condition, Black Rock and Boags Rock wastewater outfalls) cause turbidity, reduce light levels, promote excess growth of algae, epiphytes and phytoplankton, decrease dissolved oxygen). Impacts include decline in seagrass cover, reduced mangrove health, loss of brown algae, decreased fish diversity and abundance (including harvested species), potential seafood contamination

- Proximity to Port of Melbourne shipping lanes increases vulnerability to oil or chemical spills. Impacts include oiling of seabirds, oil accumulation over intertidal areas, contamination of ground or surface water, loss of recreation
- Urban areas covered by impervious surfaces, high stormwater runoff (e.g. Ocean Grove-Barwon Heads) deliver excess freshwater and pollutants
- Marine debris from ocean and litter/other debris from urban areas leads to entanglement in and ingestion of thin plastics by marine fauna

Biounit 8: Port Phillip Heads



Physical setting

The 27,442 hectare Port Phillip Heads biounit extends south of the Great Sands at the extent of the tidal currents to Rip Bank at 19 metres depth between Point Lonsdale and Point Nepean. The Port Phillip Heads Marine National Park consists of six separate areas (Swan Bay MA 53, Mud Islands, Point Lonsdale, Point Nepean, Popes Eye, Portsea Hole) over the tide-swept region of inner Port Phillip Heads (MA 49).The biounit includes the upper Rip Bank bar across the entrance, canyon system (MA 51) from the entrance to Schnapper Deep and Portsea Hole, Simmons Channel south (MA 52), Great Sands flood tide delta (including MA 70), Mud Islands, Swan Bay (MA 53) and Capel Sound (MA 71). Other significant areas include the Lonsdale Bight (MA 50), Blairgowrie-Rosebud nearshore (MA 72) and Nepean Bay (MA 73). Habitats include high to low energy, wave and tide-dominated beaches, rocky coast and headlands, tide-swept sublittoral reef and sediments, coastal inlet and lagoon, complex and very deep reef and canyon system, seagrass beds and Great Sands delta.

The Port Phillip Heads biounit has been extensively mapped. Over 98 per cent has been mapped at the broad habitat level and over 96 per cent at the biotope complex level. Dominant biotope complexes include coarse sand, seagrass beds and muddy sand. Within Port Phillip Heads MNP, 82 per cent mapped to biotope complex. Seagrass beds (53 per cent) and southern tidal sands sand (13 per cent) are the most extensive biotopes. Further mapping should prioritise circalittoral sponge gardens.

Unique or rare biotopes include:

- Seagrass: *Zostera* spp. and *Ruppia* spp. beds
- Brown algae: high energy common kelp communities
- Sessile invertebrates: entrance canyon sponge garden, moderate to high complexity circalittoral rock with prominent sea plumes-sea tulips-hydroid fans, high energy circalittoral rock with seabed covering sponges
- Tidal reef
- Southern tidal sands sand
- Sandy low profile reef wave surge communities

Traditional Owners

- Part of the sea country of Wathaurung/Wadawurrung (west of entrance) and Bunurong/Boon Wurrung (east of entrance)
- Country Plans will be produced in 2019
- At end of last interglacial phase, about 6000 years ago, sea level rose to flood large flat plains of Port Phillip where Aboriginal communities hunted animals and collected food
- Over 200 Aboriginal archaeological sites recorded in Point Nepean National Park and Mornington Peninsula National Park, predominantly shell middens, stone artefacts

- Large shell middens recorded at Buckley Park Foreshore Reserve and Swan Bay shoreline

Natural values

- Ticonderoga Bay dolphin sanctuary zone
- One of only two Victorian Burrunan dolphin populations. Genetically distinct population of Burrunan dolphins vulnerable to extinction due to small size, female natal philopatry (returning to their birthplace to breed), restricted home range, recreation
- Records of southern right and humpback whales, southern elephant seal, loggerhead turtle. Concern about disturbance
- Habitat for southern bluefin tuna, grey nurse shark, great white shark (juveniles)
- Australian fur seal haul out site (Chinaman's Hat)
- Swan Bay and Port Phillip Bay islands KBA and Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar sites important breeding areas for waterbirds, shorebirds and seabirds
- Orange-bellied parrot in saltmarsh (Swan Bay, Mud Islands)
- Bird-dominated island ecosystem (Mud Islands)
- Unique fish assemblage and high sponge richness (Popes Eye)
- Portsea Hole local biodiversity
- Port Phillip Bay Entrance deep canyon (MA 51) listed marine community dominated by reef-dwelling sessile invertebrates: sponges, ascidians, bryozoans, hydrozoans, corals. At least 115 sponges endemic to Port Phillip Heads
- Intertidal rocky reef platforms at (Cheviot and Point Lonsdale)
- Over 150 species of opisthobranch molluscs observed within Point Lonsdale area, the type locality for many marine species.
- Endemic listed chiton (*Bassethulia glypta*) (Port Phillip Heads); ghost shrimp (*Paraglypturus tooradin*) (Swan Bay, Portsea, southern Port Phillip Bay). Endemic bivalves (*Venerupsis obesa*, *Mysella dromanaensis*) and gastropod (*Eatoniella victoriae*)
- Sea pens and hard corals support fish aggregations at Capel Sound (MA 71)
- Port Phillips Heads is the type locality for three ascidian species, one of which is endemic
- High seaweed diversity including rare species
- Sheltered seagrass meadows (Swan Bay MA 53, Mud Islands). *Amphibolis antarctica* relatively long-lived, slow recolonisation
- Historic giant kelp beds. Giant kelp decreased across Victoria in last 20 years, likely related to increasing water temperature and nutrient levels. Provides vertical structure to reef habitats, loss may influence water currents/wave action
- Port Phillip Bay sediment basin (MA 54) important for nitrogen cycling
- Conservation-listed communities (e.g. Port Phillip Bay Entrance deep canyon marine community) and species (e.g. chiton), endemic or rare species (e.g. ghost shrimp) and species at distributional limit particularly vulnerable to environmental change

Social and economic values

European cultural heritage Sullivan's Bay near Sorrento site of first official European settlement in 1803. 120 shipwrecks known to have occurred within a 10 nautical mile radius of Port Phillip Heads. Shipwreck Protected Zones around *Clarence* (1850), *Joanna* (1843), *Will O' the Wisp* (1853) and *William Salthouse* (1841). Wrecks of the *Holyhead* (1890) and *George Roper* (1883) part of underwater shipwreck discovery trail. Maritime safety navigational buoys established in 1837. Boat pilots stationed at Shortlands Bluff (Queenscliff) in 1839. Queenscliff sandstone lighthouse built in 1843. Quarantine station at Point Nepean in 1852. Point Lonsdale flagstaff to signal tides installed in 1852. Life boat to assist shipwrecks installed at Queenscliff in 1857. Entrance to Port Phillip used for defence activities from 1850s. Fortifications at Queenscliff, Swan Island and South Channel Fort (1879) and Point Nepean (1882). Second battery built near Fort Franklin (Portsea) (1885). Further fortifications added near Point Nepean lighthouse (1914). Prime Minister Harold Holt's disappearance at Cheviot Bay (1967).

Coastal development Townships of Queenscliff, Portsea, Sorrento, Blairgowrie, Rye within easy reach of Melbourne and Geelong. Queenscliff very high vulnerability to inundation under climate change

Tourism and recreation Port Phillip Heads Marine National Park an internationally-recognised dive location. Mornington and Bellarine peninsulas popular for recreational activities, include diving, snorkelling, swimming, beachcombing, rock-pool rambling, nature observation, recreational boating. Port Phillip Bay recreational fishing hotspot, shore (Queenscliff and Sorrento piers) and boat-based fishing. Marine Discovery Centre at Queenscliff. Sheltered cruising and boating areas. Wreck diving on Eliza Ramden and William Salthouse. Popular for club-based yachting, kite and sail boarding

Commercial fishing and aquaculture Commercial fisheries licences for eastern rock lobster zone and central abalone zone. Greenlip abalone production. Commercially important species (King George whiting, flathead, garfish, bream) occur over seagrass. No aquaculture reserves or proposals for aquaculture

Ports and shipping Port of Melbourne and Port of Geelong entrances. Ships travelling to Ports of Geelong and Melbourne use deepwater channels through the heads and the South Channel towards Rosebud. Associated marine pollution risk is very high

Energy Entrance to heads has potential for tidal energy but no current proposals

Emerging uses

- Recreational fishing and boating increasing
- Rates of visitation to Port Phillip Heads MNP likely to increase

Threats

- Alterations in waves or currents affect seagrass productivity
- Sea level rise reduces area for seagrass, mudflats, mangroves and saltmarsh where
- Sea level rise changes coastal features (including inundation of beaches, intertidal reefs, low-lying reefs and islands) which affects shorebird, seabird and seal resting, feeding and breeding habitats
- More frequent storm events and nutrient pulses entering estuaries causes algal growth and sedimentation threatening seagrass (especially in Swan Bay and adjacent areas)
- Increased hot, dry weather puts beach nesting birds at risk from fires

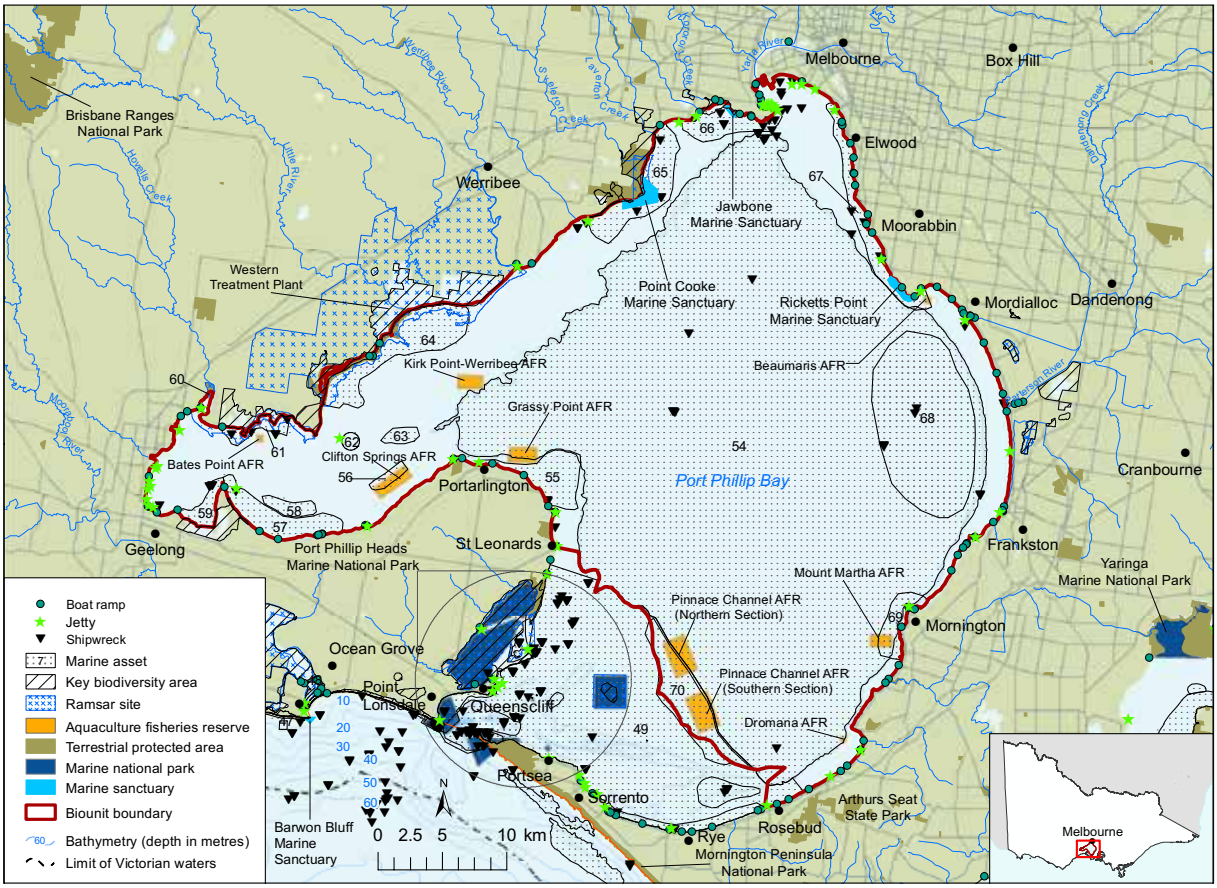
- Removal of beach wrack (kelp and invertebrates) affects ecological processes and biodiversity
- Inappropriate shore-based development (especially around holiday towns) impacts on biota (e.g. disturbance, reduced water quality)
- Coastal modifications (e.g. three groynes in Point Lonsdale section of MNP) alter patterns of longshore drift, deposition, erosion.
- Dredging to allow passage of more or larger ships causes turbidity, sedimentation, reduces light penetration, alters wave patterns, mobilises toxins from polluted sediments. Impacts include smothered seagrass and sponges (e.g. sediments, rock falls), decreased sessile invertebrate feeding efficiency, impaired function of infauna communities
- Coastal saltmarsh and intertidal reef platforms vulnerable to trampling, especially during warmer months
- Intensive use of intertidal areas for education threatens biota through trampling and disturbance
- Seagrass beds, mudflats and subtidal reef sensitive to propeller scarring and vessel groundings in shallow water (especially at low tide) and anchor damage

- Small patches of common kelp dieback observed off Point Franklin, Lonsdale Bay
- Port Phillip Bay has most marine pests in Victorian waters including northern Pacific seastar, broccoli weed (Swan Bay and Mud Islands), European fan worm (Swan Bay, southern Port Phillip Bay), green shore crab (Mud Islands, likely present all intertidal zone), Japanese kelp (north of Port Phillip Bay and gradually colonising subtidal habitats southwards along east), Asian date mussel, Pacific oyster, red algae (*Grateloupia turuturu*)
- Introduced mammals prey on and disturb roosting, feeding and nesting birds and eggs (e.g. hooded plover) and intertidal fauna
- Weeds on Mud Islands include boxthorn, mirror bush, tree mallow, prickly saltwort, galenia, kikuyu, couch-grass. Weeds displace native species in saltmarsh
- Silver gulls at Mud Islands increased since 1970s. Gulls increase exotic plants through soil disturbance, nutrients, seed transport
- Straw-necked and Australian white ibis at Mud Islands increased since 1990s. Nesting causes bare areas subsequently colonised by weeds (coastal hollyhock)
- At high density, native white sea urchin creates urchin barrens (Port Phillip Bay) where erect macroalgae (e.g. kelp) and seagrass usually absent. Unclear whether recent increases part of a natural cycle or persistent increase
- Disturbance to beach nesting birds (e.g. hooded plover), through recreation (e.g. dogs, horses, vehicles, shore-based activities) leads to nesting failure

- Elevated nutrients and sediments (e.g. agricultural runoff, coastal development in Portarlington, degraded riparian vegetation, ageing stormwater drainage systems in Queenscliff, failing septic tank systems) cause turbidity, reduce light levels, excess growth of algae, epiphytes and phytoplankton, decrease dissolved oxygen). Impacts include decline in seagrass cover, reduced habitat quality of mud flats for migratory waders, decreased fish diversity/abundance (including harvested species), potential seafood contamination, impairment of denitrification capacity increasing risk of eutrophication

- Proximity to shipping lanes and Port of Melbourne, and use by recreational boats increases vulnerability to oil or chemical spills. Impacts include oiling of seabirds, oil accumulation over intertidal areas, contamination of ground or surface water, loss of recreation
- Urban areas covered by impervious surfaces, high stormwater runoff
- Growing urban populations (e.g. Portarlington, Rosebud, Rye, Sorrento) can deliver excess freshwater and pollutants
- Marine debris from ocean and litter and other debris from urban areas leads to entanglement in and ingestion of thin plastics by marine fauna

Biounit 9: Port Phillip Bay



Physical setting

The 166,724 hectare Port Phillip Bay biounit is the low energy embayment of Port Phillip Bay, Geelong Arm and Corio Bay, excluding the inner heads flood tide delta region. There are numerous estuaries, many of which are modified and three marine protected areas: Point Cooke, Jawbone and Ricketts Point marine sanctuaries (MS). The sheltered embayment is strongly influenced by the Western Treatment Plant nutrient input (MA 64) and the Yarra River freshwater plume as there is constricted water exchange with the open coast. The muddy sediment basin (MA 54) performs a crucial ecosystem service of nitrogen cycling. Other important areas include the Corio Bay northern shoreline (MA 61), Point Wilson Pier (MA 62) and the Great Sands eastern bank (MA 70). Habitats include low energy, shallow reefs, sandy and muddy sediment beds, seagrass beds, drift algal beds, biogenic reefs and saltmarsh.

The Port Phillip Bay biounit has been extensively mapped. Over 99 per cent has been mapped at the broad habitat level and over 94 per cent at the biotope complex level. The biotope complexes are dominated by muddy substrates. Point Cooke MS has been mapped to biotope complex (81 per cent). Green algae (*Caulerpa* spp.) communities on low energy subtidal rock (33 per cent) and Point Wilson/Altona shallow sand (31 per cent) dominate. Jawbone MS has been mapped to biotope complex (44 per cent) and is mostly Point Wilson/Altona shallow sand (35 per cent). Rickets Point MS has been mapped to biotope complex (35 per cent) and is largely Elwood/Seaford shallow sand (22 per cent).

Further mapping within the biounit should prioritise:

- Safety Beach seagrass bed
- Common kelp biotopes
- Infralittoral Japanese kelp (marine pest) on low energy rock
- Non-reef forming sponge-ascidian-seaweed clump biotopes
- Lagoons, littoral and sublittoral habitats of Limeburners Bay, Point Lillias, Point Wilson, Kirk Point

Unique or rare biotopes include:

- Terrestrial: white mangrove
- Seagrass: *Zostera* spp. and *Ruppia* spp. beds, *Halophila australis* beds
- Green algae: *Caulerpa* spp. beds, *Caulerpa* spp. communities on low energy subtidal rock
- Sessile invertebrates: eastern and southern sediment slope seaweed-ascidian community
- Southern tidal sands sand
- Port Phillip Bay northern deep lower muds relic channel

Traditional owners

- Part of the sea countries of the Wathaurung/Wadawurrung, Wurundjeri and Bunurong/Boon Wurrung
- Country Plans that incorporate Wathaurung/Wadawurrung and Bunurong/Boon Wurrung Sea Country will be produced in 2019. Wurundjeri Country Plan currently under review
- At end of last interglacial phase, about 6000 years ago, sea level rose to flood large flat plains of Port Phillip where Aboriginal communities hunted animals and collected food
- Middens, burial sites, rock wells and stone tools along coast between Williamstown and Werribee, in Jawbone MS, Beaumaris coast

Natural values

- One of two Victorian Burrunan dolphin populations. Genetically distinct population of Burrunan dolphins vulnerable to extinction due to small size, female natal philopatry, restricted home range, recreation (e.g. boat collisions and disturbance)
- Records of conservation-listed southern right whale, humpback whale, common dolphin, southern elephant seal, subantarctic fur seal, Australian fur seal, long-nosed fur seal, grey nurse shark
- Migratory shorebird and seabird feeding areas and colonies (e.g. Western Treatment Plant shoreline). Numerous KBAs (Bellarine wetlands, Swan Bay and Port Phillip Bay islands, Werribee and Avalon, Cheetham and Altona, Carrum wetlands) and Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site recognise importance of sites. Little penguin breeding colony (St Kilda). Orange-bellied parrot in saltmarsh habitats
- Larval hotspot for fish spawning (e.g. snapper) (MA 68), settlement area for larval fish (King George whiting, shark) at Clifton Springs
- Temperate reef communities (Indented Head MA 55, Curlewis Bank MA 57, 58, Altona-Point Cook MA 65, Williamstown-Altona MA 66, north east Port Phillip Bay MA 67, Mornington MA 69)
- Eastern and southern sediment slope seaweed-ascidian biotopes significant as larval and juvenile fish hotspot
- Soft sediment communities (denitrification) include crustaceans, molluscs and polychaetes
- Non-reef forming sponge-ascidian-seaweed clump biotopes support significant recreationally sought species (e.g. calamari)
- *Pyura stolonifera* beds form biogenic reef
- Conservation-listed sea cucumber (*Thyone nigra*) (Corio Bay), snapping shrimp (*Athanopsis australis*) (NE Portlarlington, Beaumaris), rare hydroids on subtidal reef (Ricketts Point MS)
- Point Wilson mud (MA 63)
- Seagrass beds (e.g. Bellarine Bank MA 56, Clifton Springs, Safety Beach) primarily *Zostera nigricaulis* and *Z. muelleri* with some *Halophila australis* and *Amphibolis antarctica*. *A.antarctica* relatively long-lived, horizontal recolonisation takes decades
- Mangroves and saltmarsh (Jawbone MS). Mangroves encroach saltmarsh where no landward retreat possible
- Green algae (*Caulerpa* spp.) predominant component of reef biotopes, likely to have reduced in diversity and extent
- Drift algae beds in northwest significant for biodiversity, nutrient stocks, sediment biogeochemistry and infauna
- Brown algae (*Caulocystis* spp.) and ascidian communities have potential to indicate rehabilitation (e.g. dredge spoil grounds)
- Beaumaris fossil site
- Conservation-listed communities and species (e.g. snapping shrimp) and endemic or rare species (e.g. hydroids at Ricketts Point) particularly vulnerable to environmental change

Social and economic values

European cultural heritage Three early settlement landing sites: Yarra, Gellibrand's Point (Williamstown) and Sandridge (Port Melbourne). Port of Geelong also used. Williamstown first navigational light (1840), later replaced with bluestone lighthouse (1849). Corio bathing establishment opened (1844). Alfred Graving dry dock constructed at Williamstown (1856). Jawbone intertidal area used as part of rifle range (1877-1986), long history of fishing exclusion. Numerous shipwrecks. Shipwreck protected zones around *HMVS Cerberus* (1926) and *SS City of Launceston* (1865)

Coastal development Economic and population centre of Victoria. Western Treatment Plant outfall. Beach between Frankston and Mordialloc has very high vulnerability to erosion under climate change. Areas with very high vulnerability to inundation under climate change include Point Wilson, Point Cook to St Kilda and Mordialloc to Seaford. Coastal protection structures prevalent

Tourism and recreation Popular activities include ecotourism, dolphin swim tours, seal observation, bird watching, sightseeing, diving, snorkelling, beach activities, swimming. Important recreational fishery. Six artificial reefs, three boat based (Aspendale, Seaford, Frankston) and three shore based (Altona Pier, Frankston Pier, Portarlington Pier). Other fishing locations include piers at Cunningham, Werribee, Ferguson Street, Station Pier, Mordialloc, Patterson River, Mornington. Marine sanctuaries sites for environmental education. Sheltered cruising and boating area. Twenty-four surf life saving clubs

Commercial fishing and aquaculture Commercial licences for eastern rock lobster zone, central abalone zone, scallop dive, Port Phillip and Westernport, Port Phillip Bay mussel bait. Eight offshore fisheries aquaculture reserves (Grassy Point, Clifton Springs, Bates Point, Kirk Point, Beaumaris, Mornington, Dromana, Pinnace Channel). Two onshore aquaculture fisheries reserves (Point Lillias, Avalon). Onshore abalone farms at Avalon and Indented Head

Ports and shipping A system of channels allows large ships to navigate to ports of Melbourne and Geelong. Deepwater anchorages in north west of Bay. 3200 ships visit Port of Melbourne annually, 600 visit Port of Geelong. Numerous small local access areas. Associated marine pollution risk is high (centre of Port Phillip Bay) to very high (Port of Melbourne, Port of Geelong)

Energy Oil and gas pipelines cross seafloor, no exploration or extraction

Emerging uses

- Phasing out commercial fishing in favour of recreational fishing

- Shellfish reef restoration (native flat oysters and blue mussels) in Geelong, St Kilda and Chelsea
- High population growth in many areas (e.g. Werribee South, Point Cook East, Mornington, Dromana)

Threats

- Alterations in waves or currents affect seagrass productivity
- Sea level rise alters frequency of estuary mouth opening
- Sea level rise reduces area for seagrass, mudflats, mangroves and saltmarsh
- Sea level rise changes coastal features (including inundation of beaches, intertidal reefs, low-lying reefs and islands) which affects shorebird, seabird and seal resting, feeding and breeding habitats
- More frequent storm events and nutrient pulses entering bay causes algal growth and sedimentation
- High rainfall events (result in land run off of nutrients and sediments) become more frequent or severe. Detrimental to nearshore water quality and infralittoral zones
- Increased hot, dry weather puts beach nesting birds at risk from fires
- Temperatures above 35°C detrimental to penguins on land and in burrows

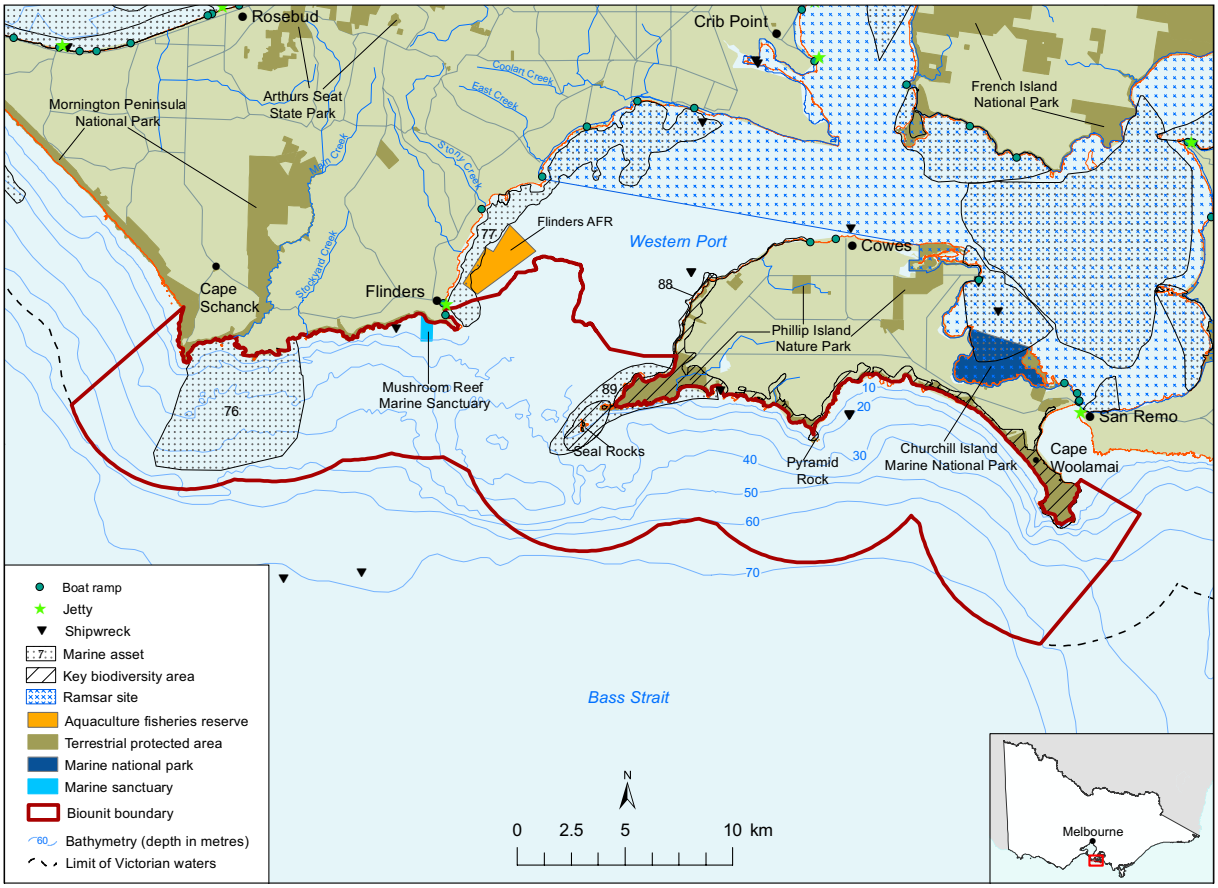
- Removal of beach wrack (kelp and invertebrates) affects ecological processes and biodiversity
- Inappropriate shore-based development impacts on biota (e.g. disturbance, reduced water quality)
- Artificial estuary opening (e.g. Patterson, Maribyrnong, Yarra, Little and Werribee rivers; Brokil, Kananook, Mordialloc, Moonee Ponds and Stony creeks; Elwood Canal all constructed and permanently open)
- Coastal modifications (e.g. Quiet Corner seawall; groyne at mouth of Kororoit Creek) alter patterns of longshore drift, deposition, erosion. Impacts may include physical damage, altered hydrodynamic processes
- Dredging to allow passage of more or larger ships causes turbidity, sedimentation, reduces light penetration, alters wave patterns, mobilises toxins from polluted sediments. Impacts include smothered seagrass and sponges (e.g. sediments, rock falls), decreased sessile invertebrate feeding efficiency, impaired function of infauna communities
- Coastal saltmarsh, mangroves and intertidal reef platforms vulnerable to trampling
- Intensive use of intertidal areas for education threatens biota through trampling and disturbance
- Seagrass beds, mudflats and subtidal reef sensitive to propeller scarring and vessel groundings in shallow water (especially at low tide) and anchor damage

- Diseases (e.g. salmonellosis, botulism) from sewage threaten birds at Western Treatment Plant
- Port Phillip Bay has most marine pests in Victorian waters including northern Pacific seastar, broccoli weed, European fan worm, green shore crab, Japanese kelp (north of Port Phillip Bay and gradually colonising subtidal habitats southwards along east), Asian date mussel, Pacific oyster, red algae (*Grateloupia turuturu*) and toxic dinoflagellate (*Alexandrium minutum*)
- Introduced mammals prey on and disturb roosting, feeding and nesting birds and eggs (e.g. hooded plover)
- Weeds displace native species in saltmarsh
- At high density, native white sea urchin creates urchin barrens (Port Phillip Bay) where erect macroalgae (e.g. kelp) and seagrass usually absent. Unclear whether recent increases part of a natural cycle or persistent increase
- Disturbance to beach nesting birds through recreation leads to nesting failure
- Birdwatchers may disturb roosting, feeding or breeding birds (Western Treatment Plant)

- Elevated nutrients and sediments (e.g. agricultural runoff from market gardens around Werribee; urban development; very poor quality of Hovells Creek and Little, Werribee and Yarra rivers; poor quality of Kororoit Creek and Maribyrnong River; moderate quality of Skeleton Creek; degraded riparian vegetation; Western Treatment Plant outfall) cause turbidity, reduce light levels, promote excess growth of algae, epiphytes and phytoplankton, decrease dissolved oxygen)
- Land clearing (urban development and agriculture) in catchment leads to increased storm water runoff, nutrient and sediment input, groundwater salinity, freshwater diversion, impacting water quality
- Reduction in nutrients from Western Treatment Plant changes intertidal flats and shorebirds
- Kororoit Creek changed significantly due to siltation caused by prolonged low flows, sand movement from coastal erosion, and construction of tyre groyne

- Agricultural use of herbicides and pesticides threaten mudflat communities
- Sediments (e.g. Kororoit Creek) accumulate toxic chemicals and heavy metals (e.g. mercury) contaminate marine animals (e.g. dolphins, fish, shellfish)
- Light pollution (e.g. development on foreshore) affects birds (e.g. little penguin)
- Proximity to shipping lanes, Port of Melbourne, use by recreational boats, oil refinery increases vulnerability to oil or chemical spills. Impacts include oiling of seabirds, oil accumulation over intertidal areas, contamination of ground or surface water, loss of recreation
- Urban areas covered by impervious surfaces, high stormwater runoff
- Growing urban areas (e.g. Portarlington, Clifton Springs, Leopold, Lara, Werribee South, Point Cook East, St Kilda, Chelsea-Bonbeach, Mornington, Dromana) deliver excess freshwater and pollutants
- Marine debris from ocean and litter and other debris from urban areas leads to entanglement in and ingestion of thin plastics by marine fauna

Biounit 10: Schanck-Woolamai



Physical setting

The 35,228 hectare Schank-Woolami biounit extends from western Cape Schanck to Cape Woolamai and includes the western entrance to Western Port and southern coast of Phillip Island. There is one marine protected area – Mushroom Reef Marine Sanctuary (MS). The basaltic, volcanic sediment and granite headlands are incised with beaches. Inshore reefs with a southerly aspect (Cape Schanck reefs MA 76) are typically shaded in winter by coastal cliffs and bluffs. Habitats include high-energy, wave-dominated beaches and rocky headlands, sublittoral reef and sediments and high complexity reef including pinnacles. Some 37 species are presumed to be at their distributional limit within the biounit.

The Schanck-Woolamai biounit has been mapped in some detail: 39 per cent at broad habitat level and 25 per cent at biotope complex level. Within mapped areas infralittoral fine sand, high energy lower infralittoral zone and high energy kelp communities dominate. Within Mushroom Reef MS 64 per cent has been mapped to biotope complex. Macroalgal communities in high-energy environments comprise the majority of the biotope complexes (cray weed: 38 per cent, common kelp-cray weed: 13 per cent, bull kelp: 10 per cent). Further mapping within the biounit should prioritise completing the remaining 61 per cent of biounit mapping at the broad habitat level so that mapping can be completed at the biotope complex level.

Unique or rare biotopes include:

- Seagrass: *Zostera* spp. and *Ruppia* spp. beds, *Amphibolis antarctica* on moderate energy rock with sandy veneer
- Brown algae: high energy common kelp communities, high energy bull kelp communities
- Red algae: rhodolith beds in subtidal clean gravel or sand on open coasts
- High surge
- Suspended sediment
- Shaded biotopes

Traditional Owners

- Part of the sea country of the Bunurong/Boon Wurrung.
- Country Plan that incorporates Sea Country will be produced in 2019
- 217 registered sites in Phillip Island Nature Parks, mostly on southern coastline

Natural values

- Part of whale migration route
- Australian fur seal breeding colony at Seal Rocks (MA 89)
- Migratory shorebird feeding areas and colonies (hooded plover) (MA 77), and seabird colonies (crested terns, little penguins, short-tailed shearwaters) (MA 89). Summerland Peninsula only Victorian breeding site for kelp gull. Phillip Island KBA
- Great white shark patrol area near seal colony

- Reef fish include moonlighter's and magpie perch, wrases, Port Jackson shark, cat shark
- Seagrass beds (*Amphibolis antarctica* on Somers to Flinders reefs MA 77) important sea dragon habitat and possible squid breeding area. *A. antarctica* relatively long-lived, horizontal recolonisation takes decades
- Mushroom reef supports one of most diverse intertidal reef communities in Victoria on basalt including abundant abalone
- Endemic sea cucumber (*Apsolidium densum*) and chiton (*Bassethullia glypta*) at Mushroom Reef
- Rhodolith beds
- High biodiversity and unique values (The Pinnacle, Cape Schanck reefs MA 76)
- Conservation-listed communities and species (e.g. great white shark), endemic or rare species (e.g. sea cucumber) or species at distributional limit particularly vulnerable to environmental change

Social and economic values

European cultural heritage Sealers on Phillip Island from late 1700s. Cape Schanck lighthouse constructed 1859. Wreck of the *Bismarck* (1901). West Head at Flinders site of gun emplacement in WWI

Coastal development Flinders township and settlements on southern coast of Phillip Island. Significant coastal landscape values

Tourism and recreation Phillip Island Nature Park major tourist destination (1.17 million visitors in 2016/17). Subtidal reefs popular for diving and snorkelling. Dive spots include Pulpit Rock, Seal Rocks, Pyramid Rock, The Pinnacle. Surf spots include Cape Schanck, Flinders, Smiths Beach, Sunderland Bay, Forest Caves, Woolamai. Surf life saving at Woolamai beach

Commercial fishing and aquaculture Commercial fisheries licences for eastern rock lobster zone and central abalone zone. Bismarck reef offshore of Mushroom Reef productive abalone site. No aquaculture reserves or proposals for aquaculture

Ports and shipping Approximately 150 ships enter Western Port annually through western entrance between Flinders and Phillip Island. Associated marine pollution risk is moderate

Energy No proposals for oil and gas exploration or development of wind, tidal or wave energy

Emerging uses

Continued tourism growth at Phillip Island Nature Parks and flow on effects to adjacent marine areas

Threats

- Alterations in waves or currents affect seagrass productivity
- Sea level rise reduces area for seagrass where landward migration not possible
- Sea level rise changes coastal features (including inundation of beaches and intertidal reefs) which affects shorebird, seabird and seal resting, feeding and breeding habitats
- Increased hot, dry weather puts beach nesting birds at risk from fires
- Temperatures above 35°C detrimental to penguins on land and in burrows

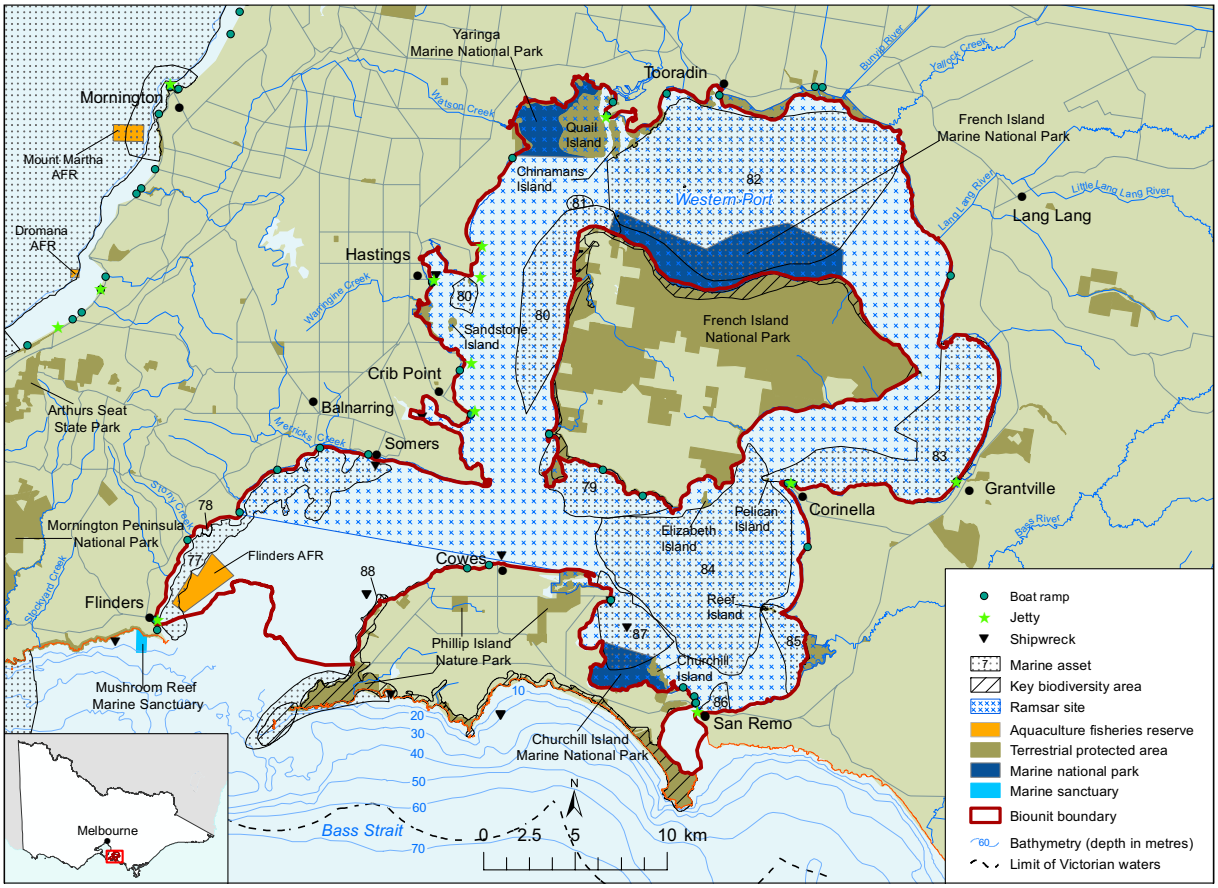
- Removal of beach wrack (kelp and invertebrates) affects ecological processes and biodiversity
- Intertidal reef platforms vulnerable to trampling, especially during warmer months
- Intensive use of intertidal areas for education threatens biota through trampling and disturbance

- Pilchard herpes virus affected fish stocks in 1995 and 1998 with flow-on effects to little penguin populations
- Likely pests include green shore crab (intertidal areas), displaces local crabs
- Concern about spread of Pacific oyster, Asian date mussel, 16 other exotic species (Western Port), seven exotic species (Port of Hastings), Japanese kelp (previously removed from Western Port), broccoli weed (San Remo and Newhaven), European fan worm and northern Pacific seastar (Port Phillip Bay)
- Introduced mammals prey on and disturb roosting, feeding and nesting birds and eggs (e.g. hooded plover)
- Disturbance to breeding seals leads to crushed or drowned pups, loss of territory by bulls
- Disturbance to beach nesting birds (e.g. hooded plover), through recreation (e.g. dogs, horses, vehicles, shore-based activities) leads to nesting failure

- Elevated nutrients and sediments (e.g. coastal development on Phillip Island) cause turbidity, reduce light levels, promote excess growth of algae, epiphytes and phytoplankton, decrease dissolved oxygen). Impacts include decline in seagrass cover, disturbance and burial of rhodoliths, decreased fish diversity/abundance (including harvested species), potential seafood contamination

- Light pollution (e.g. development on foreshore) affects birds (e.g. short-tailed shearwater fledglings).
- Urban areas covered by impervious surfaces, high stormwater runoff
- Growing urban areas (e.g. Phillip Island) deliver excess freshwater and pollutants
- Marine debris from ocean and litter and other debris from urban areas leads to entanglement in and ingestion of thin plastics by marine fauna

Biounit 11: Western Port



Physical setting

The 65,009 hectare Western Port biounit is the moderate to low energy embayment of Western Port. Three marine protected areas (Yaringa, French Island, Churchill Island marine national parks (MNP). Seven main estuaries (Hanns Inlet, Hastings Bight, Watsons Inlet, Rutherford Inlet, Sawtells Inlet, Bass River, Swan Bay), two large and several small offshore islands (French Island, Phillip Island and Sandstone, Quail, Chinaman, Barrallier, Pelican, Elizabeth, Reef and Churchill islands). Strong tidal stream influence, dendritic channels and banks. Habitats include moderate energy, circalittoral and infralittoral reefs, sandy and muddy sediment beds, tide-swept sediment channels, seagrass beds, green algae sediment beds, biogenic bryozoan reefs, saltmarsh, mangroves.

Over 99 per cent of the Western Port biounit has been mapped at the broad habitat level and 25 per cent at the biotope complex level. Seagrass beds on littoral sediments dominate the mapped biotope complexes. Yaringa MNP has been mapped to biotope complex level (91 per cent) and is predominantly comprised of white mangrove (35 per cent), coastal saltmarsh/wet saltmarsh shrubland (26 per cent) and seagrass beds on littoral sediments (22 per cent). Part of French Island MNP has been mapped to biotope complex level (38 per cent), most of which is seagrass beds on littoral sediments (36 per cent). The situation is similar at Churchill Island MNP, where 70 per cent has been mapped and 68 per cent is seagrass beds on littoral sediment.

Further mapping within the biounit should prioritise:

- Complete biotope complex level mapping (76 per cent of biounit)
- Lamp (brachiopod) shell beds, seapen beds
- Subtidal sediment
- Intertidal mud flats, seagrass, mangroves, saltmarsh
- Differentiation between littoral and sublittoral seagrass
- Basalt littoral rock, infralittoral biotopes, circalittoral reefs
- Sublittoral seagrass (*Zostera* spp.)/green algae (*Caulerpa* spp.) beds

Unique or rare biotopes include:

- Terrestrial: white mangrove, mangrove shrubland
- Seagrass: seagrass beds on littoral sediments, *Amphibolis antarctica* on moderate energy rock with sandy veneer, *Zostera* spp. and *Ruppia* spp. beds, *Halophila australis* beds
- Red algae: rhodolith beds in tide-swept sheltered channels
- Sessile invertebrates: bryozoan biogenic reef, seapen beds
- San Remo intertidal and subtidal reef
- Moderate energy tide-swept faunal communities

Traditional Owners

- Part of the sea country of the Bunurong/Boon Wurrung
- Three shell middens near Mushroom Reef MS and fish trap in intertidal reefs
- Country Plan that incorporates Sea Country will be produced in 2019

Natural values

- Migratory shorebird feeding, roosting and breeding areas (MA 79, 80, 82, 83, 85, 87, 88) and seabird breeding colonies (fairy tern, Caspian tern) (MA 79) parts of Western Port KBA and Ramsar site. Barrallier Island major high tide roosting site
- Bass River delta nursery for shark and whiting
- Southeast basin (MA 84) elephantfish breeding area, school shark and gummy shark nursery area
- Post-larval settlement of King George whiting appear from September to November
- High invertebrate diversity (Honeysuckle Reef MA 78, MA 79, Crawfish Rock MA 81)
- Conservation-listed or rare invertebrates: hydroid (*Ralpharia coccinea*) (Crawfish Rock); snapping shrimp (*Alpheus australosulcatus*), chiton (*Bassethulia glypta*), sea cucumber (*Apsolidium densum*) (North Head); snapping shrimp (*Michelea microphylla*, *Eucallix tooradin*, *Paraglyptus tooradin*) (Crib Point); sea cucumber (*Apsolidium handrecki*) (Merricks); brittle star (*Amphiura triscacantha*) (French Island MNP)
- Restricted distribution of *Ralpharia coccinea* makes it vulnerable to environmental changes, dependent on host coral species (*Erythropodium hicksoni*) which competes with seaweeds/sessile invertebrates for space
- San Remo marine community with numerous nudibranchs and bryozoans (MA 86), two opisthobranch taxa (*Platydoris galbana* and *Rhodope* sp.) listed under *Flora and Fauna Guarantee Act 1988*
- Rare 'living fossils' *Magellania flavescens* (Lamp shell beds MA 87), and bivalve molluscs *Neotrigonia margaritacea*, *Andara tripezia* highly restricted distribution
- Rhodolith beds (Newhaven MA 86), *Lithothamnion superpositum* Victorian endemic species
- Sea pen (*Sarcoptilus grandis*) beds regionally unique
- Seagrass beds (*Amphibolis antarctica* MA 77, *Zostera* spp. MA 87) support seadragons, possible squid breeding area, recreational fish species (King George whiting, leatherjackets, flounder, black bream, garfish, flathead). Continued decline of seagrass. *Amphibolis antarctica* relatively long-lived, horizontal recolonisation takes decades
- Unvegetated mudflats support high biomass of microalgae, invertebrates, serve as feeding areas for juvenile fish
- Most extensive and well-developed mangroves in Victoria (e.g. north shore of French Island NP).
- Saltmarsh floristically rich and relatively undisturbed, supports orange-bellied parrot. Yaringa MNP supports at least five different saltmarsh communities
- Over 69 species at distributional limits within Western Port, many from Crawfish Rocks (MA 81)
- Mornington Peninsula and Western Port Biosphere Reserve recognises coastal embayment with relatively undisturbed mudflats and salt marsh facing challenges of sustainable development in surrounding catchment
- Conservation-listed communities (e.g. San Remo marine community) and species (e.g. chiton), endemic or rare species (e.g. lamp shells) or species at distributional limit particularly vulnerable to environmental change

Social and economic values

European cultural heritage Western Port early site of sea-based exploration from 1798. Sealers on Phillip Island from late 1700s. Settlement Point near Corinella and another site on Phillip Island near Rhyll sites of second European settlement in Victoria in 1826. Churchill Island homestead site. Shipwrecks.

Coastal development Townships and access points of Flinders, Crib Point, Hastings, Tooradin, San Remo, Cowes. Draining of Koo Wee Rup swamp altered Western Port and shaped physical parameters. South East Growth Corridor for metropolitan Melbourne. Tooradin has very high vulnerability to inundation under climate change

Tourism and recreation Phillip Island Nature Parks major tourist destination (1.17 million visitors in 2016/17). Important recreational fishery (King George whiting, rock flathead, snapper, garfish). Shore-based fishing at Flinders jetty, Cowes jetty, Merricks Beach, Stony Point pier, Hastings jetty, Tooradin Inlet, Corinella pier, San Remo jetty, Rhyll jetty. Excellent locations for bird watching and natural history activities. Opportunities for scenic recreation, marine education and ecotourism. Recreational boating, including sailing and sea kayaking. Commercial pelican feeding at San Remo pier. Dive sites at Flinders Pier, West head, Channel drift. Sheltered cruising and boating area. Surf life saving club at Point Leo. Good surf breaks from Flinders around to Point Leo

Commercial fishing and aquaculture Commercial fisheries licences for eastern rock lobster zone and central abalone zone. Offshore aquaculture fisheries reserve (Flinders)

Ports and shipping Port of Hastings commercial port. Associated marine pollution risk is moderate (north and east of French Island) to very high (San Remo, Crib Point, Long Island)

Energy Tidal energy converters successfully trialled at Newhaven at narrow eastern entrance to Western Port. No current proposals for commercial projects. Proposal for floating regassification plant at Crib Point and jetty upgrade for liquid natural gas tankers

Emerging uses

Part of the South East growth corridor for Melbourne, high population growth in Koo Wee Rup and the catchment to the north, with subsequent increased demand for access and use of marine environment

Threats

- Alterations in waves or currents affect seagrass productivity
- Sea level rise alters frequency of estuary mouth opening (e.g. Merricks Creek seasonally closed) and inland extent of tidal creeks around northern area
- Sea level rise reduces area for seagrass, mudflats, mangroves and saltmarsh
- Sea level rise changes coastal features (including inundation of beaches, intertidal reefs, low-lying reefs and islands) which affects shorebird and seabird resting, feeding and breeding habitats
- More frequent storm events and nutrient pulses entering estuaries causes algal growth and sedimentation threatening seagrass
- Decreased freshwater flows alter frequency of estuary mouth opening and salinity regime. Impacts fish diversity or abundance and connectivity for fish that use fresh and marine waters (e.g. Australian grayling)
- High rainfall events (result in land run off of nutrients/sediments) become more frequent or severe. Detrimental to mudflats
- Increased hot, dry weather puts beach nesting birds at risk from fires
- Temperatures above 35°C detrimental to penguins on land and in burrows. Prolonged exposure causes heat stress and mortality

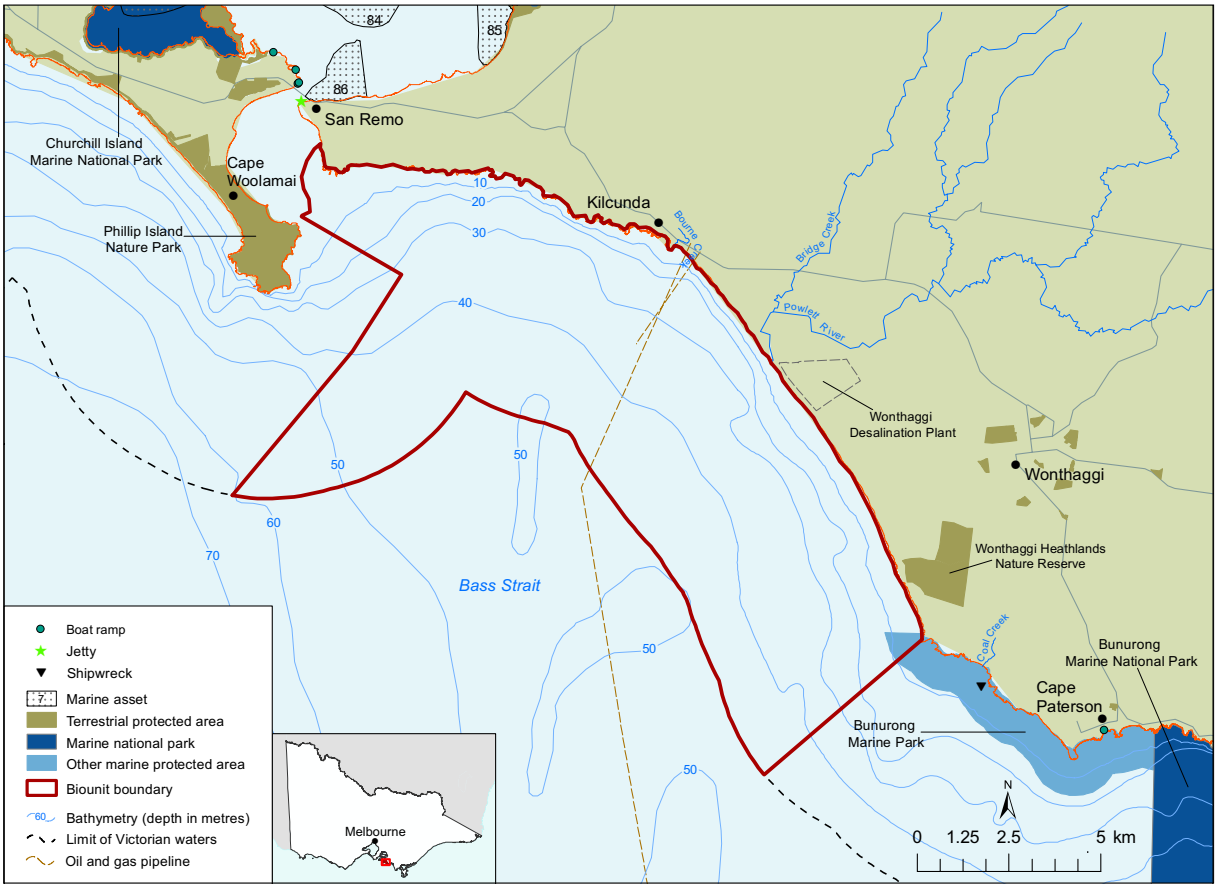
- Inappropriate shore-based development (especially around holiday settlements) impacts on biota (e.g. disturbance, reduced water quality)
- Artificial estuary opening (e.g. Yallock drain, Bunyip River, Deep and Cardinia creeks constructed entrances) produces silt plumes and sedimentation.
- Coastal modifications (e.g. coastal protection structures) may alter patterns of longshore drift, deposition, erosion. Threatens conservation-listed San Remo marine community
- Coastal saltmarsh, mangroves, intertidal reef platforms vulnerable to trampling, especially during summer
- Seagrass beds, mudflats and subtidal reef sensitive to propeller scarring and vessel groundings in shallow water (especially at low tide) and anchor damage

- Concern about spread of Pacific oyster, Asian date mussel (Yaringa and French Island MNPs), 16 other exotic species (Western Port), seven exotic species (Port of Hastings), Japanese kelp (previously removed from Western Port), broccoli weed (San Remo and Newhaven), European fan worm and northern Pacific seastar (Port Phillip Bay)
- Introduced mammals prey on and disturb roosting, feeding and nesting birds and eggs (e.g. hooded plover)
- Cord grass Spartina invades saltmarsh, mangroves and mudflats binding sediments and altering mud habitat, occurs at mouth of Bass River, drain outlets near Tooradin
- Uncontrolled grazing (hog deer, goats, rabbits and domestic stock) close to waterways and wetlands leads to bank erosion. Damages or degrades intertidal areas, saltmarsh and mangroves
- Recreational fishing threatens slow reproducing species (e.g. elephantfish, school sharks)
- Disturbance to beach nesting birds (e.g. hooded plover) through recreation (e.g. dogs, horses, vehicles, shore-based activities) leads to nesting failure

- Water quality in Western Port affected through input in north
- Elevated nutrients and sediments (e.g. agricultural runoff from market gardens; urban development in south east urban growth corridor; very poor condition of Lang Lang River, Watson, Deep and Yallock creeks and Bunyip main drain; moderate condition of Bass River, Warringine Creek and Wylies drain) causes turbidity, reduces light levels, promotes excess growth of algae, epiphytes and phytoplankton, decreases dissolved oxygen. Impacts include decline in seagrass cover, disturbance and burial of rhodoliths, reduced habitat quality of mud flats for migratory waders, reduced mangrove health, decreased fish diversity/abundance (including harvested species), potential seafood contamination
- Dominant catchment source of fine sediment is subsoil from channel and gully erosion of the Bunyip and Lang Lang river systems

- Agricultural use of herbicides and pesticides threaten mudflat communities
- Light pollution (e.g. development on foreshore) affects birds (e.g. short-tailed shearwater fledglings)
- Proximity to Port of Hastings and use by recreational boats increase vulnerability to oil or chemical spills. Clockwise flow of water and slow flushing time in northern and eastern parts of Western Port may magnify impacts of any pollutants. Impacts include oiling of seabirds, oil accumulation over intertidal areas, contamination of ground or surface water, loss of recreation
- Urban areas covered by impervious surfaces, high stormwater runoff
- Growing urban areas (e.g. South East growth corridor, Koo Wee Rup, Wonthaggi-to Inverloch) deliver excess freshwater and pollutants
- Litter and other debris from urban areas leads to entanglement in and ingestion of thin plastics by marine fauna

Biounit 12: Wonthaggi



Physical setting

The 12,418 hectare Wonthaggi biounit extends from east of San Remo to west of Harmers Haven. Encompasses part of Bunurong Marine Park and the Powlett River estuary. Coast directly exposed to surf waves with gently stepped and sloped reefs and sand patches. Heavily influenced by turbid Western Port waters from the eastern entrance. Habitats include high-energy, wave-dominated beaches and small rocky headlands, sublittoral reef and sediments.

The Wonthaggi biounit has been mapped only at broad habitat level (31 per cent). Sublittoral sediment and infralittoral rock are the main broad habitat types. Further mapping within the biounit should prioritise completing mapping at the broad habitat level (69 per cent of biounit) so that mapping can begin at the biotope complex level.

Unique or rare biotopes include:

- Seagrass: *Amphibolis antarctica* on moderate energy rock with sandy veneer
- High surge biotopes
- Suspended sediment biotopes
- Turbid biotopes

Traditional Owners

- Part of the sea country of the Bunurong/Boon Wurrung. Country Plan that incorporates Sea Country will be produced in 2019
- Middens identified around Coal Point and Wonthaggi Heathlands Reserve

Natural values

- Records of conservation-listed humpback whale, southern right whale, bottlenose dolphin, common dolphin, long-nosed fur seal, Australian fur seal, leopard seal, subantarctic fur seal
- Powlett River estuary extensive saltmarsh (coastal tussock saltmarsh, wet saltmarsh herbland) and wetland (estuarine wetland) communities, feeding habitat for critically endangered orange-bellied parrot
- Hooded plovers breed at Powlett River estuary
- Australian grayling (conservation-listed) occurs in Powlett River
- Kelp canopy communities
- Rhodolith beds
- Rich Mesozoic fossil site
- Conservation-listed communities and species (e.g. Australian grayling) and endemic or rare species (e.g. rhodoliths) particularly vulnerable to environmental change
- *Amphibolis antarctica* relatively long-lived, horizontal recolonisation takes decades

Social and economic values

European cultural heritage Sealing and whaling early 1800s. Wonthaggi a prosperous mining town from 1909 to 1960s, miners' huts built on coastal Crown land

Coastal development Coastal town of Kilcunda. Victorian desalination plant intake and outfall. Wastewater outfall from Inverloch and Cape Paterson at Baxters Beach

Tourism and recreation Powlett River popular for non-motorised boating (kayak, canoe), picnics, barbeques, recreational fishing, sightseeing, swimming, walking and bird watching. Surf locations at Kilcunda and Powlett River mouth

Commercial fishing and aquaculture Commercial fisheries licences for eastern rock lobster zone and central abalone zone. No aquaculture reserves

Ports and shipping: No shipping routes. Associated marine pollution risk is moderate

Energy BassGas pipeline to wells in Commonwealth waters. Coal reserves at Cape Paterson. Potential for wave energy identified along this coast

Emerging uses

- Increased demand for water from desalination plant under drier climate
- New Bunurong Coastal Park planned (joining up coastal Crown land from San Remo to Inverloch)

Threats

- Sea level rise alters frequency of estuary mouth opening (e.g. Powlett River seasonally closed)
- Sea level rise reduces area for seagrass where landward migration not possible
- Sea level rise changes coastal features (including inundation of beaches) which affects shorebird and seabird resting, feeding and breeding habitats
- More frequent storm events and nutrient pulses entering estuaries may cause algal growth and sedimentation
- Decreased rainfall could lead to increased demand for desalination
- Decreased freshwater flows alter frequency of estuary mouth opening and salinity regime. Impacts on fish diversity or abundance and connectivity for fish that use fresh and marine waters
- Increases in hot, dry weather put beach nesting birds at risk from fires

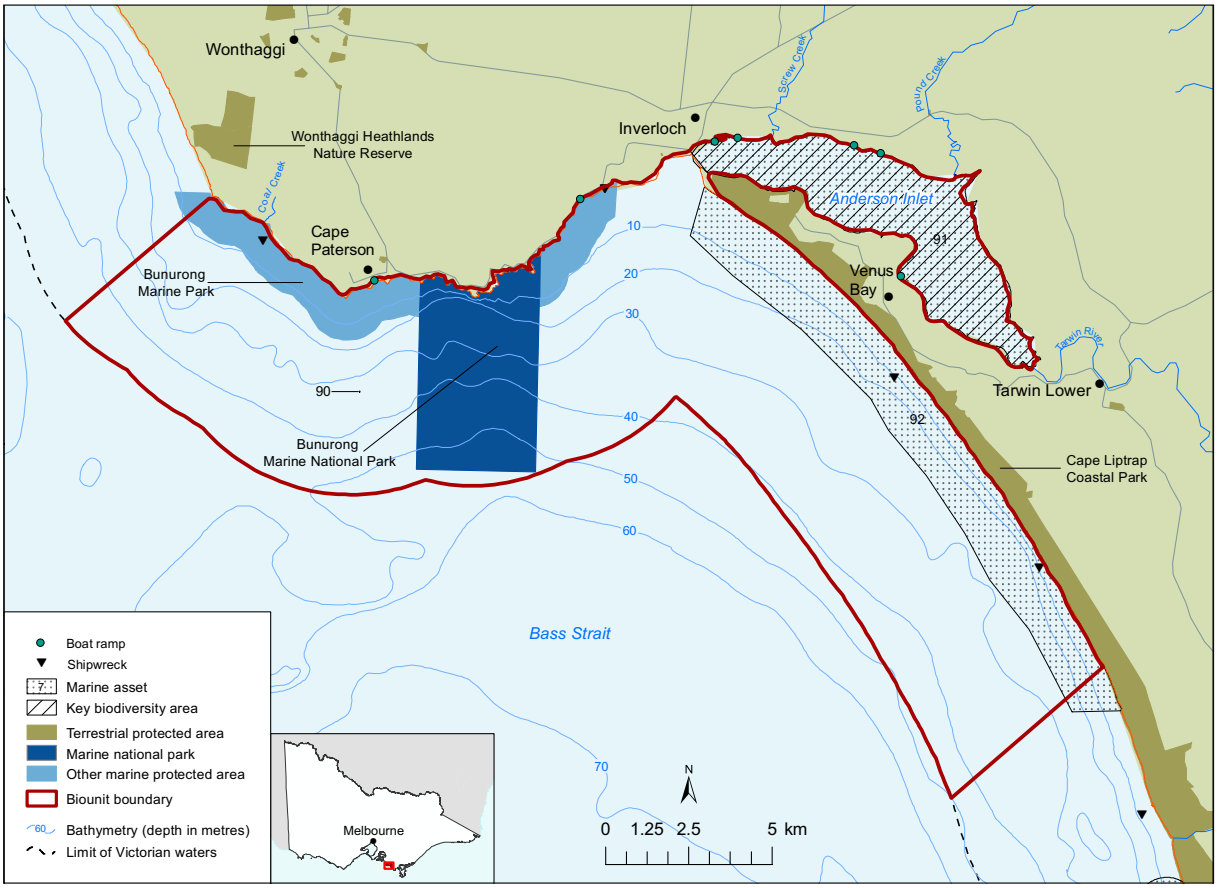
- Coastal saltmarsh vulnerable to trampling, especially during warmer months

- Likely pests include green shore crab (intertidal areas), displaces local crabs
- Concern about spread of Pacific oyster, Asian date mussel, broccoli weed from Western Port
- Introduced mammals prey on and disturb roosting, feeding and nesting birds and eggs (e.g. hooded plover)
- Weeds displace native species in saltmarsh
- Disturbance to beach nesting birds (e.g. hooded plover) through recreation (e.g. dogs, horses, vehicles, shore-based activities) leads to nesting failure

- Elevated nutrients and sediments (e.g. urban development Wonthaggi to Inverloch; poor condition of Powlett River due to pest plants and animals, degraded riparian vegetation, disturbance of acid sulphate soils, trampling; desalination plant outfall) causes turbidity, reduces light levels, promotes excess growth of algae, epiphytes and phytoplankton, decreases dissolved oxygen. Impacts include disturbance and burial of rhodoliths, decreased fish diversity/abundance (including harvested species), potential seafood contamination

- Underwater seismic surveys for oil and gas disturb large (e.g. cetaceans) and small (e.g. zooplankton, scallops) marine organisms
- Proximity to offshore oil and gas production platforms and pipelines increases vulnerability to oil or chemical spills. Impacts include oiling of seabirds, oil accumulation over intertidal areas
- Growing urban areas (e.g. Wonthaggi to Inverloch) deliver excess freshwater and pollutants

Biounit 13: Bunurong



Physical setting

The 23,775 hectare Bunurong biounit extends from east of Coal Point to north of Arch Rock and includes the Bunurong Marine National Park (MNP) and the multiple-use Bunurong Marine Park (MP). The coast is cliffed with sandy beaches and coastal dunes. Bunurong reefs are sheltered from breaking surf but are subject to very strong, long-period ground surge. The Tarwin River drains into Andersons Inlet. Habitats include high, moderate and low energy, wave dominated beaches and rocky headlands, sublittoral reef and sediments, rhodolith beds, coastal inlet and lagoon. At least 21 species are presumed to be at distributional limits within the biounit including blue groper and some seaweed species. Eagles Nest is a site of national geological significance.

The Bunurong biounit has been mapped only at the broad habitat level (34 per cent). The mapped area is comprised of sublittoral sediment, infralittoral rock and littoral sediment. Most of the Bunurong MNP is unmapped (24 per cent mapped). Much of the mapped area is infralittoral rock (19 per cent), with a small amount of sublittoral sediment (6 per cent). The Bunurong MP has been extensively mapped to broad habitat level (99 per cent), divided between infralittoral rock (90 per cent) and sublittoral sediment (9 per cent). Further mapping within the biounit should prioritise completing mapping at the broad habitat level (66 per cent of biounit) so that mapping can begin at the biotope complex level.

Unique or rare biotopes include:

- Terrestrial: white mangrove
- Red algae: rhodolith beds
- Sessile invertebrates: sponge-stalked ascidian–bryozoan communities on deep subtidal reefs

Traditional Owners

- Part of the sea country of the Bunurong/Boon Wurrung. Country Plan that incorporates Sea Country will be produced in 2019
- Current registered Gunaikurnai Federal Native Title application
- Numerous archaeological sites include occupation sites at Morgan Creek, near Point Smythe, at Ten Mile Creek, Five Mile Creek and near Bell Point

Natural values

- Records of conservation-listed humpback and southern right whales, bottlenose and common dolphins, Australian and subantarctic fur seals, leopard seal
- Anderson Inlet (MA 91) KBA supports chestnut teal, double-banded plover, eastern curlew, great knot, orange-bellied parrot, Pacific gull, red-necked stint. Venus Bay beach (MA 92) important nesting and feeding area for hooded plover, also red-necked stint, sanderling. Eagles Nest habitat for breeding hooded plovers and peregrine falcon
- Mangroves and saltmarsh around Anderson Inlet
- Extensive intertidal sandstone rock platforms and shallow subtidal rocky reefs extend several kilometres from shore, different from much of Victorian coastline. Highest diversity of intertidal and shallow subtidal invertebrate fauna recorded in Victoria on sandstone
- High diversity of chitons including endemic species, conservation-listed sea cucumber (*Pentocnus bursatus*) (Cape Paterson)
- Cape Paterson rhodolith bed (MA 90)
- Distinct communities rich in red and brown algae due to absence of large kelps (rare *Zonaria* sp., *Myriodesma tuberosa*)
- Seagrass (*Amphibolis antarctica*) in sheltered coves on sand substrates important fish habitat*. A. antarctica* relatively long-lived, horizontal recolonisation takes decades
- Fossil-bearing rocks between Cape Paterson and Flat Rocks, including dinosaur fossil site at The Caves
- Conservation-listed communities and species (e.g. hooded plover), endemic or rare species (e.g. sea cucumber) and species at distributional limit particularly vulnerable to environmental change

Social and economic values

European cultural heritage Wrecks of *Amazon* (1863) at Flat Rocks and *Artisan* (1901) at Wreck Beach, others suspected at Cape Paterson. Wreck of steel barque *Magnat* (1900) visible at low tide on Venus Bay beach. Early European coal mining and shacks. Sealing and whaling in early 1800s

Coastal development Harmers Haven, Cape Paterson, Inverloch, Venus Bay coastal towns. South Gippsland Regional Water Authority outfall pipeline southwest of Venus Bay. Venus Bay coast has very high vulnerability to erosion under climate change

Tourism and recreation Popular activities include diving, clifftop scenic views, beach activities, swimming, surfing, camping, fishing, walking and boating. Also horse riding, gemstone fossicking and shellfish collecting. Flat Rocks, Eagles Nest, Shack Bay, Twin Reefs, Cape Paterson, Harmers Haven popular for diving. Anderson Inlet Fisheries Reserve for recreational fishing. Recreational collection of pipis in Venus Bay. Surf life saving clubs at Cape Patterson, Inverloch, Wonthaggi, Venus Bay

Commercial fishing Commercial fisheries licences for eastern rock lobster zone, central abalone zone, eel. High greenlip abalone production. No aquaculture reserves or proposals for aquaculture

Ports and shipping No shipping routes. Anderson Inlet local port. Associated marine pollution risk is high

Energy Coal reserves at Cape Paterson. Potential for wave energy identified along this coast

Emerging uses

- Growth of tourism in Venus Bay limited by lack of available land and difficulties with wastewater management and water supply
- New Bunurong coastal park planned (joining up coastal Crown land from San Remo to Inverloch)

Threats

- Alterations in waves or currents affect seagrass productivity
- Sea level rise alters frequency of estuary mouth opening (Coal and Wreck creeks and Tarwin River seasonally closed)
- Sea level rise reduces area for seagrass, mangroves and saltmarsh where landward migration not possible
- Sea level rise changes coastal features (including inundation of beaches, intertidal and low-lying reefs) which affects shorebird and seabird resting, feeding and breeding habitats
- More frequent storm events and nutrient pulses entering estuary may cause algal growth and sedimentation, threatens seagrass
- Decreased freshwater flows alter frequency of estuary mouth opening and salinity regime. Impacts fish diversity or abundance and connectivity for fish that use fresh and marine waters
- Increases in hot, dry weather put beach nesting birds at risk from fires
- Increased ambient temperatures impact bull kelp

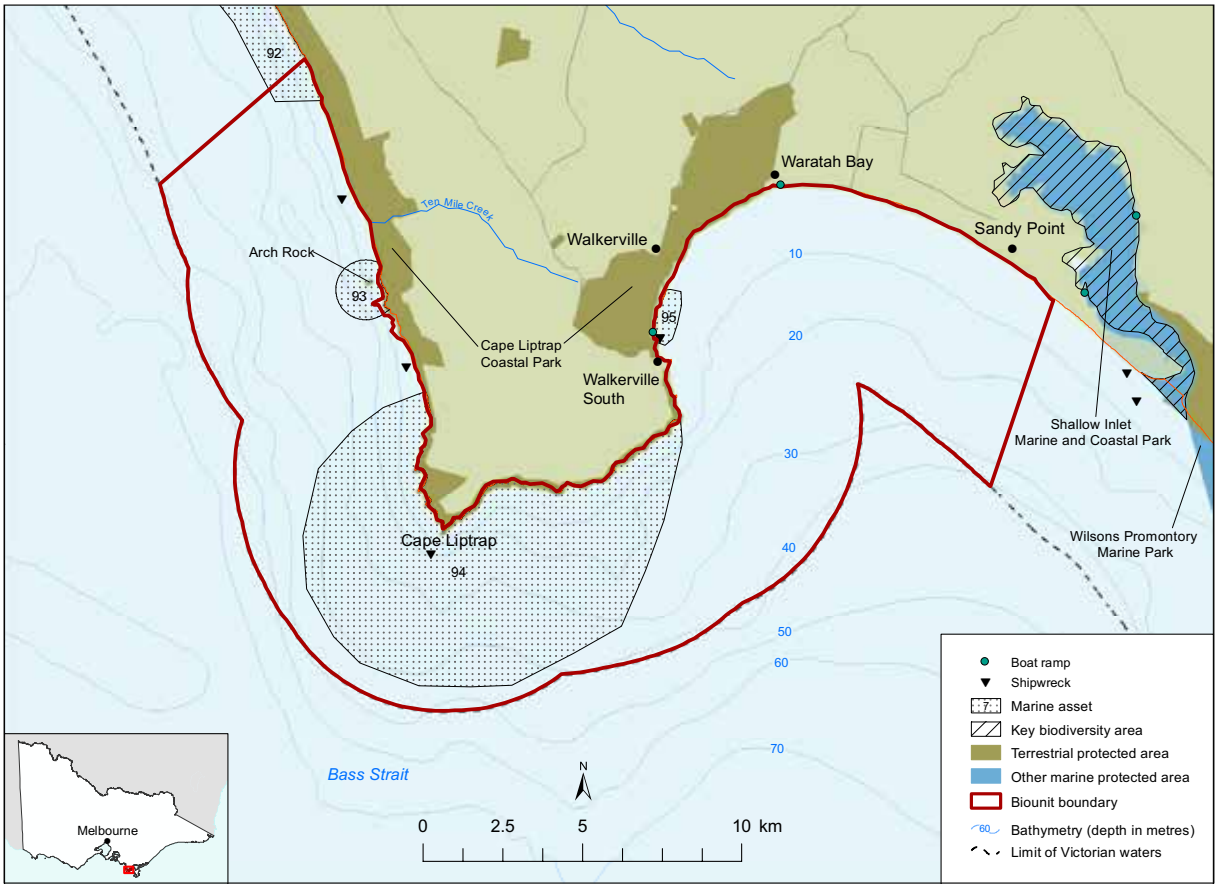
- Coastal saltmarsh, mangroves and intertidal reefs vulnerable to trampling, especially during warmer months
- Levee banks restrict tidal movement and landward migration of saltmarsh and mangroves

- Likely pests include green shore crab (intertidal areas), displaces local crabs
- Northern Pacific seastar previously recorded at Inverloch but controlled
- Introduced mammals prey on and disturb roosting, feeding and nesting birds and eggs (e.g. hooded plover)
- Cord grass *Spartina* invades saltmarsh, mangroves and mudflats binding sediments and altering mud habitat
- Sea spurge on coastal dunes
- Black sea urchin forms barrens devoid of habitat-forming macroalgae e.g. kelp. Concern about range expansion from current western limit at Wilsons Promontory
- Localised mollusc populations susceptible to over-exploitation (e.g. summer pipi collection at Venus Bay)
- Disturbance to beach nesting birds (e.g. hooded plover) through recreation (e.g. dogs, horses, vehicles, shore-based activities) leads to nesting failure

- Elevated nutrients and sediments (e.g. urban development Wonthaggi to Inverloch, poor condition of Screw Creek, moderate condition of Tarwin River) cause turbidity, reduce light levels, promote excess growth of algae, epiphytes and phytoplankton, decrease dissolved oxygen. Impacts include decline in seagrass cover, disturbance and burial of rhodoliths, reduced habitat quality of mud flats for migratory waders, decreased fish diversity/abundance (including harvested species), potential seafood contamination

- Urban areas covered by impervious surfaces, high stormwater runoff
- Growing urban areas (e.g. Wonthaggi to Inverloch) deliver excess freshwater and pollutants
- Litter and other debris from urban areas (e.g. Cape Paterson, Inverloch, Venus Bay) leads to entanglement in and ingestion of thin plastics by marine fauna

Biounit 14: Cape Liptrap



Physical setting

The 25,621 hectare Cape Liptrap biounit extends from southern Venus Bay (including The Arches) to the southeastern side of Waratah Bay. No marine protected areas or major estuaries. Eroded sedimentary rock outcrops (The Arches), basaltic headland (Cape Liptrap), moderately sheltered Waratah Bay. Habitats include high to moderate energy, wave dominated beaches and rocky headlands, sublittoral reef and sediments. Waratah Bay the eastern limit of Flindersian bioregion species, especially seaweeds. Significant rock stacks (Arch Rock MA 93) and small caves in calcarenite formations.

The Cape Liptrap biounit has been mapped only at the broad habitat level (68 per cent). The mapped component is predominantly sublittoral sediment with some infralittoral and circalittoral rock. Further mapping within the biounit should prioritise completing mapping at the broad habitat level so that mapping can begin at the biotope complex level. At the biotope complex level, effort should focus on infralittoral and circalittoral biotopes. Cape Liptrap biota relatively understudied, likely to include threatened or rare species.

Unique or rare biotopes include sea whip circalittoral rock biotopes.

Traditional Owners

- Current registered Gunaikurnai Federal Native Title application
- Numerous middens and other significant sites

Natural values

- Venus Bay beach (MA 92) important nesting and feeding area for hooded plover, also red-necked stint, great knot and sanderling
- Cape Liptrap subtidal reefs (MA 94) support high diversity of fish and invertebrates
- South Walkerville intertidal reefs (MA 95) support diverse marine life including molluscs, barnacles, and gastric brooding seastar of conservation concern
- Walkerville limestones hold diverse fossil fauna
- Conservation-listed communities and species (e.g. orange-bellied parrot), endemic or rare species (e.g. gastric brooding seastar) and species at distributional limit particularly vulnerable to environmental change

Social and economic values

European cultural heritage Remnants of burnt out lime kilns (1875–1926) in cliffs of Walkerville South. Cape Liptrap lighthouse. Shipwrecks around Cape Liptrap include *Duke of Wellington* (1853), *Cremona* (1853), *Greyhound* (1855), *Nautilus* (1856), *Bertha* (1870), *Four Winds* (1923), *Ada Burgess* (1934)

Coastal development Walkerville South, Waratah Bay, Sandy Point coastal towns. Relatively low level of development

Tourism and recreation Coastal views from vantage points including Cape Liptrap, Walkerville heathlands, Waratah Bay. Horse riding on beach. Swimming, surfing, camping, fishing, walking and boating are popular recreational activities. Other pastimes include gemstone fossicking (jasper and serpentine) and shellfish collecting. Surf life saving club at Waratah Beach. Surf spots at Waratah Bay and Sandy Point. Popular windsurfing area towards Sandy Point

Commercial fishing and aquaculture Commercial fisheries licences for eastern rock lobster zone, central abalone zone. No aquaculture reserves or proposals for aquaculture

Ports and shipping Heavy shipping routes pass Cape Liptrap. Associated marine pollution risk is moderate (in east) to high (in west)

Energy No proposals for wind, tidal or wave energy. No oil or gas exploration

Emerging uses

- Growth of tourism in Walkerville limited by lack of available land and difficulties with wastewater management and water supply

Threats

- Sea level rise changes coastal features (including inundation of beaches, intertidal reefs, low-lying reefs and islands) which affects shorebird and seabird resting, feeding and breeding habitats
- Increases in hot, dry weather put beach nesting birds at risk from fires

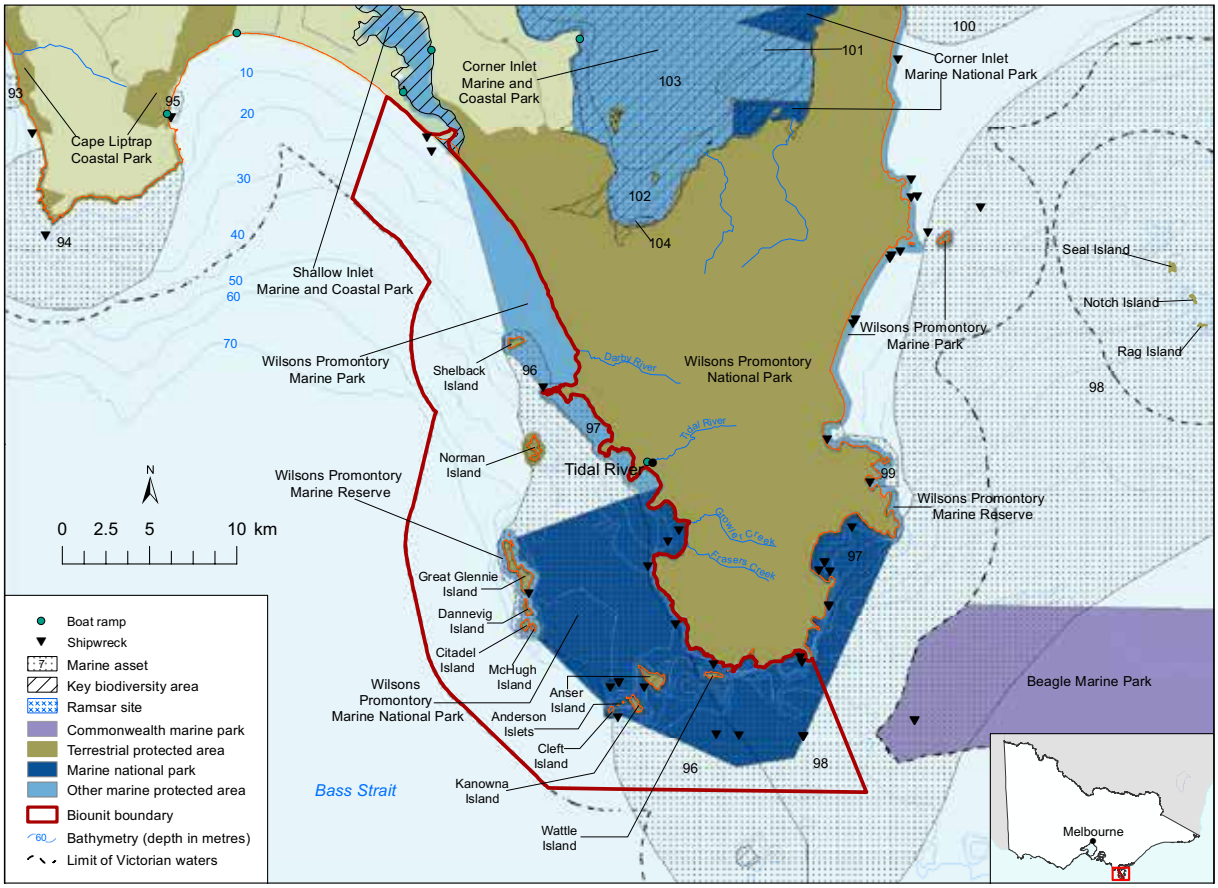
- Intertidal areas vulnerable to trampling, especially during warmer months

- Known pests include northern Pacific sea star, New Zealand screw shell (Waratah Bay), green shore crab
- Introduced mammals prey on and disturb roosting, feeding and nesting birds and eggs (e.g. hooded plover)
- Sea spurge on coastal dunes
- Black sea urchin forms barrens devoid of habitat-forming macroalgae e.g. kelp. Concern about range expansion from current western limit at Wilsons Promontory
- Localised mollusc populations susceptible to over-exploitation (e.g. summer pipi collection at Venus Bay)
- Disturbance to beach nesting birds (e.g. hooded plover) through recreation (e.g. dogs, horses, vehicles, shore-based activities) leads to nesting failure

- Elevated nutrients and sediments (e.g. seepage from septic tanks/domestic grey water systems in Walkerville) affects community structure and biodiversity of infauna at beaches, potential seafood contamination

- Marine debris and litter and other debris from urban areas leads to entanglement in and ingestion of thin plastics by marine fauna

Biounit 15: Wilsons Prom West



Physical setting

The 48,246 hectare Wilsons Prom West biounit extends from southern Waratah Bay to Southeast Point. It includes Wilsons Promontory Marine National Park (MNP) and three multiple-use marine protected areas: Shallow Inlet Marine and Coastal Park (MCP), Wilsons Promontory Marine Park (MP), Wilsons Promontory Marine Reserve (MR). There are three main estuaries: Shallow Inlet, Darby River, Tidal River. The biounit combines the southwest coast with very high exposure and clear water. Unique geoforms include high relief and high complexity granite, sand dune, pinnacles, walls and deep scour holes. Habitats include high to moderate energy, weak to strong tidal streams, high water clarity and light climate, complex circalittoral reefs, islands, pinnacles, and outcrops (Darby calcarenite reef), wave-dominated beaches and rocky headlands, extensive low-profile reef, extensive sediment beds, coastal inlet (Shallow Inlet), deep holes and sand waves. As Wilsons Promontory is the meeting point of the eastern and western marine biogeographic provinces of southern Australia, some 126 species are presumed to be at their distributional limit around the promontory. Southern Island biota relatively understudied, likely to include threatened/rare species. The Shallow Inlet sand spit and entrance is of state geological and geomorphological significance.

The Wilsons Prom West biounit has been mapped in some detail: 46 per cent at broad habitat level and 38 per cent at biotope complex level. Of the mapped areas, the dominant biotope complexes are circalittoral fine sand and mixed sediments and high energy kelp communities. Wilsons Promontory MNP is extensively mapped at biotope complex level (99 per cent). The main biotope complexes are circalittoral fine sand (45 per cent) and circalittoral mixed sediments (43 per cent). Wilsons Promontory MP has been mapped to biotope complex level (66 per cent). The main biotopes are circalittoral fine sand (44 per cent) and high energy common kelp/cray weed communities. Wilsons Promontory MR has been mapped to biotope complex level (64 per cent). Circalittoral fine sand (26 per cent) and moderate to high complexity circalittoral rock with covering of small colonies and well spaced erect sponges (9 per cent) are the main biotope complexes. Only 2 per cent of Shallow Inlet MCP has been mapped to broad habitat level and this is sublittoral sediment. Further mapping within the biounit should prioritise circalittoral biotopes including sponge, bryozoan, rock (granite, shell hash, sediment, deep holes).

The entire biounit has high biodiversity and biotope richness. Unique or rare biotopes include:

- Brown algae: macroalgae communities dominated by cray weed and common kelp, high energy common kelp communities
- Sessile invertebrates: high-energy circalittoral rock with bushy branching and low erect sponges, moderate to high complexity circalittoral rock with covering of small colonies and well-spaced erect sponges
- Infralittoral and circalittoral rock (granite, shell hash, sediment, deep holes)
- Sandy low-profile reef wave surge communities

Traditional Owners

- Current registered Gunaikurnai Federal Native Title application

Natural values

- Open sea pelagic environment (MA 98) important for conservation-listed juvenile great white shark, southern right whale, humpback whale, killer whale, bottlenose dolphin, common dolphin, leopard seal, leatherback and green turtles
- Breeding population Australian fur seals (Kanowna Island, Anderson Islets), haul out sites (Norman Island), small breeding colony long-nosed fur seal (Kanowna Island)
- Shallow Inlet KBA mudflats and sandy intertidal areas habitat for shorebirds (curlew sandpiper, double-banded plover, Pacific golden plover, pied oystercatcher, red-capped plover, red-necked stint, sanderling) and orange-bellied parrot
- Wilsons Promontory Islands KBA nesting habitat for shorebirds (hooded plover), seabirds (black-faced cormorant, Caspian tern, fairy prion, little penguin, Pacific gull, short-tailed shearwater, white-bellied sea-eagle)
- Fish communities usually dominated by barber perch, blue-throated wrasse, purple wrasse, long-finned pike, herring cale. Western/eastern fish communities, herring cale dominant in west. Deepwater habitat (MA 97) supports high reef fish biomass including butterfly and magpie perch, leatherjackets, morid cod
- Wilsons Promontory south islands (MA 96: Shellback and Norman islands, Glennie group, Anser group, Rodondo Island) support wall and pinnacle reef habitats uncommon elsewhere in Victoria, highly productive due to water clarity, high diversity of epifauna (sponges, stalked ascidians, sea whips)
- Two distinct invertebrate communities: south east (typically *Nectria macrobranchia* dominant), north west (typically *Patiriella brevispina* and *P. vernicina* dominant)
- Snapping shrimp (*Alpheus australosulcatus*) (Leonard Bay), four molluscs endemic to Wilsons Promontory MNP (*Liotella vercoi*, *Cystiscus halli*, *Eulima styliformis*, *E. victoriae*)
- Mangrove and saltmarsh in Shallow Inlet
- Seagrass meadows on subtidal soft sediment in sheltered bays (*Zostera* spp. in Oberon Bay)
- High energy wave exposed rock faces and resulting high water clarity support cray weed/common kelp dominated macro algae community up to 30 metres depth
- Wilsons Promontory Biosphere Reserve recognises a granite massif with prominent peaks, outcrops and headlands flanked by extensive swamps, dune deposits and beaches as well as fifteen islands
- Conservation-listed communities and species (e.g. snapping shrimp), endemic or rare species (e.g. molluscs) and species at distributional limit particularly vulnerable to environmental change

Social and economic values

European cultural heritage Whaling and sealing industry (Refuge and Home Coves) in 1800s. At least 28 shipwrecks in the area. Lighthouse at Southeast Point built in 1859 and still operational

Coastal development Sandy Point township and Tidal River resort. Tourism-associated development within Wilsons Promontory National Park

Tourism and recreation Wilsons Promontory National Park activities include sightseeing, camping, general beach activities, coastal bushwalking. Wilsons Promontory Marine National Park activities include scuba diving and snorkelling, sightseeing, camping aboard vessels, and fishing (including spear fishing) in the marine park and marine reserve. Sea kayaking increasingly popular. Boating, fishing, kitesurfing and windsurfing popular in Shallow Inlet MCP. Boat launching from vehicles on beach in Shallow Inlet. Surf spots at Darby Beach, Squeaky Beach, Norman Bay. Popular dive sites between Great Glennie and Kanowna islands

Commercial fishing and aquaculture Commercial fisheries licences for eastern rock lobster zone, central abalone zone. No aquaculture reserves or proposals for aquaculture

Ports and shipping Heavy shipping routes along southern tip of Wilsons Promontory. Associated marine pollution risk is high

Energy No proposals for wind, tidal or wave energy. No oil or gas extraction

Emerging uses

- Guided ecotours and fishing charters are expected to increase in popularity
- Growth in tourism at Tidal River

Threats

- Alterations in waves or currents affects pelagic fish populations, seagrass productivity
- Sea level rise alters frequency of estuary mouth opening (e.g. Darby and Tidal rivers, Growler Creek seasonally closed)
- Sea level rise reduces area for seagrass, mudflats, mangroves and saltmarsh where landward migration not possible
- Sea level rise changes coastal features (including inundation of beaches, intertidal areas, low-lying reefs and islands) which affects shorebird, seabird and seal resting, feeding and breeding habitats
- More frequent storm events and nutrient pulses entering estuaries may cause algal growth and sedimentation, threatening seagrass
- Decreased freshwater flows alter frequency of estuary mouth opening and salinity regime. Impacts fish diversity or abundance and connectivity for fish that use fresh and marine waters
- High rainfall events result in land run off of nutrients and sediments. Predicted to become more frequent severe, detrimental to mudflats and deep water habitats
- Increases in hot, dry weather put beach nesting birds at risk from fires
- Temperatures above 35°C detrimental to penguins on land and in burrows. Prolonged exposure causes heat stress and mortality

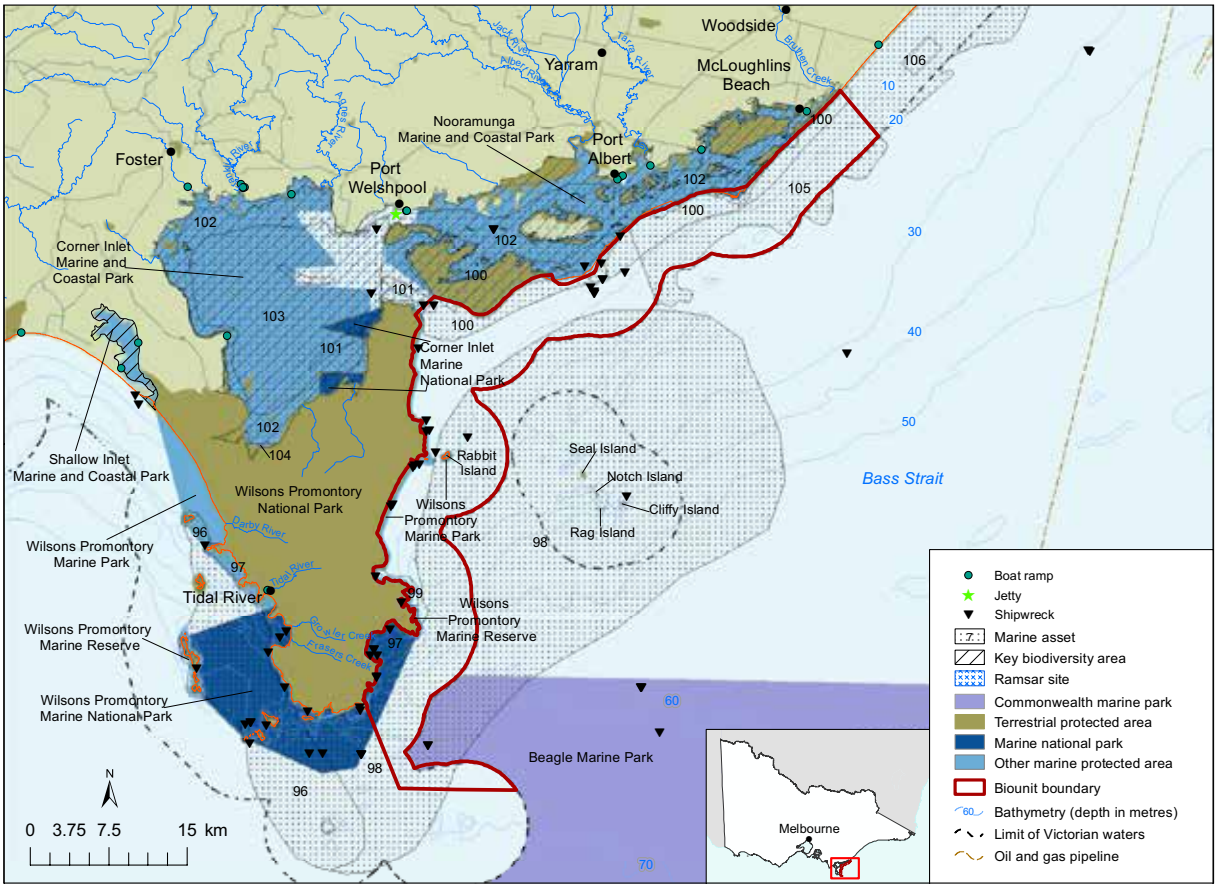
- Coastal saltmarsh and mangroves vulnerable to trampling, especially during warmer months
- Seagrass beds and mudflats sensitive to propeller scarring and vessel groundings in shallow water (especially at low tide) and anchor damage
- Sandy beach biota and shorebirds vulnerable to impacts from vehicles on beach (compaction of sediments and disturbance)

- Known pests include green shore crab, bryozoan *Bugula neritina* (south-east Wilsons Promontory MNP), Pacific oyster (Tidal River), northern Pacific seastar (controlled in Tidal River estuary in 2012)
- Pests of concern include New Zealand seastar and screw shell (occur in Shallow Inlet, Point Hicks and Cape Howe marine protected areas), European fan worm, Japanese kelp and broccoli weed
- Introduced mammals prey on and disturb roosting, feeding and nesting birds and eggs (e.g. hooded plover)
- Black sea urchin forms barrens devoid of habitat-forming macroalgae e.g. kelp
- Disturbance to breeding seals (October to December) leads to crushed or drowned pups, loss of territory by bulls
- Disturbance to beach nesting birds (e.g. hooded plover) through recreation (e.g. dogs, horses, vehicles, shore-based activities) leads to nesting failure

- Elevated nutrients and sediments (e.g. agricultural runoff, moderate condition of Tidal River estuary, seepage from wastewater treatment at Tidal River) cause turbidity, reduce light levels, promote excess growth of algae, epiphytes and phytoplankton, decrease dissolved oxygen. Impacts include decline in seagrass cover, reduced habitat quality of mud flats for migratory waders, decreased fish diversity/abundance (including harvested species), reduced condition of subtidal rocky reef and communities at Norman Bay, potential seafood contamination

- Agricultural use of herbicides and pesticides threaten mudflat communities
- Proximity to shipping lanes and use by recreational boats increase vulnerability to oil or chemical spills. Minor oil spills previously occurred in area. Impacts include oiling of seabirds, oil accumulation over intertidal areas, contamination of ground or surface water, loss of recreation
- Marine debris and litter and other debris from tourist areas (e.g. Tidal River) leads to entanglement in and ingestion of thin plastics by marine fauna

Biounit 16: Wilsons Prom East



Physical setting

The 60,387 hectare Wilsons Prom East biounit extends from Southeast Point to east of Nooramunga. It contains the Wilsons Promontory Marine National Park (MNP) and two multiple-use marine protected areas: Wilsons Promontory Marine Reserve (MR), Wilsons Promontory Marine Park (MP). The biounit abuts the Commonwealth multiple-use Beagle Marine Park. The low clarity water is strongly influenced by Corner Inlet waters. The area is sheltered from the southwest but exposed to easterlies. Unique geoforms occur within the biounit including high relief and high complexity granite, sand dunes, pinnacles, walls and deep scour holes. Habitats include high to moderate energy, weak to strong tidal streams, low water clarity and light climate, circalittoral reefs, wave dominated beaches and rocky headlands, extensive muddy sediment beds (MA 100) and sediment waves. Wilsons Promontory is the meeting point of the eastern and western marine biogeographic provinces of southern Australia and at least 126 species within the promontory are presumed to be at their distributional limit.

The Wilsons Prom East biounit has been mapped in some detail: 74 per cent at the broad habitat level and 12 per cent at the biotope complex level. Circalittoral fine sand is the main biotope complex. Wilsons Promontory MP has been mapped to biotope complex (66 per cent). The main biotopes are circalittoral fine sand (44 per cent) and high-energy common kelp/cray weed communities. Wilsons Promontory MR has been mapped to biotope complex level (64 per cent). Circalittoral fine sand (26 per cent) and moderate to high complexity circalittoral rock with covering of small colonies and well-spaced erect sponges (9 per cent) are the main biotope complexes. Wilsons Promontory MNP is almost completely mapped at biotope complex level (99 per cent). The main biotope complexes are circalittoral fine sand (45 per cent) and circalittoral mixed sediments (43 per cent). Further mapping within the biounit should prioritise completing mapping at the broad habitat level (26 per cent of biounit) so that more extensive mapping can occur at the biotope complex level. At the biotope complex level, further work should focus on circalittoral biotopes including sponge, bryozoan and rock (granite, shell hash, sediment, deep holes).

The entire biounit has high biodiversity and biotope richness. Unique or rare biotopes include:

- Seagrasses: *Posidonia australis* beds, *Zostera* spp. and *Ruppia* spp. beds
- Brown algae: highly persistent kelp, common kelp assemblages on moderate energy rock
- Sessile invertebrates: high energy circalittoral rock with bushy branching and low erect sponges, moderate to high complexity circalittoral rock with covering of small colonies and well spaced erect sponges
- Infralittoral and circalittoral rock (granite, shell hash, sediment, deep holes)

Traditional Owners

- Part of the Sea Country of Gunaikurnai
- Additional area subject to current registered Gunaikurnai Federal Native Title application
- Increased participation of Traditional Owners in land management and decision making. Gunaikurnai Whole-of-Country Plan will be amended in 2019 with increased focus on sea birds

Natural values

- Open sea pelagic environment (MA 98) important for conservation-listed juvenile great white shark, southern right whale, humpback whale, killer whale, bottlenose dolphin, common dolphin, leopard seal, leatherback and green turtles
- Refuge Cove to Sealers Cove (MA 99) important thresher shark pupping, nursery and aggregation area
- Wilsons Promontory Islands KBA nesting habitat for shorebirds (hooded plover), seabirds (black-faced cormorant, caspian tern, fairy prion, little penguin, Pacific gull, short-tailed shearwater, white-bellied sea-eagle)
- Fish communities usually dominated by barber perch, blue-throated wrasse, purple wrasse, long-finned pike, herring cale. Western/eastern fish communities, herring cale dominant in west. Deepwater habitat (MA 97) supports high reef fish biomass including butterfly and magpie perch, leatherjackets, morid cod
- Unusual sponge and sea whip communities (South East Point, Church Rocks)
- Mudflats (MA 100) highly productive. Microphytobenthos (benthic microalgae) present in top millimetres of oxygenated sediments, support diverse benthic invertebrates. Significant feeding ground for resident and migratory birds
- Two distinct invertebrate communities: south east (typically *Nectria macrobranchia*), north west (typically *Patiriella brevispina* and *P. vernicina*)
- Snapping shrimp (*Alpheus australosulcatus*) (Horn Point), four molluscs endemic to MNP (*Liotella vercoi*, *Cystiscus halli*, *Eulima styliformis*, *E. victoriae*)
- Port Albert to Lakes Entrance sandy plain (MA 105) most diverse benthic infauna communities recorded, including ghost shrimp (*Biffarius arenosus*, *Trypaea australiensis*)
- Seagrass meadows on subtidal soft sediment in sheltered bays (*Amphibolis antarctica* and *Halophila australis* in Waterloo Bay). Extensive dieback of *Posidonia australis* beds since 1970s. Currently at risk from white sea urchin outbreaks. *A. antarctica* relatively long-lived, horizontal recolonisation takes decades
- High abundance subtidal algae (Refuge Cove)
- Wilsons Promontory Biosphere Reserve recognises a granite massif with prominent peaks, outcrops and headlands flanked by extensive swamps, dune deposits and beaches as well as fifteen islands
- Conservation-listed communities and species (e.g. snapping shrimp) and species at distributional limit particularly vulnerable to environmental change

Social and economic values

European cultural heritage Sealers and whalers from late 1700s (Sealers, Refuge and Home coves). At least 28 shipwrecks in the area. Lighthouse at Southeast Point built in 1859 and still operational. Shipwreck Protection Zone around *PS Clonmel* (1841), the wrecking of which led to the opening up of Gippsland for European settlement

Coastal development Negligible

Tourism and recreation Wilsons Promontory MNP, Wilsons Promontory National Park popular tourist destinations. Popular tourist activities in the national park including sightseeing, camping, general beach activities, coastal bushwalking. The main activities in the Wilsons Promontory MNP are scuba diving and snorkelling, sightseeing, picnicking, camping aboard vessels, and fishing in the marine park and marine reserve. Sea kayaking increasingly popular. Surfing at Waterloo Bay, Sealers Cove. Dive sites at Rodonda Island, Horn Point

Commercial fishing and aquaculture Commercial fisheries licences for eastern rock lobster zone, central abalone zone. No aquaculture reserves or proposals for aquaculture

Ports and shipping Heavy shipping routes along southern tip of Wilsons Promontory. Associated marine pollution risk is high in the south to moderate in the north. Vessels servicing the Bass Strait oil and gas fields use the Barry Beach Marine Terminal in Corner Inlet

Energy No proposals for wind, tidal or wave energy. No oil or gas extraction. The proposed ‘Star of the South’ offshore wind farm will be developed in adjacent Commonwealth waters

Emerging uses

None identified

Threats

- Alterations in waves or currents affects pelagic fish populations, seagrass productivity
- Sea level rise alters frequency of estuary mouth opening (e.g. Sealer and Miranda Creeks seasonally closed)
- Sea level rise reduces area for seagrass, mudflats, mangroves and saltmarsh where landward migration not possible
- Sea level rise changes coastal features (including inundation of beaches, intertidal areas, low-lying reefs and islands) which affects shorebird, seabird and seal resting, feeding and breeding habitats
- More frequent storm events and nutrient pulses entering estuaries may cause algal growth and sedimentation, threatening seagrass
- Decreased freshwater flows alter frequency of estuary mouth opening and salinity regime. Impacts fish diversity or abundance and connectivity for fish that use fresh and marine waters
- High rainfall events result in land run off of nutrients and sediments. Predicted to become more frequent/severe, detrimental to mudflats and deep water habitats
- Increases in hot, dry weather put beach nesting birds at risk from fires
- Temperatures above 35°C detrimental to penguins on land and in burrows. Prolonged exposure causes heat stress and mortality

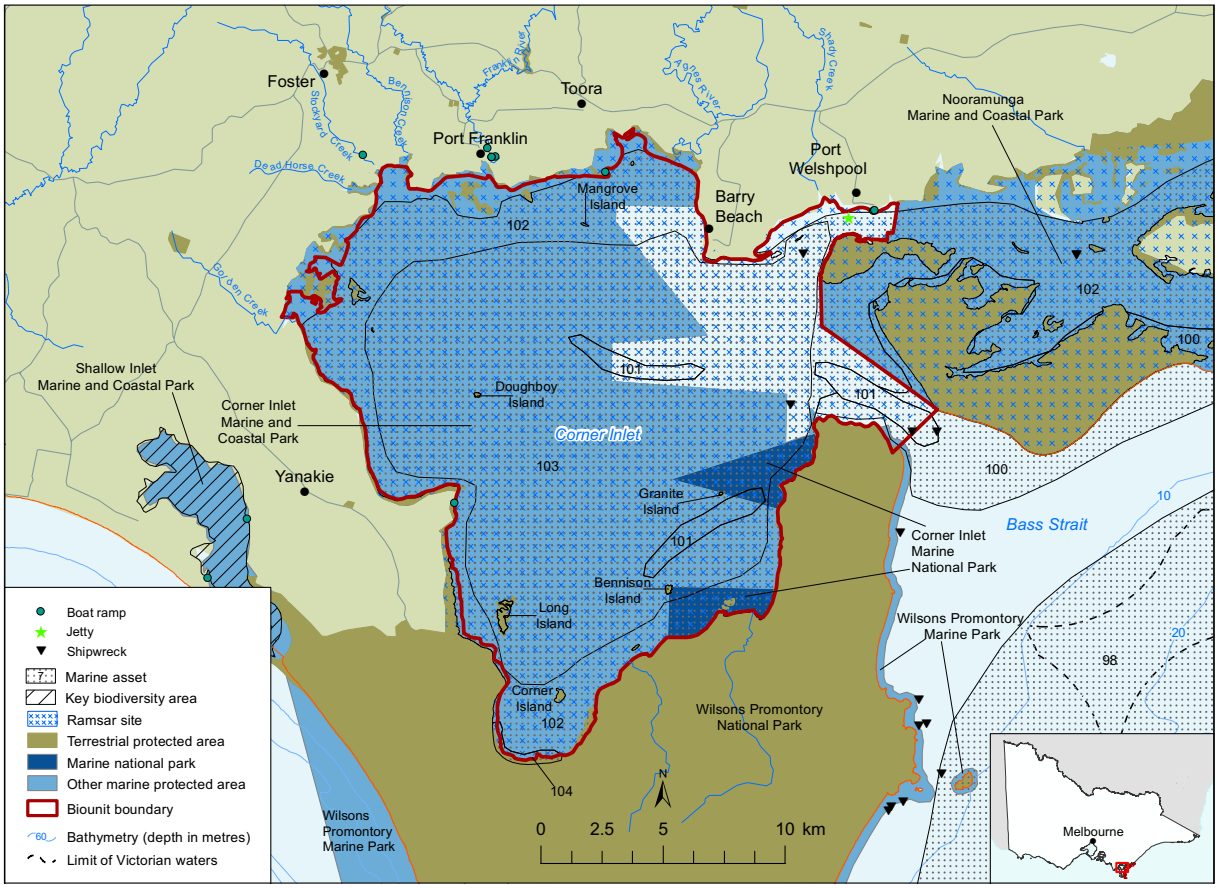
- Seagrass beds and mudflats sensitive to propeller scarring and vessel groundings in shallow water (especially at low tide) and anchor damage

- Known pests include green shore crab, bryozoan *Bugula neritina* (south-east Wilsons Promontory MNP), Pacific oyster (Tidal River), northern Pacific seastar (controlled in Tidal River estuary in 2012)
- Pests of concern include New Zealand seastar and screw shell (occur in Shallow Inlet, Point Hicks and Cape Howe marine protected areas), European fan worm, Japanese kelp and broccoli weed
- Introduced mammals prey on and disturb roosting, feeding and nesting birds and eggs (e.g. hooded plover)
- Black sea urchins form barrens devoid of habitat-forming macroalgae e.g. kelp
- Disturbance to beach nesting birds (e.g. hooded plover) through recreation (e.g. dogs, horses, vehicles, shore-based activities) leads to nesting failure

- Elevated nutrients and sediments (e.g. agricultural runoff, tidal exchange with Corner Inlet) cause turbidity, reduce light levels, promote excess growth of algae, epiphytes and phytoplankton, decrease dissolved oxygen. Impacts include decline in seagrass cover, reduced habitat quality of mud flats for migratory waders, decreased fish diversity/abundance (including harvested species), reduced condition of subtidal rocky reefs, potential seafood contamination

- Proximity to east-west Bass Strait shipping lane, entrance to ports in Corner Inlet and use by recreational boats increase vulnerability to oil or chemical spills. Minor oil spills previously occurred in area. Impacts include oiling of seabirds, oil accumulation over intertidal areas, contamination of ground or surface water, loss of recreation

Biounit 17: Corner Inlet



Physical setting

The 36,232 hectare Corner Inlet biounit is bounded by the Nooramunga Marine and Coastal Park (MCP) in the east and the entrance to the embayment in the southeast. It includes the Corner Inlet Marine National Park (MNP) and the multiple-use Corner Inlet MCP. There are three major estuaries: Franklin River, Agnes River, Chinamans Creek. The sheltered embayment has a network of dendritic channels and shallow beds and also includes littoral sediment flats, circalittoral rock and granite islands. Habitats include low energy, moderate to strong tidal streams, sand flats, banks and channels, circalittoral rock biotopes, seagrass beds, biogenic reef in channels (MA 101), mangroves and saltmarsh. Eleven species are presumed to be at their distributional limit in the biounit

The Corner Inlet biounit has been mapped at broad habitat (78 per cent) and biotope complex (70 per cent) levels. Infralittoral bare mixed sediments and seagrass beds dominate the biotope complexes mapped to a finer scale. Corner Inlet MCP has been mapped to biotope complex (75 per cent) and has the same mix of biotopes as the entire biounit. Corner Inlet MNP has been mapped to biotope complex (60 per cent). Seagrass beds (27 per cent) and infralittoral bare mixed sediments (23 per cent) dominate. Further mapping within the biounit should prioritise *Posidonia australis* seagrass distribution, channel non-reef forming epibiota and circalittoral reef and sediments.

Unique or rare biotopes include:

- Terrestrial: white mangrove
- Seagrasses: *Posidonia australis* beds, *Zostera* spp. and *Ruppia* spp. beds
- Circalittoral reef

Traditional Owners

- Part of the Sea Country of the Gunaikurnai
- Increased participation of Traditional Owners in land management and decision making. Gunaikurnai Whole-of-Country Plan will be amended in 2019 with increased focus on sea birds

Natural values

- Records for conservation-listed southern right and humpback whales
- Over 30 species of resident (e.g. pied and sooty oystercatchers) and migratory shorebirds (e.g. bar-tailed godwit, great knot) and seabirds (e.g. little tern) recorded at Corner Inlet. Significance recognised in Corner Inlet Ramsar site and KBA. Important for chestnut teal and black swan
- Scallops and epibiota in channels (MA 101) provide extensive habitat for fishes, rays, sharks. Inshore sandy areas east of Wilsons Promontory important feeding areas for gummy shark pups
- Only location where *Posidonia australis* forms large seagrass meadows (MA 103). Seagrass meadows with four species (including *Zostera* spp. MA 102, *P. australis*) habitat for commercial and recreational fish (King George whiting, garfish, rock flathead). Extensive dieback of *P. australis* beds since 1970s, especially in western Corner Inlet. Long lived, recolonises only by patch expansion. Currently at risk from white sea urchin outbreaks
- Conservation-listed brittle stars (*Amphiura triscacantha*, *Ophiocomina australis*) and sea cucumber (*Trochodota shepherdi*)
- Mudflats (MA 100) highly productive. Microphytobenthos (benthic microalgae) present in top mm of oxygenated sediments, support diverse benthic invertebrates. At least 39 fish species recorded over mudflats
- Most southerly population of mangroves in the world (MA 104)
- Coastal saltmarsh in Miranda Creek important habitat for orange-bellied parrot
- Wilsons Promontory Biosphere Reserve recognises a granite massif with prominent peaks, outcrops and headlands flanked by extensive swamps, dune deposits and beaches as well as fifteen islands
- Conservation-listed communities and species (e.g. brittle star), endemic or rare species (e.g. *Posidonia australis*) and species at distributional limit particularly vulnerable to environmental change

Social and economic values

European cultural heritage Chinese fishers fished here in the 1860s and smoked fish for sale on Victorian goldfields. Shipwrecks

Coastal development Yanakie, Port Franklin, Toora, Port Welshpool townships. Yanakie, Port Franklin, Toora and Port Welshpool provide access to Corner Inlet and Bass Strait. Wastewater outfalls for Toora, Foster and Welshpool

Tourism and recreation Important recreational fishery. Opportunities for a range of recreational activities on remote areas of coastline including boat-based touring opportunities and diving

Commercial fishing and aquaculture Commercial fisheries licences for eastern rock lobster zone, central abalone zone, 18 Corner Inlet commercial fishery licences. No aquaculture reserves or proposals for aquaculture

Ports and shipping Barry Beach and Port Welshpool local ports. Shelter for larger commercial and recreational vessels during easterly weather. Associated marine pollution risk is high

Energy Barry Beach Marine Terminal main supply depot for oil and gas exploration in Gippsland Basin. Entrance to Corner Inlet has potential for tidal energy

Emerging uses

Growth of recreational fishing and ecotourism

Threats

- Alterations in waves or currents affects pelagic fish populations, seagrass productivity
- Sea level rise alters frequency of estuary mouth opening (e.g. Chinamans Creek seasonally closed)
- Sea level rise reduces area for seagrass, mudflats, mangroves and saltmarsh where landward migration not possible
- Sea level rise changes coastal features (including inundation of beaches, intertidal areas, low-lying reefs and islands) which affects shorebird and resting, feeding and breeding habitats
- More frequent storm events and nutrient pulses entering estuaries may cause algal growth and sedimentation, threatening seagrass
- Decreased freshwater flows alter frequency of estuary mouth opening and salinity regime. Impacts fish diversity or abundance and connectivity for fish that use fresh and marine waters
- High rainfall events result in land run off of nutrients and sediments. Predicted to become more frequent/severe, detrimental to mudflats and deep water habitats
- Increases in hot, dry weather put beach nesting birds at risk from fires

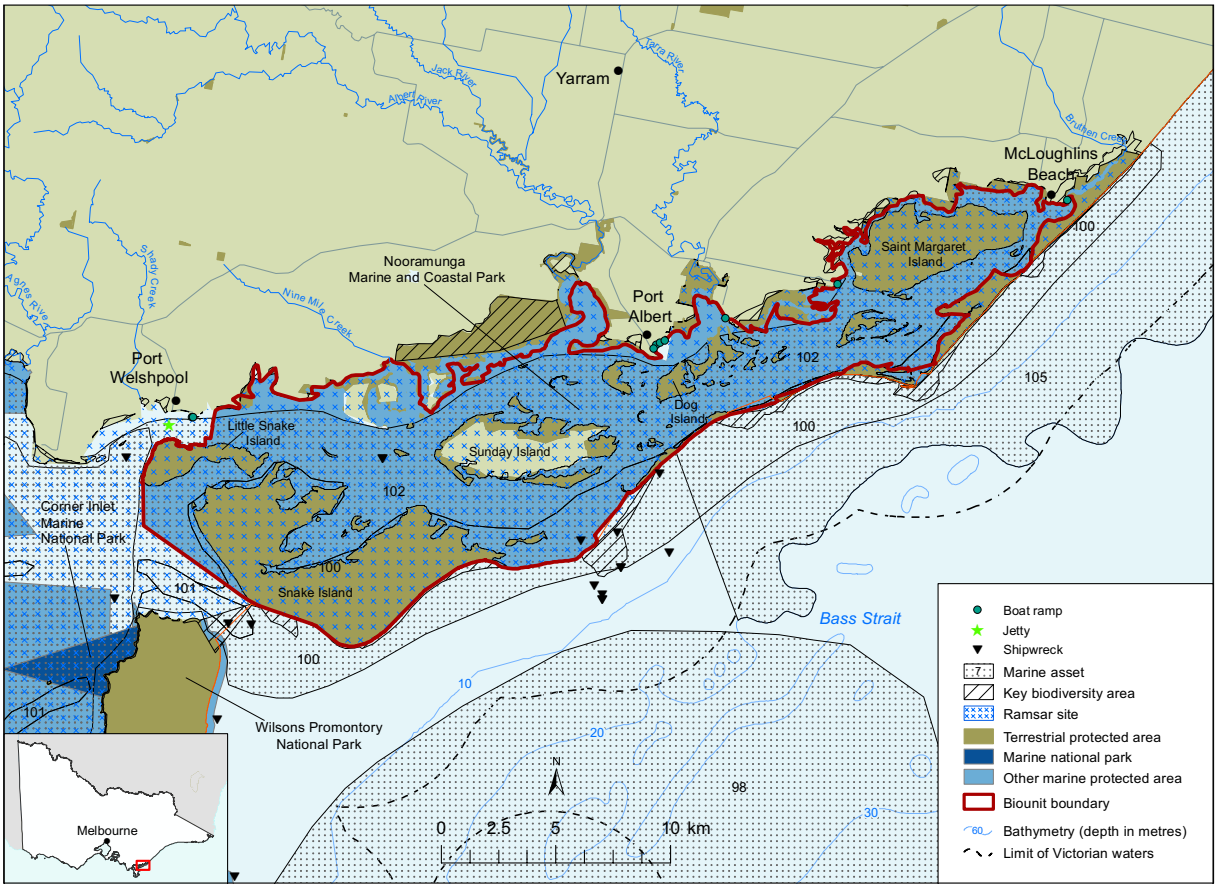
- Coastal modifications (e.g. dredging, sea walls) may alter patterns of longshore drift, deposition, erosion. Impacts include depressed breeding of fish such as shark and flounder, impaired function of infauna communities and altered hydrodynamic processes
- Dredging to allow passage of more or larger ships causes turbidity, sedimentation, reduces light penetration, alters wave patterns, mobilises toxins from polluted sediments. Impacts include decreased sessile invertebrate feeding efficiency and impaired function of infauna communities
- Levee banks restrict tidal movements and landward migration of saltmarsh and mangroves
- Coastal saltmarsh and mangroves vulnerable to trampling, especially during warmer months
- Seagrass beds and mudflats sensitive to propeller scarring and vessel groundings in shallow water (especially at low tide) and anchor damage

- Known pests include green shore crab, Pacific oyster, New Zealand screw shell and broccoli weed
- Pests of concern include include northern Pacific seastar, European fan worm and Japanese kelp
- Introduced mammals prey on and disturb roosting, feeding and nesting birds and eggs (e.g. hooded plover)
- Cordgrass *Spartina* widespread in south Gippsland, including northern Corner Inlet. Aggressively invades saltmarsh, mangroves and mudflats binding sediments and altering mud habitat
- Black sea urchin forms barrens devoid of habitat-forming macroalgae e.g. kelp
- At high density, native white sea urchin also creates urchin barrens where erect macroalgae (e.g. kelp) and seagrass usually absent. Unclear whether recent increases part of a natural cycle or persistent increase
- Disturbance to beach nesting birds (e.g. hooded plover), through recreation (e.g. dogs, horses, vehicles, shore-based activities) leads to nesting failure

- Elevated nutrients and sediments (e.g. nutrient runoff from feed lots near Yanakie; moderate condition of Franklin and Agnes rivers; 30 stormwater and agricultural drains and three treated wastewater outfalls discharge into Corner Inlet) cause turbidity, reduce light levels, promote excess growth of algae, epiphytes and phytoplankton, decrease dissolved oxygen. Impacts include decline in seagrass cover, reduced habitat quality of mud flats for migratory waders, reduced mangrove health, decreased fish diversity and abundance (including harvested species), potential seafood contamination
- Western end of Corner Inlet particularly susceptible to sediment run-off during high rainfall
- Land clearing (logging of plantations) in catchment leads to increased storm water runoff, nutrient and sediment input, groundwater salinity, freshwater diversion, impacting water quality and seagrass

- Agricultural use of herbicides and pesticides threaten mudflat communities

Biounit 18: Nooramunga



Physical setting

The 17,682 hectare Nooramunga biounit extends from east of Port Welshpool and north of multiple barrier islands and includes the multiple-use Nooramunga Marine and Coastal Park (MCP). There are two major estuaries (Albert and Tarra rivers). The sheltered embayment with channels has numerous sandy islands (including Little Snake, Sunday and Saint Margaret islands) and barrier islands (including Snake Island, Clonmel Island, Box Bank, Dream Island). Habitats include low energy, moderate to strong tidal streams, sand flats, banks and channels, seagrass beds, mangroves and saltmarsh. The area is of national geomorphological significance as an example of barrier island formation.

The Nooramunga biounit has been mapped at the broad habitat (69 per cent) and biotope complex (61 per cent) levels. The dominant biotope complexes within mapped areas are infralittoral bare mixed sediments and seagrass beds. As the Nooramunga MCP has very similar boundaries to the biounit, the distribution of mapped biotope complexes within the marine and coastal park is the same. Further mapping within the biounit should prioritise *Posidonia australis* seagrass distribution, channel non-reef forming epibiota and circalittoral reef and sediments.

Unique or rare biotopes include:

- Terrestrial: estuarine scrub, white mangrove
- Seagrass: *Posidonia australis* beds, *Zostera* spp. and *Ruppia* spp. beds
- Circalittoral reef

Traditional Owners

- Part of the Sea Country of the Gunaikurnai
- Increased participation of Traditional Owners in land management and decision making. Gunaikurnai Whole-of-Country Plan will be amended in 2019 with increased focus on sea birds

Natural values

- Over 30 species of resident (inc. pied and sooty oystercatchers) and migratory (e.g. bar-tailed godwit, great knot) shorebirds and seabirds (e.g. little tern) recorded at Corner Inlet. Significance recognised in the Corner Inlet Ramsar site and KBA
- At least 39 fish species recorded over mudflats
- Inshore sandy areas east of Wilsons Promontory important feeding areas for gummy shark pups
- Seagrass meadows (*Zostera* spp. MA 102) habitats for commercial and recreational fish (e.g. King George whiting, garfish, rock flathead). Extensive dieback of *Posidonia australis* beds since 1970s, especially in western Corner Inlet. Long lived, recolonises only by patch expansion. Currently at risk from white sea urchin outbreaks
- Mangrove nursery areas provide food and shelter from predation for juvenile fish, saltmarsh on landward side of mangroves
- Scallops and epibiota in channels (MA 101)

- Mudflats (MA 100) highly productive. Microphytobenthos (benthic microalgae) present in top millimetres of oxygenated sediments, support diverse benthic invertebrates
- Port Albert to Lakes Entrance sandy plain (MA 105) most diverse benthic infauna communities recorded, include ghost shrimp *Biffarius arenosus* and *Trypaea australiensis*
- Endemic or rare species (e.g. ghost shrimp) particularly vulnerable to environmental change

Social and economic values

European cultural heritage Shipwrecks. Port Albert is one of Victoria's oldest seaports, established in 1841. Life boat to assist shipwrecks installed at Port Albert in 1859

Coastal development Port Albert and Robertsons Beach, Manns Beach, McLouglins Beach coastal settlements. Some 65 kilometres of levees protect low-lying coastal flats, requiring substantial investment to maintain effectiveness

Tourism and recreation Significant recreational fishery boat and shore-based. Dispersed bush camping on some islands (Snake, Little Snake, Saint Margaret islands) and overnight hiking. Port Albert yacht club

Commercial fishing and aquaculture Commercial fisheries licences for eastern rock lobster zone, central abalone zone, eel, 18 Corner Inlet commercial fishery licences. No aquaculture reserves or proposals for aquaculture

Ports and shipping Port Albert township with local port and access areas, navigation channels. Associated marine pollution risk is low

Energy Gippsland Basin offshore. Proposal for wind farm 'Star of the South' in Commonwealth waters 10 to 20 kilometres offshore

Emerging uses

Growth of recreational fishing and ecotourism

Threats

- Alterations in waves or currents affects pelagic fish populations, seagrass productivity
- Sea level rise changes coastal features (including inundation of beaches, intertidal areas, low-lying reefs and islands) which affects shorebird and resting, feeding and breeding habitats
- More frequent storm events and nutrient pulses entering estuaries may cause algal growth and sedimentation, threatening seagrass
- High rainfall events result in land run off of nutrients and sediments. Predicted to become more frequent/severe, detrimental to mudflats and deep water habitats
- Increases in hot, dry weather put beach nesting birds at risk from fires

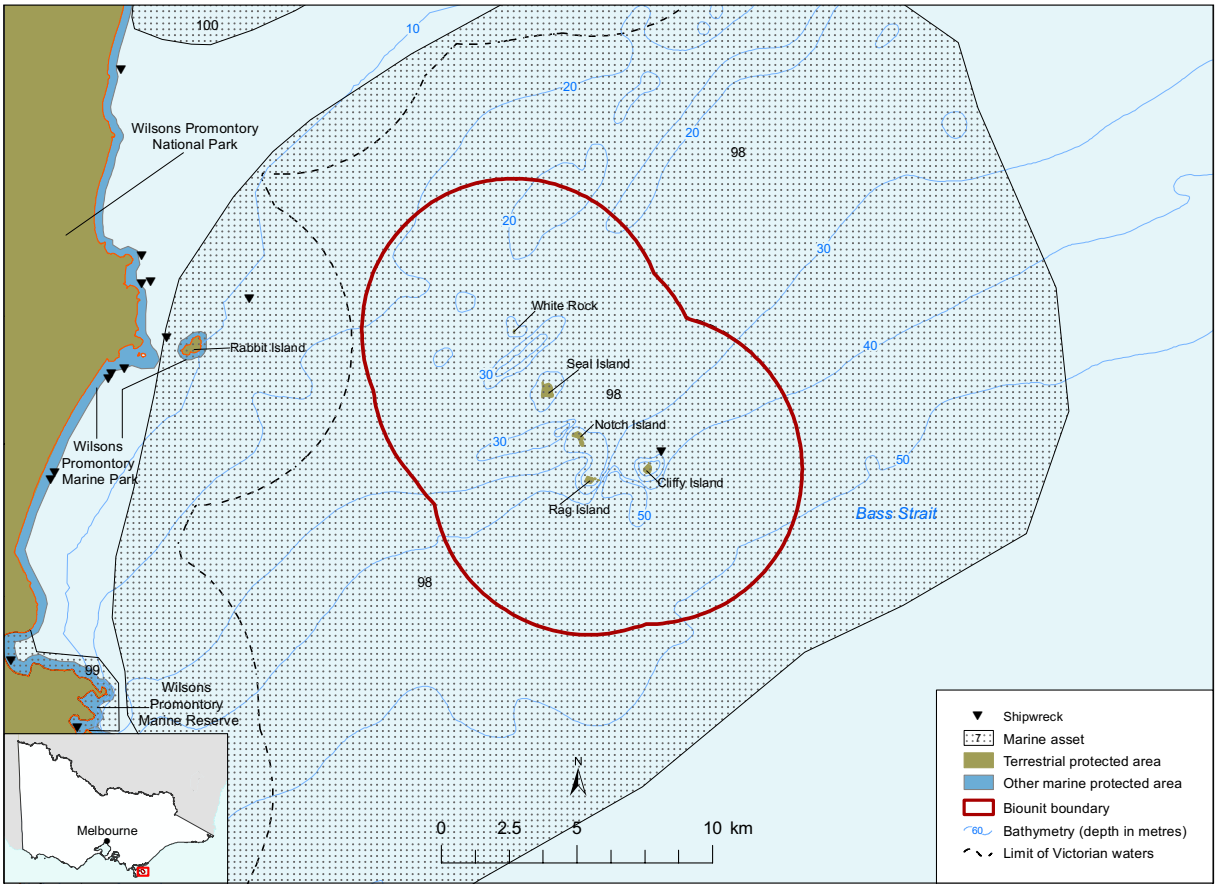
- Coastal modifications (e.g. dredging, sea walls) may alter patterns of longshore drift, deposition, erosion. Impacts include depressed breeding of fish such as shark and flounder, impaired function of infauna communities and altered hydrodynamic processes
- Levee banks restrict tidal movements and landward migration of saltmarsh and mangroves
- Coastal saltmarsh and mangroves vulnerable to trampling, especially during warmer months
- Seagrass beds and mudflats sensitive to propeller scarring and vessel groundings in shallow water (especially at low tide) and anchor damage

- Known pests include green shore crab, New Zealand screw shell, Pacific oyster, northern Pacific seastar and broccoli weed
- Introduced mammals prey on and disturb roosting, feeding and nesting birds and eggs (e.g. hooded plover)
- Cordgrass *Spartina* widespread in south Gippsland. Aggressively invades saltmarsh, mangroves and mudflats binding sediments and altering mud habitat
- Black sea urchin forms habitats devoid of habitat-forming macroalgae e.g. kelp
- At high density, native white sea urchin also creates urchin barrens where erect macroalgae (e.g. kelp) and seagrass usually absent. Unclear whether recent increases part of a natural cycle or persistent increase
- Disturbance to beach nesting birds (e.g. hooded plover) through recreation (e.g. dogs, horses, vehicles, shore-based activities) leads to nesting failure

- Elevated nutrients and sediments (e.g. agricultural runoff, moderate condition of Albert and Tarra rivers) cause turbidity, reduce light levels, excess growth of algae, epiphytes and phytoplankton, decrease dissolved oxygen. Impacts include decline in seagrass cover, reduced habitat quality of mud flats for migratory waders, reduced mangrove health, decreased fish diversity/abundance (including harvested species), potential seafood contamination

- Agricultural use of herbicides and pesticides threaten mudflat communities
- Marine debris and litter leads to entanglement in and ingestion of thin plastics by marine fauna

Biounit 19: Cliffy Group



Physical setting

The 19,281 hectare Cliffy Group biounit contains a group of five granite islands that are part of a submerged granite mountain range: White Rock, Seal Island, Notch Island, Rag Island, Cliffy Island. There are no marine protected areas. The isolated islands have high exposure and are part of the deep sediment shelf. No habitat mapping is available for the biounit. Habitat complex mapping should be undertaken so that more detailed biotope complex mapping can follow.

Traditional Owners

- Current registered Gunaikurnai Federal Native Title application

Natural values

- Wilsons Promontory Islands KBA nesting habitat for seabirds (short-tailed shearwater, Pacific gull, black-faced cormorant, fairy prion, little penguin)
- Australian fur seal colony, Seal Island named for them
- Open sea pelagic environment (MA 98) important for juvenile great white shark, also whale migration
- Biota relatively understudied, likely to contain affinities with Wilsons Promontory east biotopes
- Wilsons Promontory Biosphere Reserve recognises a granite massif with prominent peaks, outcrops and headlands flanked by extensive swamps, dune deposits and beaches as well as fifteen islands

Social and economic values

European cultural heritage Cliffy Island lighthouse and keepers' cottages constructed in 1884, the lighthouse automated in 1971 and cottages demolished. Some historical stonework remains. Historical whaling/sealing. Shipwreck near Cliffy Island

Coastal development None

Tourism and recreation Negligible

Commercial fishing and aquaculture No aquaculture reserves or proposals for aquaculture

Ports and shipping Associated marine pollution risk is moderate

Energy None

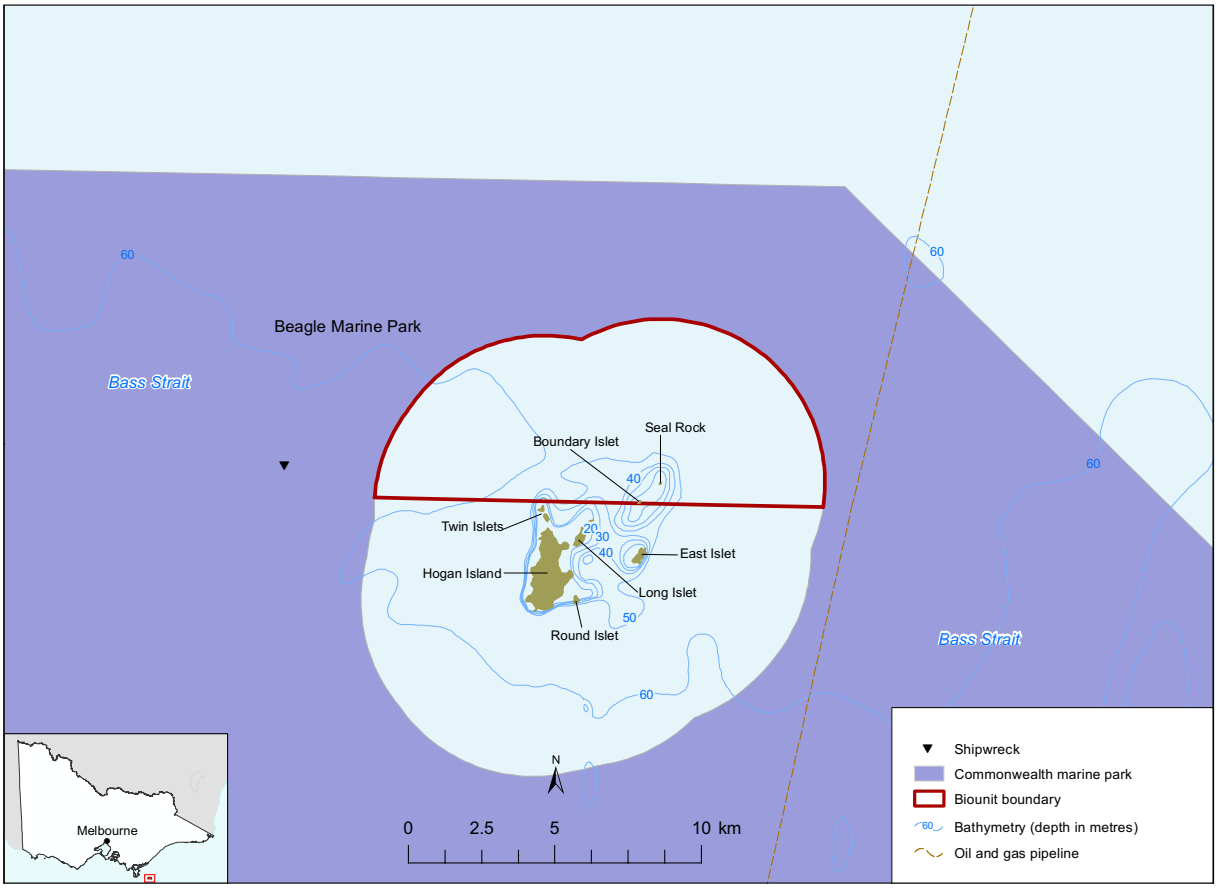
Emerging uses

Islands accessible only by helicopter. Lighthouse site closed to public so unlikely to support tourism

Threats

	• Alterations in waves or currents affect pelagic fish populations • Sea level rise changes coastal features (including inundation of low-lying reefs and islands) which affects shorebird, seabird and seal resting, feeding and breeding habitats
	• No data
	• Introduced predators and herbivores can have significant impacts on small islands. European rabbits recorded on Rag Island, domestic dogs recorded on Notch Island
	• No data
	• No data

Biounit 20: Hogan Group North



Physical setting

The 7712 hectare Hogan Group North biounit is surrounded by the Commonwealth multiple-use Beagle Marine Park. The group of islands was historically part of the land bridge linking Tasmania to the mainland and was the first section of the land bridge on the eastern side to be isolated by post-glacial sea level rise. Habitats include isolated islands, high swell exposure, maximal wind exposure, and deep sediment shelf. No habitat mapping is available for the biounit. Habitat complex mapping should be undertaken so that more detailed biotope complex mapping can follow.

Apart from Boundary Islet and Seal Rocks, the remaining islands in the Hogan Group are under the jurisdiction of Tasmania.

Natural values

- Deep water biotopes likely similar to those in the Commonwealth Beagle Marine Park which include Southeast Shelf Transition and associated sea floor communities. Possibly includes rocky reefs supporting beds of encrusting, erect and branching sponges and sediment with sparse sponge habitats
- Migration area for southern right whale
- Foraging area for Australian fur seal, killer whale, seabirds (shy albatross, Australasian gannet, short-tailed shearwater, Pacific and silver gulls, common diving petrel, fairy prion, black-faced cormorant, little penguin), great white shark
- Research team in 2017 filmed hundreds of Port Jackson sharks resting on the seafloor among the sponges in the adjacent Beagle Marine Park
- Biota relatively understudied, likely to include threatened or rare species

Traditional Owners

- Not identified

Social and economic values

European cultural heritage Historically, fur seals were harvested from the island group. Two shipwrecks in Commonwealth reserve to the east of Wilsons Promontory: *Eliza Davies* (1924), *SS Cambridge* (1940)

Coastal development Southernmost extent of Victorian waters

Tourism and recreation Negligible

Commercial fishing and aquaculture No aquaculture reserves or proposals for aquaculture

Ports and shipping Ships associated with oil and gas pipeline

Energy Nearby oil and gas pipeline

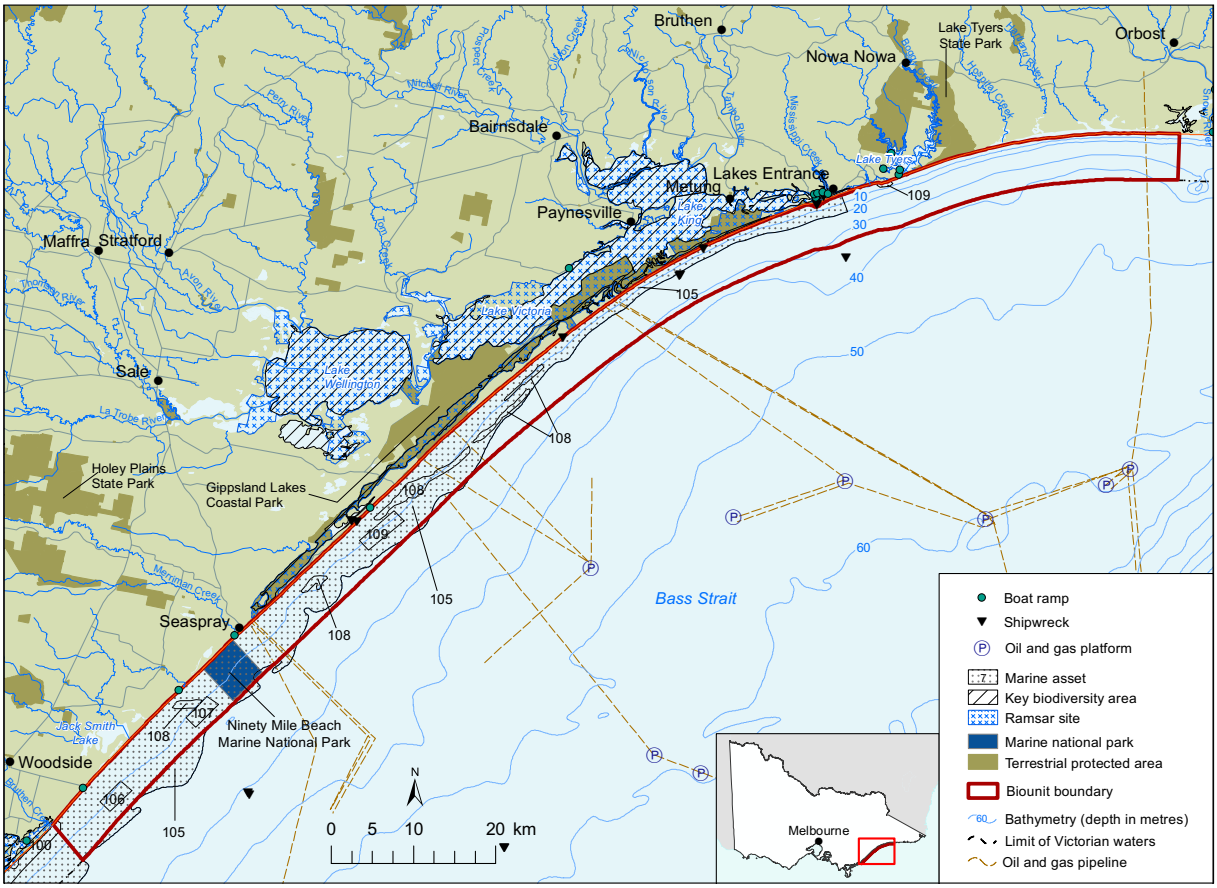
Emerging uses

Remote, unlikely to support tourism

Threats

	• Alterations in waves or currents affect pelagic fish populations • Sea level rise changes coastal features (including inundation of low-lying reefs and islands) which affects shorebird, seabird and seal resting, feeding and breeding habitats
	• No data
	• No data
	• No data
	• Risk of oils released from dredging or spills from ships and other vessels. Presence of offshore oil and gas pipelines increase vulnerability. Impacts include oiling of seabirds, oil accumulation over intertidal areas • Marine pollution risk associated with shipping moderate

Biounit 21: Ninety Mile Beach



Physical setting

The 95,267 hectare Ninety Mile Beach biounit extends from east of Nooramunga to east of Marlo and includes the Ninety Mile Beach Marine National Park (MNP) and several estuaries and coastal lagoons including Jack Smith Lake and Lake Tyers. The linear, exposed ocean beach and dune system has expansive sediment beds and emergent patch reefs. Habitats include high energy, weak to moderate tidal streams, emergent patch reefs, extensive sediment beds, non-reef forming sediment epibiota, scallop beds and coastal lagoon.

While 66 per cent of the Ninety Mile Beach biounit has been mapped at the broad habitat level, only 2 per cent has been mapped at the biotope complex level. Where mapping has occurred, the broad habitats are predominantly sublittoral sediments. Most of the Ninety Mile Beach MNP has been mapped to broad habitat level (92 per cent) and is also sublittoral sediment. Further mapping within the biounit should prioritise completing mapping at the broad habitat level so that more mapping can occur at the biotope complex level.

Unique or rare biotopes include:

- Seagrass: *Zostera* spp. and *Ruppia* spp. beds
- Invertebrates: high-density feather star (*Cenolia* sp.)
- Sessile invertebrates: non-reef forming epibiota assemblages dominated by sponge mounds
- Low complexity circalittoral rock

Traditional Owners

- Part of the Sea Country of Gunaikurnai
- Increased participation of Traditional Owners in land management and decision making. Gunaikurnai Whole-of-Country Plan will be amended in 2019 with increased focus on sea birds

Natural values

- Sandy beaches breeding habitat for hooded plover, other shorebirds and seabirds including Caspian tern, crested tern, fairy tern, pied oystercatcher
- Juvenile great white shark aggregation area, inshore sandy areas east of Wilsons Promontory feeding areas for gummy shark pups
- Port Albert to Lakes Entrance sandy plain (MA 105) most diverse benthic infauna communities recorded, include ghost shrimp *Biffarius arenosus* and *Trypaea australiensis*
- Scallop and epibiotic communities
- Coastal saltmarsh
- Patchy, low profile reefs (MA 108) periodically covered by sand dominated by sessile invertebrates
- Endemic seastar (*Coscinasterias muricata*) occurs in large numbers, rare crab *Halicarcinus* sp., opisthobranch *Platydoris galbana* (Woodside beach MA 106)
- Soft coral (*Pseudogorgia godeffroyi*) only occurs in Victoria between McGuarans (MA 107) and Delray beaches (MA 109)
- Red Bluff/Shelley beach (MA 110)
- Conservation-listed communities and species (e.g hooded plover) and endemic or rare species (e.g. *Halicarcinus* sp.) particularly vulnerable to environmental change

Social and economic values

European cultural heritage First Europeans in Victoria landed at Ninety Mile Beach in 1797 from wreck of *Sydney Cove*. Historical sealing and whaling. Shipwreck Protection Zone around *SS Glenelg* (1900) in Commonwealth waters

Coastal development Seaspray, Lakes Entrance, Lake Tyers townships. Limited access to ocean waters for marine vessels. Saline wastewater outfall pipeline at McGaurans Beach, secondary treated wastewater at Delray Beach. Coast with very high vulnerability to erosion under climate change. Seaspray has very high vulnerability to inundation under climate change. Entrance into Gippsland Lakes maintained as permanent entrance

Tourism and recreation Lake Tyers recreational fisheries reserve with four artificial reefs (Mill Point, Glass House, Bath House, Hendries). Popular activities include surf fishing, beach activities, charter boat operations. Surf life saving clubs at Seaspray, Woodside Beach. Lakes Entrance and Red Bluff popular surf locations

Commercial fishing and aquaculture Commercial fisheries licences for eastern rock lobster zone, central and eastern abalone zone, one Lake Tyers bait licence, scallop fishery, ocean fishery. No aquaculture reserves or proposals for aquaculture

Ports and shipping Gippsland Lakes local port. Associated marine pollution risk is very low (Golden Beach to Ocean Grange) to moderate (Lakes Entrance)

Energy Gippsland Basin offshore with pipelines through state waters

Emerging uses

- Marine stocking trialled with eastern king prawn in Lake Tyers
- Offshore gas exploration expansion
- Carbon capture and storage

Threats

- Alterations in waves or currents affects pelagic fish populations, seagrass productivity
- Sea level rise alters frequency of estuary mouth opening (e.g. Merriman Creek, Bunga River, Lake Tyers seasonally closed)
- Sea level rise reduces area for seagrass, mudflats and saltmarsh where landward migration not possible
- Sea level rise changes coastal features (including inundation of beaches and intertidal areas) which affects shorebird resting, feeding and breeding habitats
- More frequent storm events and nutrient pulses entering estuaries cause algal growth and sedimentation. impacts seagrass
- Storm surges inundate dunes infested with marram grass
- Decreased freshwater flows alter frequency of estuary mouth opening and salinity regime. Impacts fish diversity or abundance and connectivity for fish that use fresh and marine waters
- Increases in hot, dry weather put beach nesting birds at risk from fires

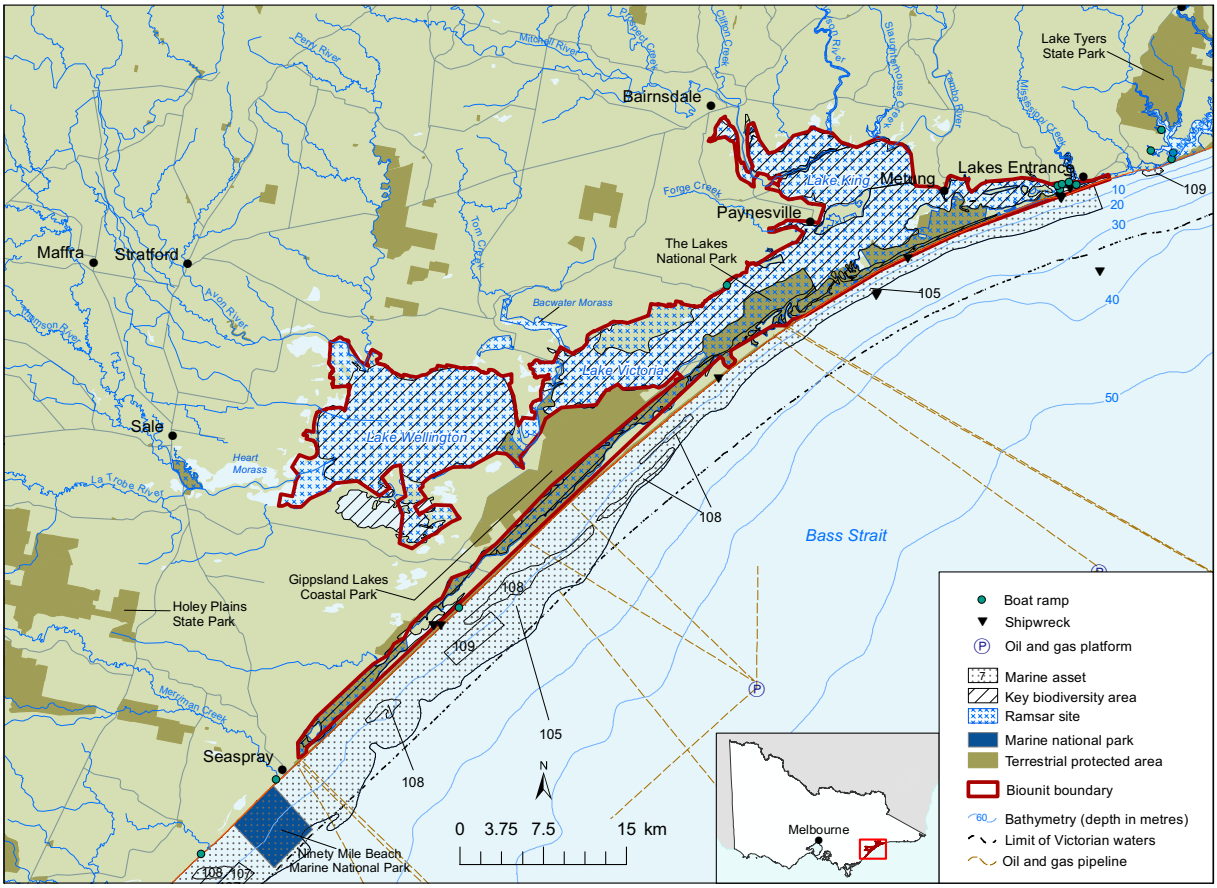
- Inappropriate shore-based development (especially around holiday settlements) disturbs biota, reduces water quality
- Coastal saltmarsh vulnerable to trampling, especially during warmer months
- Seagrass beds and subtidal reef sensitive to propeller scarring and vessel groundings in shallow water (especially at low tide) and anchor damage (e.g. Lake Tyers)

- Likely pests include New Zealand screw shell (soft sediments). Could reduce native suspension feeders in high densities via direct competition for food and by changing sediment characteristics
- Pests of concern include northern Pacific seastar and broccoli weed
- Introduced mammals prey on and disturb roosting, feeding and nesting birds and eggs (e.g. hooded plover)
- Native dune vegetation replaced by marram grass. Results in single-ridge dune susceptible to wind and wave erosion, inundation by wave action and reduced suitability for beach-nesting birds
- Black sea urchin forms barrens devoid of habitat-forming macroalgae e.g. kelp
- Disturbance to beach nesting birds (e.g. hooded plover) through recreation (e.g. dogs, horses, vehicles, shore-based activities) leads to nesting failure

- Elevated nutrients and sediments (e.g. agricultural runoff; moderate condition of Bruthen, Merriman and Stony creeks; septic systems in Seaspray; outfall at Delray beach) cause turbidity, reduce light levels, promote excess growth of algae, epiphytes and phytoplankton, decrease dissolved oxygen. Impacts include decreased fish diversity or abundance (including harvested species), potential seafood contamination

- Agricultural use of herbicides and pesticides threaten mudflat communities
- Sediments (e.g. Gippsland Lakes) accumulate toxic chemicals and heavy metals (e.g. mercury) contaminate marine animals (e.g. dolphins, fish, shellfish)
- Underwater seismic surveys for oil and gas disturb large (e.g. cetaceans) and small (e.g. zooplankton, scallops) marine life
- Proximity to offshore oil and gas production platforms and pipelines increase vulnerability to oil or chemical spills. Impacts include oiling of seabirds, oil accumulation over intertidal areas, contamination of ground or surface water, loss of recreation
- Marine debris and litter or other debris from urban areas (e.g. Lakes Entrance, Lake Tyers) leads to entanglement in and ingestion of thin plastics by marine fauna

Biounit 22: Gippsland Lakes



Physical setting

The 55,678 hectare Gippsland Lakes biounit encompasses the Gippsland Lakes and associated inlets and saltmarshes. There are no marine protected areas. The biounit is a system of sheltered embayments with connecting channels and sandy islands. The lakes are fed by a number of river systems, the largest of which are the LaTrobe, Avon, Mitchell, Nicholson and Tambo rivers. Habitats include low energy, weak to moderate tidal streams, sediment flats, banks and channels, seagrass beds, sediment epibiota, sediment biogenic reef and saltmarsh. The Gippsland Lakes biounit has been mapped to broad habitat (95 per cent) and biotope complex (27 per cent) levels. Within areas mapped at a finer scale, the dominant biotope complexes are wet saltmarsh herbland (8 per cent) and seagrass beds (7 per cent).

Unique or rare biotopes include:

- Terrestrial: seasonally inundated sub-saline herbland, brackish herbland
- Seagrass: *Zostera* spp. and *Ruppia* spp. beds
- Sessile invertebrates: ascidian (*Stolonica australis*) beds, blue mussel biogenic reefs

Traditional Owners

- Part of the Sea Country of Gunaikurnai
- Area with one of highest incidences of Aboriginal sites in Victoria (middens with shellfish remains, charcoal, scorched pebbles)
- Increased participation of Traditional Owners in land management and decision making. Gunaikurnai Whole-of-Country Plan will be amended in 2019 with increased focus on sea birds

Natural values

- One of only two known Burrunan dolphin populations. Genetically distinct population of Burrunan dolphins vulnerable to extinction due to small size, female natal philopatry, restricted home range, recreation and increased impacts from use of lakes by recreational vessels
- Lakes Entrance Ramsar site and KBA supports significant populations of waterbirds (e.g. musk duck), shorebirds (e.g. hooded plover) and seabirds (e.g. white-bellied sea-eagle, Caspian tern)
- Seagrass beds among most extensive in Victoria
- Biogenic reef (*Mytilus edulis*) supports species of commercial/recreational importance
- Ascidian beds (*Stolonica australis*) support high local biodiversity, including sea hare and seahorse
- Saltmarsh
- Estuarine sediment beds and burrows mating habitat for seahorses and seasonal aggregation of blue swimmer crab
- Conservation-listed communities and species (e.g. hooded plover) particularly vulnerable to environmental change

Social and economic values

European cultural heritage The lakes were first found by Europeans in 1839. Shipping trade developed in 1858. Work on an artificial entrance began in 1872 with the entrance finally opened after a storm in 1889

Coastal development Seaspray, Loch Sport, Paynesville, Bairnsdale, Metung, Lakes Entrance regional towns. Significant amount of boating facilities and access throughout lakes. Entrance to lakes permanently maintained

Tourism and recreation Most use during warmer summer months. Boating and fishing main recreational activities. Important recreational fishery, two artificial reefs at Metung and Nungurner. Also bushwalking, sailing, swimming, camping, hunting, birdwatching, horse riding, picnicking, sight-seeing. Surf life saving clubs at Golden Beach, Lakes Entrance. Sheltered cruising and boating area

Commercial fishing and aquaculture Commercial fisheries licences for eastern rock lobster zone, central and eastern abalone zones, eel fishery, 10 Gippsland Lakes fishery licences, nine Gippsland Lakes (bait) fishery licences, two Gippsland Lakes (mussel dive) licences. No aquaculture reserves or proposals for aquaculture

Ports and shipping Lakes Entrance local port. Associated marine pollution risk is very low

Energy Gippsland Basin offshore with pipelines through state waters

Emerging uses

- Phasing out commercial fishing in favour of recreational fishing
- Offshore gas exploration expansion

Threats

- Alterations in waves or currents affect pelagic fish populations, seagrass productivity
- Sea level rise alters frequency of estuary mouth opening (e.g. Tom Roberts Creek seasonally closed)
- Sea level rise reduces area for seagrass, mudflats and saltmarsh where landward migration not possible
- Sea level rise changes coastal features (including inundation of beaches and intertidal areas) which affects shorebird resting, feeding and breeding habitats
- More frequent storm events and nutrient pulses entering estuaries may cause algal growth and sedimentation, threatening seagrass
- Storm surges inundate dunes infested with marram grass
- Decreased freshwater flows alter frequency of estuary mouth opening and salinity regime. Impacts fish diversity or abundance and connectivity for fish that use fresh and marine waters
- High rainfall events result in land runoff of nutrients and sediments. Predicted to become more frequent/severe, detrimental to mudflats and deep water habitats
- Increases in hot, dry weather put beach nesting birds at risk from fires

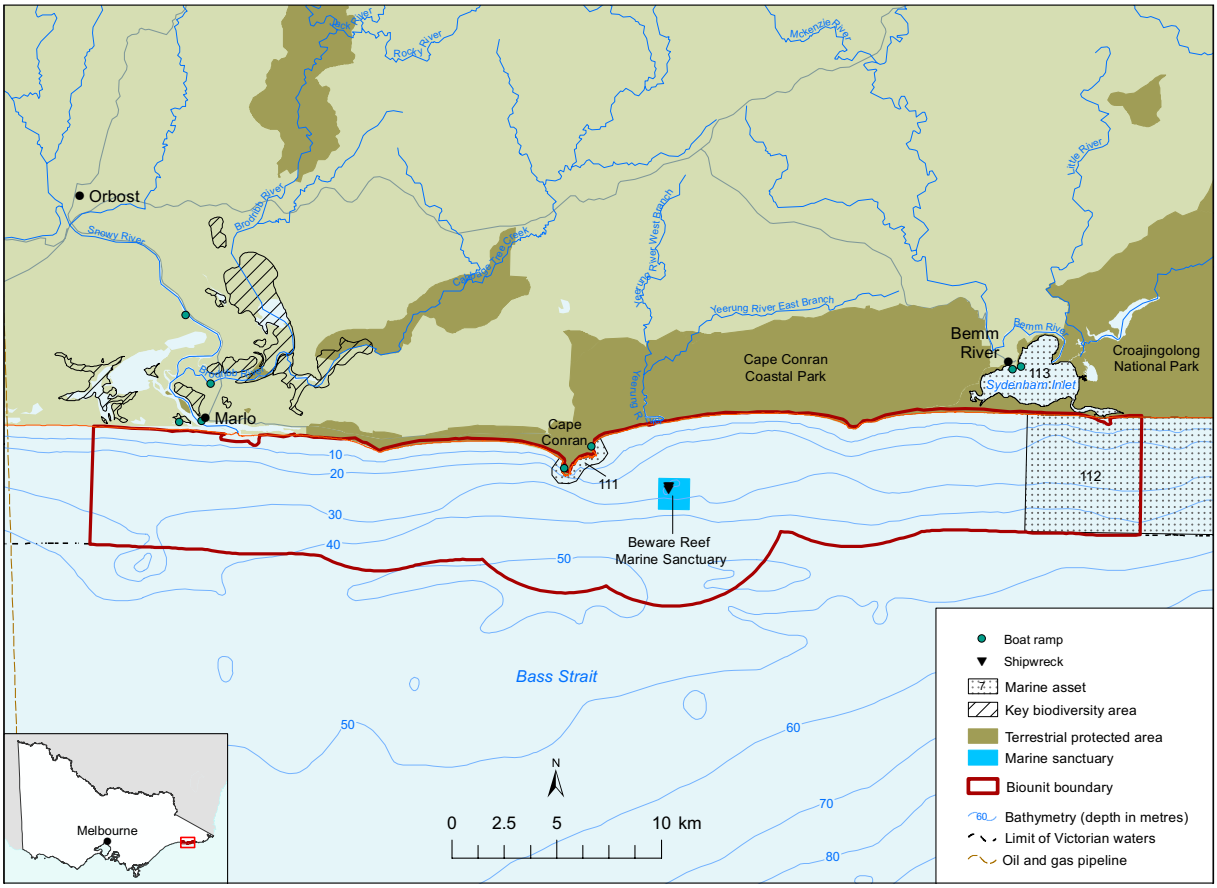
- Inappropriate shore-based development (especially around holiday settlements) impacts on biota (e.g. disturbance, reduced water quality)
- Reduced freshwater flow and permanent opening at Lakes Entrance in 1889 transformed freshwater system into marine system
- Coastal modifications (e.g. dredging, stormwater disposal, coastal protection structures, beach renourishment, harbours) may alter patterns of longshore drift, deposition, erosion
- Coastal saltmarsh vulnerable to trampling, especially during warmer months
- Seagrass beds and subtidal reef sensitive to propeller scarring and vessel groundings in shallow water (especially at low tide) and anchor damage

- Known pests include green shore crab, New Zealand screw shell and Asian date mussel
- Northern Pacific seastar previously detected but controlled
- Introduced mammals prey on and disturb roosting, feeding and nesting birds and eggs (e.g. hooded plover)
- Uncontrolled grazing (hog deer, goats, rabbits and domestic stock) close to waterways and wetlands leads to bank erosion, potential to degrade saltmarsh
- European carp in brackish waters prey on native species
- Toxic algal blooms result in seafood being unfit for human consumption
- Cord grass *Spartina* invades saltmarsh and mudflats binding sediments and altering mud habitat
- Recreational hunting of waterbirds creates physical and noise disturbance, accidental shooting of protected species
- Disturbance to beach nesting birds (e.g. hooded plover) through recreation (e.g. dogs, horses, vehicles, shore-based activities) leads to nesting failure

- Elevated nutrients and sediments (e.g. agricultural runoff from dairying in Maffra to Warragul area; coastal development in Paynesville; poor condition of the Mitchell River; moderate condition of Nicholson and Tambo rivers and Forge Creek; La Trobe River one of most highly polluted rivers in Victoria) cause turbidity, reduce light levels, promote excess growth of algae, epiphytes and phytoplankton, decrease dissolved oxygen. Impacts include decline in seagrass cover, reduced habitat quality of mud flats for migratory waders, decreased fish diversity/abundance (including harvested species), potential seafood contamination
- Land clearing (agricultural, industrial, urban development) in catchment increases stormwater runoff, nutrient and sediment input, groundwater salinity, freshwater diversion, impacts water quality
- Irrigation water diverted from most river systems
- Increasingly saline groundwater changes ecology of Lakes through oxygen depletion resulting in large-scale fish kills (black bream, Australian bass)

- Agricultural use of herbicides and pesticides threaten mudflat communities
- Sediments accumulate toxic chemicals and heavy metals (e.g. mercury from historical gold mining) contaminate marine animals (e.g. dolphins, fish, shellfish)
- Proximity to offshore oil and gas production platforms and pipelines and use by recreational vessels increase vulnerability to oil or chemical spills. Impacts include oiling of seabirds, oil accumulation over intertidal areas, contamination of ground or surface water, loss of recreation
- Urban areas covered by impervious surfaces, high stormwater runoff
- Growing urban populations (e.g. Paynesville) can deliver excess freshwater and pollutants
- Litter or other debris from urban areas (e.g. Paynesville, Lakes Entrance) leads to entanglement in and ingestion of thin plastics by marine fauna

Biounit 23: Cape Conran



Physical setting

The 34,635 hectare Cape Conran biounit extends from east of Marlo to west of Bemm Reefs and includes the Beware Reef Marine Sanctuary (MS). There are three main estuaries: Snowy River, Yeerung River, Sydenham Inlet (MA 113). North of Bass Canyon, Cape Conron (MA 111) is a granite point with an offshore reef and island system flanked by sedimentary reefs systems. Habitats include high energy, weak to strong tidal streams, complex reefs, sediment beds, sediment epibiota. The mixing of colder southern waters with warmer northern waters results in higher nutrient levels, creating an ecosystem with high productivity. Fifteen species are presumed to be at their distributional limits within the biounit.

The Cape Conran biounit has been mapped at the broad habitat (43 per cent) and the biotope complex (20 per cent) level. Within mapped areas, infralittoral fine sand dominates (16 per cent). Beware Reef MS has been mapped to biotope complex (63 per cent). Important biotopes are infralittoral fine sand (42 per cent), circalittoral mixed sediments (16 per cent) and black sea urchin grazed barrens (7 per cent). Further mapping within the biounit should prioritise completing mapping at the broad habitat level so that more mapping can occur at the biotope complex level. At the biotope complex level, infralittoral and circalittoral marine sanctuary biotopes require attention.

Unique or rare biotopes include:

- Seagrass: *Zostera* spp. and *Ruppia* spp. beds
- Brown algae: high energy common kelp communities
- Sessile invertebrates: sea whip and tall branching sponge communities on open coast circalittoral rock

Traditional Owners

- Part of the Sea Country of Gunaikurnai
- The Traditional Owners of Far East Gippsland (the Bidwell, Monero/Ngarigo, Yuin and others) assert rights and interests for part of the area, east of the Snowy River mouth
- Increased participation of Traditional Owners in land management and decision making. Gunaikurnai Whole-of-Country Plan will be amended in 2019 with increased focus on sea birds

Natural values

- Records of conservation-listed southern right whale, humpback whale, southern elephant seal, killer whale, bottlenose and common dolphins
- Exposed Beware Reef a haul out site for Australian and long-nosed fur seals, also sea birds (e.g. little penguins, pied cormorants)
- Feeding habitat for shy and wandering albatrosses
- Lower Brodribb KBA supports breeding Australasian bitterns, Sydenham Inlet breeding colony for little tern
- Saltmarsh (Marlo, Sydenham Inlet)
- Mud and Swan Lakes extensive wetland and tidal channel system important for waterbird habitat, displaying variety of geomorphic processes of state significance
- Bemm River region reef upwelling communities (MA 112) contain rare seaweeds and unique communities
- Inshore sandy areas important feeding areas for gummy shark pups
- Many reef fishes including schools of over a thousand butterfly perch, blue-throated and purple wrasses common
- Intertidal invertebrates dominated by cunjevoi
- Subtidal reef invertebrates include large finger sponges, stalked and colonial ascidians, sea urchins
- Granite reefs support bull kelp forests. Giant kelp decreased across Victoria in last 20 years, likely related to increasing water temperature and nutrient levels. Provides vertical structure to reef habitats, loss may influence water currents/wave action
- Bemm River silt jetty
- Conservation-listed communities and species (e.g. shy albatross), endemic or rare species and species at distributional limit particularly vulnerable to environmental change

Social and economic values

European cultural heritage Shipwrecks include *Auckland* (1871), *Ridge Park* (1881), *Neptune* (1889), *Albert San* (1926), also Sailors Grave reportedly from the shipwreck of *Ridge Park*

Coastal development Marlo, Bemm River regional towns. Coastal development and facilities for boating around Marlo. Limited access to ocean for marine vessels. Coast with very high vulnerability to erosion under climate change

Tourism and recreation Popular activities include boat-based recreational fishing, diving, offshore sea kayaking. Inlets popular for camping, boating, fishing, swimming. Wilderness coast walk. Cape Conran surf spot

Commercial fishing and aquaculture Commercial fisheries licences for eastern rock lobster zone, eastern abalone zone, two Sydenham Inlet bait fishery licences, two Snowy River fishery (bait) licences. No aquaculture reserves or proposals for aquaculture

Ports and shipping Snowy River local port at Marlo. Associated marine pollution risk is low (most of coast) to moderate (Sydenham Inlet)

Energy Gippsland Basin offshore in Commonwealth waters

Emerging uses

Marine stocking trialled in Bemm River with estuary perch

Threats

- Alterations in waves or currents affects pelagic fish populations, seagrass productivity
- Sea level rise alters frequency of estuary mouth opening (e.g. Yeerung and Bemm rivers seasonally closed)
- Sea level rise reduces area for seagrass, mudflats and saltmarsh where landward migration not possible
- Sea level rise changes coastal features (including inundation of beaches, intertidal areas, low-lying reefs and islands) which affects shorebird, seabird and seal resting, feeding and breeding habitats
- More frequent storm events and nutrient pulses entering estuaries may cause algal growth and sedimentation
- Decreased freshwater flows alter frequency of estuary mouth opening and salinity regime. Impacts fish diversity or abundance and connectivity for fish that use fresh and marine waters
- High rainfall events result in land runoff of nutrients and sediments. Predicted to become more frequent/ severe, detrimental to mudflats and deep water habitats
- Increases in hot, dry weather put beach nesting birds at risk from fires
- Increased ambient temperatures impact bull kelp

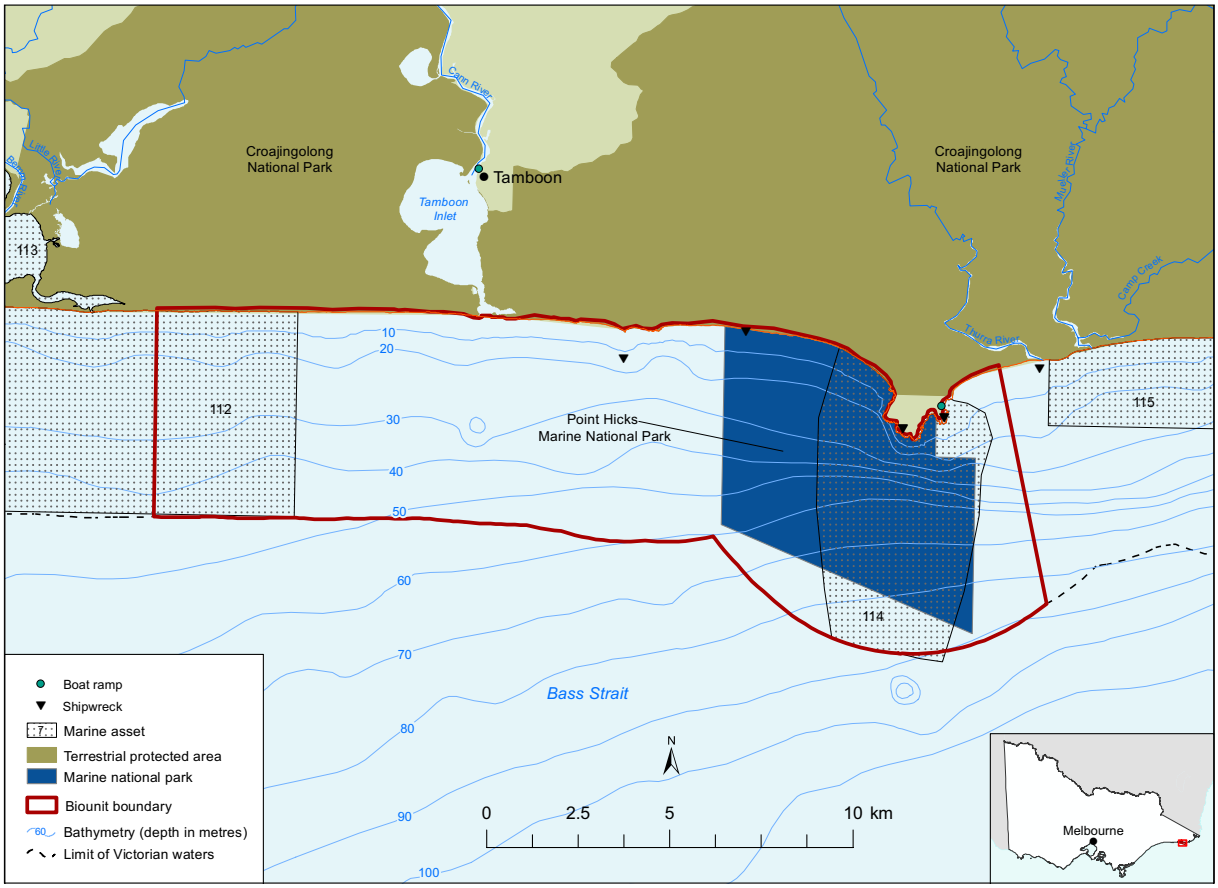
- Artificial estuary opening produces silt plumes, fish kills and sedimentation. Sydenham Inlet intermittently closed to sea when river mouth blocked by sand bar, artificial opening occasionally necessary to lower persistent high water levels and reduce flooding
- Inappropriate shore-based development (especially around holiday settlements) impacts on biota (e.g. disturbance, reduced water quality)
- Coastal saltmarsh and intertidal areas vulnerable to trampling, especially during warmer months
- Mudflats and subtidal reef sensitive to propeller scarring and vessel groundings in shallow water (especially at low tide) and anchor damage

- Likely pests include green shore crab (intertidal areas)
- New Zealand screw shell and New Zealand sea star recorded in Point Hicks and Cape Howe MNPs
- Other species of concern include northern Pacific seastar, European fan worm, Japanese kelp and broccoli weed
- Introduced mammals prey on and disturb roosting, feeding and nesting birds and eggs (e.g. hooded plover)
- Active and previous river deltas at Sydenham Inlet being degraded by erosion associated with grazing by stock
- Black sea urchin forms barrens devoid of habitat-forming macroalgae e.g. kelp
- Recreational hunting of waterbirds (Sydenham Inlet) creates physical and noise disturbance, accidental shooting of protected species
- Disturbance to beach nesting birds (e.g. little tern) through recreation (e.g. dogs, horses, vehicles, shore-based activities) leads to nesting failure

- Threat of catchment-derived pollutants in stormwater low as catchment relatively unmodified, remote location and protection from adjoining terrestrial parks
- Major flooding or timber harvesting within catchment increases sediment loads
- Snowy and Yeerung rivers in moderate condition

- No data

Biounit 24: Point Hicks



Physical setting

The 15,872 hectare Point Hicks biounit extends from the Bemm Reefs to west of the Mueller River reefs and includes the Point Hicks Marine National Park (MNP) and one major estuary (Tamboon Inlet). The Point Hicks cape (formerly known as Cape Everard) and offshore granite emergent reefs are influenced by the Bemm River upwelling region (MA 112) at the head of the Everard Canyon which links to Bass Canyon further offshore. Habitats include high energy, weak to strong tidal streams, isolated and complex reefs, sediment beds and sediment epibiota. The mixing of colder southern waters with warmer northern waters results in higher nutrient levels, creating an ecosystem with high productivity. Fourteen species are presumed to be at their distributional limit within the biounit.

The Point Hicks biounit has been mapped at the broad habitat (62 per cent) and biotope complex (55 per cent) levels. In mapped areas, important biotope complexes include infralittoral fine sand (33 per cent) and circalittoral mixed sediments (19 per cent). Point Hicks MNP has been extensively mapped at the biotope complex level (99 per cent). Like the entire biounit, circalittoral mixed sediments (56 per cent) and infralittoral fine sand (39 per cent) dominate. Black sea urchin grazed barrens play a minor role (3 per cent). Further mapping within the biounit should prioritise circalittoral rock with unique morphospecies.

Unique or rare biotopes include:

- Seagrass: *Zostera* spp. and *Ruppia* spp. beds
- Brown algae: infralittoral bull kelp, high energy common kelp communities
- Green algae: *Caulerpa* spp. beds on sediment
- Sessile invertebrates: sea whip and tall branching sponge communities on open coast circalittoral rock
- Circalittoral sediments
- Upwelling communities

Traditional Owners

- The Traditional Owners of Far East Gippsland (the Bidwell, Monero/Ngarigo, Yuin and others) assert rights and interests in the area.

Natural values

- Records of conservation-listed southern right whale, humpback whale, killer whale, whale shark, leopard seal, leatherback turtle
- Tamboon Inlet breeding site for little tern, hooded plover, white-bellied sea eagle, crested tern
- Inshore sandy areas important feeding areas for gummy shark pups
- Fish assemblages mixture of cool southern and warm eastern species, dominated by large numbers of blue throat wrasse and purple wrasse
- Isolated and complex reefs (Point Hicks Reefs MA 114). Diverse and colourful invertebrate assemblages in subtidal reefs including sponges, bryozoans, soft corals. Significant subtidal reefs at Whaleback Rock and Satisfaction Reef in Point Hicks MNP with high relief gutters (1-15 metres) and sessile invertebrate habitat on vertical walls
- Whelk *Fax molleri* presumed to be endemic to Point Hicks MNP
- Sediment sponge communities
- Bemm River region reef upwelling communities (MA 112) contain rare seaweeds and unique communities
- High seaweed uniqueness/diversity including bull kelp and giant kelp beds
- Canopy forming algae (cray weed, common kelp) with small understorey algae (encrusting and erect sponges to small fleshy red algae)
- Rare algae (*Porphyropsis minuta*, *Erythroneaema ceramoides*, *Scageliopsis pratens*)
- Croajingolong Biosphere Reserve
- Conservation-listed communities (e.g. giant kelp marine forest) and species (e.g. hooded plover), endemic or rare species (e.g. whelk) and species at distributional limit particularly vulnerable to environmental change

Social and cultural values

European cultural heritage Point Hicks first part of Victorian coastline sighted by Europeans in 1770. Shipwrecks include *Circassian* (1864), *Mimmie Dike* (1866), *Kerangie* (1879), *Saros* (1937). Point Hicks lighthouse built in 1887. Historic whaling and sealing in the area. During World War Two, East Gippsland coast used for surveillance, Point Hicks a coastal watching point for protecting important shipping routes

Coastal development Tamboon settlement. Very low level of coastal development. Coast with very high vulnerability to erosion under climate change

Tourism and recreation Point Hicks MNP and Croajingolong National Park tourist destinations. Remote nature-based recreation. Also camping, boating, fishing, swimming, canoe touring of estuaries and inlets, offshore sea kayaking. Wilderness coast walk. Shore-based recreational fishing (especially at Clinton Rocks), snorkelling, diving (Whaleback Rock and Satisfaction Reef boat based). Surfing at Point Hicks

Commercial fishing and aquaculture Commercial fisheries licences for eastern rock lobster zone, eastern abalone zone. No aquaculture reserves or proposals for aquaculture

Ports and shipping No shipping routes. Marine pollution risk is high

Energy Gippsland Basin offshore in Commonwealth waters

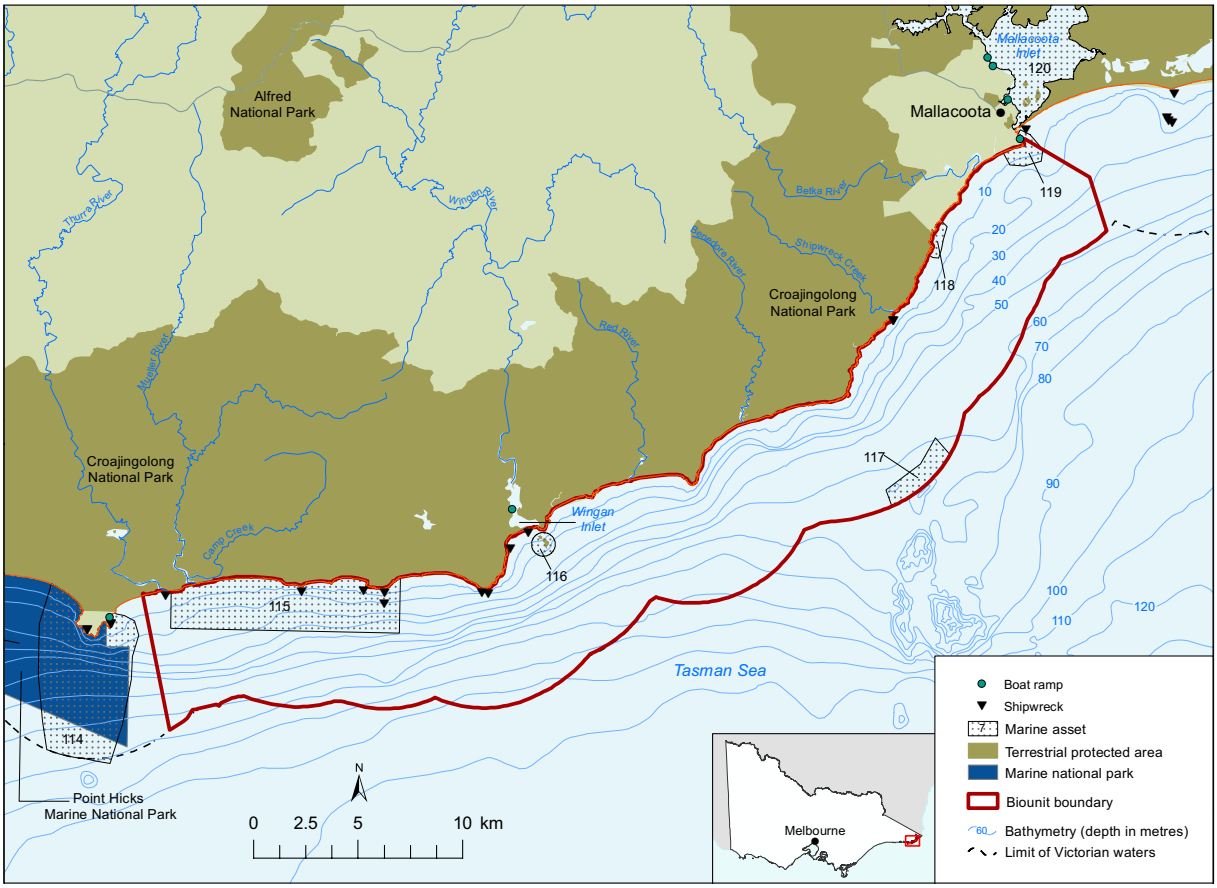
Emerging uses

Marine fish stocking trialled in Tamboon Inlet with mulloway

Threats

	• Alterations in waves or currents affects pelagic fish populations, seagrass productivity • Sea level rise alters frequency of estuary mouth opening (e.g. Tamboon Inlet seasonally closed) • Sea level rise reduces area for seagrass, mudflats and saltmarsh where landward migration not possible • Sea level rise changes coastal features (including inundation of beaches, intertidal areas, low-lying reefs and islands) which affects shorebird and seabird resting, feeding and breeding habitats • More frequent storm events and nutrient pulses entering estuaries may cause algal growth and sedimentation, threatening seagrass • Decreased freshwater flows alter frequency of estuary mouth opening and salinity regime. Impacts fish diversity or abundance and connectivity for fish that use fresh and marine waters (e.g. Australian grayling) • Increases in hot, dry weather put beach nesting birds at risk from fires • Increased ambient temperatures impact bull kelp
	• No data
	• Known pests include New Zealand screw shell, New Zealand sea star, green shore crab • Pests of concern include northern Pacific seastar, European fan worm, Japanese kelp and broccoli weed. Stable Bay particularly vulnerable to introduced marine pest colonisation from ballast water and biofouling • Introduced mammals prey on and disturb roosting, feeding and nesting birds and eggs (e.g. hooded plover) • Black sea urchin forms barrens devoid of habitat-forming macroalgae e.g. kelp • Disturbance to beach nesting birds (e.g. little tern) through recreation (e.g. dogs, horses, vehicles, shore-based activities) leads to nesting failure
	• Threat of catchment-derived pollutants in stormwater low as catchment relatively unmodified, remote location and protection from adjoining terrestrial parks • Major flooding or timber harvesting within catchment increases sediment loads
	• No data

Biounit 25: Croajingolong



Physical setting

The 32,523 hectare Croajingolong biounit extends from east of Point Hicks to Bastion Point at Mallacoota. The linear folded sedimentary coast is punctuated by granite outcrops (the Skerries MA 116, Big Rame Head, Little Rame Head, New Zealand Star Bank MA 117). There is an upwelling influence (Twofold Upwelling) and numerous coastal inlets (Thurra River, Mueller River, Wingan Inlet, Easby Creek, Red River, Benedore River, Shipwreck Creek, Betka River). Habitats include high energy, weak to strong tidal streams, extensive low complexity and patch reefs, sediment beds, sediment epibiota, offshore deep reef outcrop and coastal lagoons.

The Croajingolong biounit has been mapped at the broad habitat (38 per cent) and biotope complex (36 per cent) levels. In mapped areas, infralittoral fine sand (18 per cent) and black sea urchin grazed barrens (11 per cent) dominate. Further mapping within the biounit should prioritise circalittoral rock biotopes (including New Zealand Star Banks), giant kelp and bull kelp biotopes, urchin biotope succession.

Unique or rare biotopes include:

- Seagrass: *Zostera* spp. and *Ruppia* spp. beds
- Brown algae: infralittoral bull kelp, high energy giant kelp overstorey communities, Twofold upwelling common kelp-high diversity filter feeder understorey
- Invertebrates: high-density feather star (*Cenolia* sp.)
- Sessile invertebrates: sea whip and tall branching sponge communities on open coast circalittoral rock

Traditional Owners

- The Traditional Owners of Far East Gippsland (the Bidwell, Monero/Ngarigo, Yuin and others) assert rights and interests in the area

Natural values

- Australian fur seal colony at the Skerries (MA 116)
- The Skerries significant breeding site for crested tern and roosting site for black-faced cormorant and little tern
- Saltmarsh (Wingan Inlet)
- Extensive low complexity and patch reefs (Mueller reef, Petrel reef, Croajingolong reef MA 115, Secret beach MA 118, Bastion Point MA 119)
- Offshore deep reef outcrop (New Zealand Star Bank MA 117) with diverse and unique sessile invertebrates
- Sediment beds with sparse sponges and infauna
- Subtidal bull kelp climate change indicator species, remnant giant kelp beds regionally significant. Threatened by urchin grazing. Giant kelp decreased across Victoria in last 20 years, likely related to increasing water temperature and nutrient levels. Provides vertical structure to reef habitats, loss may influence water currents/wave action

- Kelp-filter feeder beds high localised biodiversity
- Croajingolong Biosphere Reserve
- Conservation-listed communities (e.g. giant kelp marine community) and species (e.g. Australian fur seal) particularly vulnerable to environmental change

Social and economic values

European cultural heritage No data

Coastal development Mallacoota township, Mueller Inlet and Wingan Inlet. Very low level of coastal development. Coast with very high vulnerability to erosion under climate change

Tourism and recreation Croajingolong National Park tourist destination. Recreation activities in coastal settings, ranging from developed visitor precincts to secluded, remote ocean beaches. Inlets very popular for camping, boating, fishing, and swimming. Canoe touring of estuaries and inlets and offshore sea kayaking. Wilderness coast walk. Surfing at Tip Beach

Commercial fishing and aquaculture Commercial fisheries licences for eastern rock lobster zone, eastern abalone zone. No aquaculture reserves or proposals for aquaculture

Ports and shipping Mallacoota local port. Associated marine pollution risk is moderate

Energy Gippsland Basin offshore in Commonwealth waters

Emerging uses

Sea urchin fishery

Threats

- Alterations in waves or currents affects pelagic fish populations, seagrass productivity
- Sea level rise alters frequency of estuary mouth opening (e.g. Thurra and Wingan rivers seasonally closed)
- Sea level rise reduces area for seagrass, mudflats and saltmarsh where landward migration not possible
- Sea level rise changes coastal features (including inundation of beaches, intertidal areas, low-lying reefs and islands) which affects shorebird, seabird and seal resting, feeding and breeding habitats
- More frequent storm events and nutrient pulses entering estuaries may cause algal growth and sedimentation, threatening seagrass
- Decreased freshwater flows alter frequency of estuary mouth opening and salinity regime. Impacts fish diversity or abundance and connectivity for fish that use fresh and marine waters (e.g. Australian grayling)
- Increasing range and strength of East Australian Current supports range expansion of northern temperate species
- Increases in hot, dry weather put beach nesting birds at risk from fires
- Increased ambient temperatures impact bull kelp

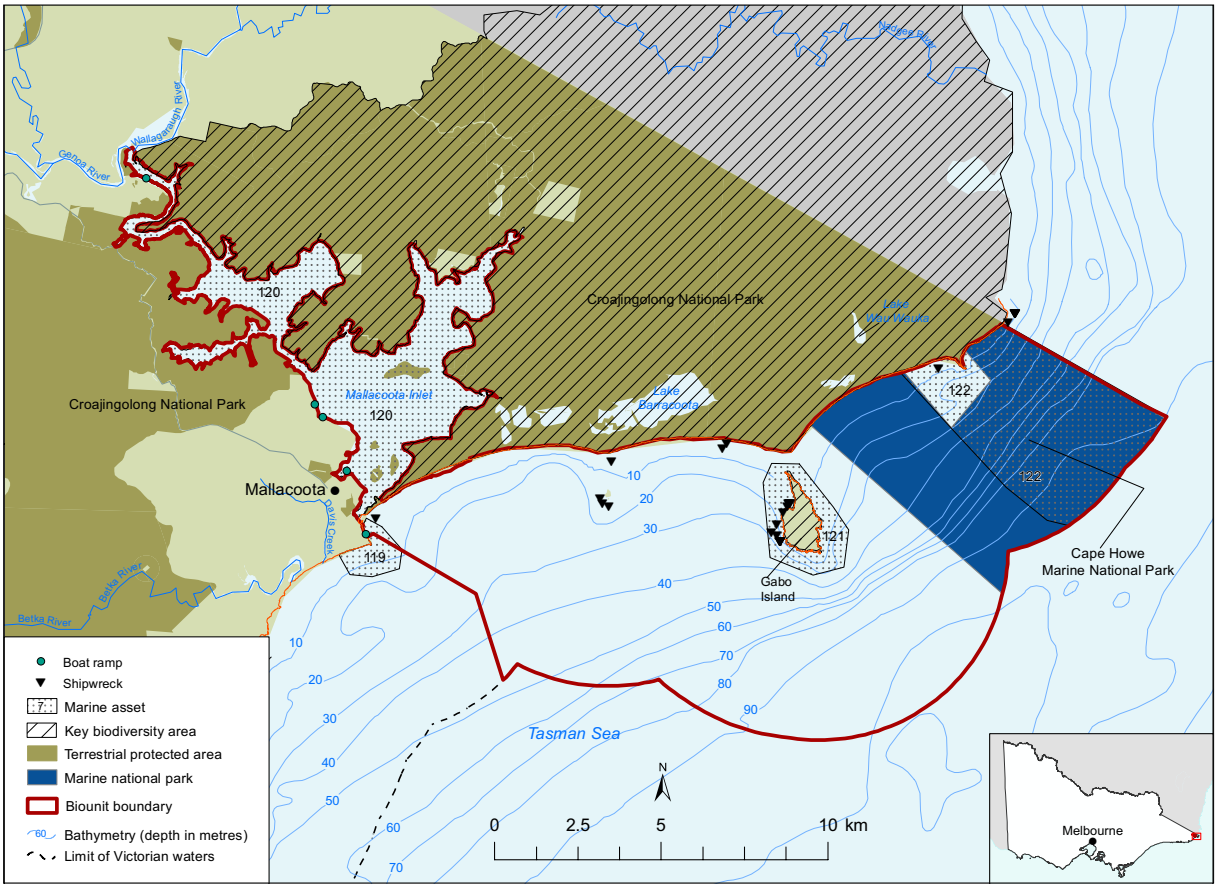
- Coastal saltmarsh and intertidal areas vulnerable to trampling, especially during warmer months

- Likely pests include New Zealand screw shell and green shore crab
- Pests of concern include northern Pacific seastar, European fan worm, Japanese kelp and broccoli weed
- Introduced mammals prey on and disturb roosting, feeding and nesting birds and eggs (e.g. crested tern)
- Black sea urchin forms barrens devoid of habitat-forming macroalgae e.g. kelp
- Disturbance to breeding seals (October to December) leads to crushed or drowned pups, loss of territory by bulls
- Disturbance to beach nesting birds (e.g. little tern) through recreation (e.g. dogs, horses, vehicles, shore-based activities) leads to nesting failure

- Threat of catchment-derived pollutants in stormwater low as catchment relatively unmodified, remote location and protection from adjoining terrestrial parks
- Major flooding or timber harvesting within catchment increases sediment loads

- No data

Biounit 26: Gabo-Howe



Physical setting

The 19,228 hectare Gabo-Howe biounit extends from east of Bastion Point to the New South Wales border. It includes Mallacoota Inlet and the Cape Howe Marine National Park (MNP) (MA 122). Wave-dominated beach and dune systems with low rocky shore occur at Cape Howe. Sediment beds are punctuated by sedimentary, metamorphic and granite outcrops and islands (Gabo Island MA 121, Tullaberga Island). Mallacoota Inlet (MA 120) is the largest estuarine lagoon system in southeastern Australia. The biota is shaped by upwelling, tidal and water mixing influences. Habitats include high energy, weak to moderate tidal streams, patch and complex reefs, sediment beds, sediment seaweed and epibiota beds, deep reef outcrops and coastal lagoons. Eastern temperate, southern cosmopolitan and temperate species co-occur as a result of the mixing of warm eastern and cool southern waters. Many warmer water species reach their southern limits here; thirty-eight species are presumed to be at their distributional limits. The tidal delta and Goodwin Sands within Mallacoota Inlet are of geological and geomorphological significance.

The Gabo-Howe biounit has been mapped at broad habitat (77 per cent) and biotope complex (64 per cent) levels. The dominant biotope complexes are infralittoral fine sand and circalittoral mixed sediments. Most of Cape Howe MNP has been mapped at the biotope complex level (96 per cent). Important biotope complexes are circalittoral mixed sediments (37 per cent), infralittoral fine sand (22 per cent) and Caulerpa beds on sediment (14 per cent). Further mapping within the biounit should prioritise urchin barrens, sponge morphospecies, circalittoral reef.

Unique or rare biotopes include:

- Seagrass: *Zostera* spp. and *Ruppia* spp. beds
- Brown algae: infralittoral bull kelp, lower infralittoral common kelp long-stipe morph, tall-canopy cray weed
- Green algae: circalittoral *Caulerpa trifaria* on coarse sediments and rhodoliths
- Red algae: Gabo Island erect coralline red algae
- Sessile invertebrates: circalittoral tall erect ascending branched sponge and seawhip

Traditional Owners

- The Traditional Owners of Far East Gippsland (the Bidwell, Monero/Ngarigo, Yuin and others) assert rights and interests in the area
- Extensive sites with middens and stone tools

Natural values

- Records of conservation-listed species: humpback whale, killer whale, minke whale, Australian fur seal, leatherback, green and hawksbill turtles
- Conservation-listed southern right whale and long-nosed fur seal have bred in Cape Howe MNP
- Nadgee to Mallacoota Inlet KBA supports nesting little tern, great knot, pied and sooty oystercatchers, occasional hooded plovers. Gabo and Tullaberga Islands KBA supports world's largest colony of little penguin, also breeding colonies for short-tailed shearwater, sooty oystercatcher, white-faced storm-petrel
- All islands, mudflats and sandflats exposed at low water mark within Bottom Lake feeding habitat for migratory shorebirds, breeding colonies of crested tern
- Reef communities include blue groper, leatherjacket, morwong, wrasse
- High diversity of intertidal (Bastion Point MA 119) and shallow subtidal invertebrates
- Saltmarsh (Mallacoota Inlet)
- Seagrass beds with three species recorded in Mallacoota Inlet
- Bull kelp beds
- Rhodolith beds with green algae (*Caulerpa trifaria*)
- Sediment sponge communities
- Croajingolong Biosphere Reserve
- Conservation-listed communities and species (e.g. little tern), endemic or rare species (e.g. rhodoliths) and species at distributional limit particularly vulnerable to environmental change

Social and economic values

European cultural heritage Many shipwrecks, including *Monumental City* (1853), *Gilbert San* (1929), *SS Iron Crown* (1942), *SS Recina* (1943). Evidence of sealing and whaling industries on Gabo Island. Gabo Island lighthouse constructed in response to wreck of *Monumental City*

Coastal development Boating facilities and access to inlet at Mallacoota, Gipsy Point and Genoa. Access to ocean at Bastion Point. Coast with very high vulnerability to erosion under climate change

Tourism and recreation Cape Howe MNP and Croajingolong National Park popular tourist destinations. Mallacoota Inlet popular recreational boating location. Mallacoota Inlet recreational fisheries reserve important for tourism. Opportunities for a range of nature-based recreational activities within a pristine and extremely remote wilderness environment including camping, boating, fishing, swimming, canoe touring of estuaries and inlets, offshore sea kayaking. Opportunities for interpretation and education about the marine environment. Wilderness coast walk. Surf life saving club at Mallacoota. Surfing at Bastian Point

Commercial fishing and aquaculture Commercial fisheries licences for eastern rock lobster zone, eastern abalone zone, eel, one Mallacoota Lower Lake bait licence, sea urchin fishery. There are no current aquaculture reserves or proposals for aquaculture

Ports and shipping Local port at Mallacoota. Heavy shipping lanes offshore. Associated marine pollution risk is high

Energy No proposals for wind, tidal or wave energy. No oil or gas extraction

Emerging uses

- Sea urchin fishery
- Recreational fishing a growing industry

Threats

- Alterations in waves or currents affects pelagic fish populations, seagrass productivity
- Sea level rise alters frequency of estuary mouth opening (e.g. numerous creeks seasonally closed)
- Sea level rise reduces area for seagrass, mudflats and saltmarsh where landward migration not possible
- Sea level rise changes coastal features (including inundation of beaches, intertidal areas, low-lying reefs and islands) which affects shorebird, seabird and seal resting, feeding and breeding habitats
- More frequent storm events and nutrient pulses entering estuaries may cause algal growth and sedimentation
- Decreased freshwater flows alter frequency of estuary mouth opening and salinity regime. Impacts fish diversity or abundance and connectivity for fish that use fresh and marine waters
- Increasing range and strength of East Australian Current supports range expansion of northern temperate species
- Increases in hot, dry weather put beach nesting birds at risk from fires
- Temperatures above 35°C detrimental to penguins on land and in burrows, prolonged exposure causes heat stress and mortality
- Increased ambient temperatures impact bull kelp

- Inappropriate shore-based development (especially around holiday settlements) impacts on biota (e.g. disturbance, reduced water quality)
- Coastal saltmarsh and intertidal areas vulnerable to trampling, especially during warmer months
- Seagrass beds and mudflats sensitive to propeller scarring and vessel groundings in shallow water (especially at low tide) and anchor damage

- Known pests include New Zealand screw shell, New Zealand sea star, green shore crab
- Pests of concern include northern Pacific seastar, European fan worm, Japanese kelp and broccoli weed. Recreational vessels and users also potential vectors for exotic species and diseases (e.g. contaminated diving equipment)
- Introduced mammals prey on and disturb roosting, feeding and nesting birds and eggs (e.g. crested tern)
- Black sea urchin forms barrens devoid of habitat-forming macroalgae e.g. kelp
- Disturbance to beach nesting birds (e.g. little tern) through recreation (e.g. dogs, horses, vehicles, shore-based activities) leads to nesting failure

- Threat of catchment-derived pollutants in stormwater low as catchment relatively unmodified, remote location and protection from adjoining terrestrial parks
- Major flooding or timber harvesting within catchment increases sediment levels
- Genoa River in moderate condition

- Proximity to shipping lanes and use by recreational boats increase vulnerability to oil or chemical spills. Impacts include oiling of seabirds, oil accumulation over intertidal areas, contamination of ground or surface water, loss of recreation
- Marine debris and litter and other debris from urban areas (e.g. Mallacoota) leads to entanglement in and ingestion of thin plastics by marine fauna

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APPENDIX 1
Common and scientific names

Algae

Common name	Scientific name	Comment
Broccoli weed	*Codium fragile fragile*	pest
Brown algae	*Caulocystis* spp. *Cystophora cymodocea* *Myriodesma tuberosa* *Zonaria* sp.	 rare rare rare
Bull kelp	*Durvillaea potatorum*	threatened
Common kelp	*Ecklonia radiata*	
Cray weed	*Phyllospora comosa*	
Dinoflagellate	*Alexandrium tamarense* *Alexandrium minutum*	cause paralytic shellfish poisoning in humans
Giant kelp	*Macrocystis pyrifera*	threatened
Green algae	*Caulerpa racemosa* var. *cylindracea* *Caulerpa* spp. *Caulerpa trifaria* *Codium pomoides*	pest rare
Japanese kelp	*Undaria pinnatifida*	pest
Neptune's necklace (brown alga)	*Hormosira banksii*	
Red algae	*Erythroneaema ceramoides* *Grateloupia turuturu* *Porphyropsis minuta* *Scageliopsis pratens*	rare pest rare rare
Rhodolith beds	*Hydrolithon rupestre* *Lithothamnion superpositum* *Mesophyllum engelhartii* *Neogoniolithon brassica-florida*	endemic

Plants

Common name	Scientific name	Comment
Boxthorn	*Lycium ferocissimum*	weed
Coastal hollyhock	*Malva preissiana*	weed
Cord grass	*Spartina anglica* *S. x townsendii* sp.	weed
Couch-grass	*Cynodon dactylon*	weed
Estuary grass	Ruppia spp.	conservation listed

Plants

Common name	Scientific name	Comment
Galenia	*Galenia* spp.	weed
Kikuyu	*Pennisetum clandestinum*	weed
Marram grass	*Ammophila arenaria*	weed
Mirror bush	*Coprosma repens*	weed
Prickly saltwort	*Salsola tragus*	weed
Sea spurge	*Euphorbia paralias*	weed
Seagrass (eelgrass)	*Zostera muelleri* *Zostera nigricaulis* *Zostera* spp.	conservation listed conservation listed conservation listed
Seagrass (paddlegrass)	*Halophila australis*	conservation listed
Seagrass (sea-nymph)	*Amphibolis antarctica*	conservation listed
Seagrass (strap weed)	*Posidonia australis*	conservation listed
Tree mallow	*Malva arborea*	weed
White mangrove	*Avicennia marina*	conservation listed

Invertebrates

Common name	Scientific name	Comment
Abalone	*Haliotis* sp.	harvested
Ascidian	*Stolonica australis*	
Ascidian (sea squirt)	Class Ascidiacea	
Asian date mussel	*Musculista senhousia*	pest
Asian semele	*Theora lubrica*	pest
Barnacle	Infraclass Cirripedia	
Basket shell	*Corbula gibba*	pest
Bivalve	*Mysella dromanaensis* *Venerupsis obesa*	endemic endemic
Black sea urchin	*Centrostephanus rodgersii*	invasive, harvested
Blacklip abalone	*Haliotis rubra*	harvested
Blue mussel	*Mytilus edulis galloprovinicialis*	harvested
Blue swimmer crab	*Portunus armatus*	

Invertebrates

Common name	Scientific name	Comment
Brittle star	*Amphiura triscacantha* *Ophiacantha heterotyla* *Ophiocomina australis*	conservation listed conservation listed
Bryozoan	Phylum Bryozoa *Bugula dentata* *Bugula neritina* *Watersipora subtorquata*	 pest pest pest
Calamari (squid)	*Sepioteuthis australis*	harvested
Common brooch-shell	*Neotrigonia margaritacea*	rare
Coral	Class Anthozoa *Erythropodium hicksoni*	
Corio sea cucumber	*Thyone nigra*	conservation listed
Crab	*Halicarcinus* sp.	rare
Crustacean	Subphylum Crustacea	
Cunjevoi	*Pyura stolonifera*	
Echinoderm	Phylum Echinodermata	
Eleven-arm seastar	*Coscinasterias muricata*	endemic
European fan worm	*Sabella spallanzanii*	pest
Feather star	*Cenolia* sp.	
Flame limpet	*Notoacmea flammea*	rare
Flat oyster	*Ostrea angasi*	harvested
Gastric brooding seastar	*Smilasterias multipara*	rare
Gastropod	*Eatoniella victoriae*	endemic
Ghost shrimp	*Biffarius arenosus* *Eucallix tooradin* *Michelea microphylla* *Paraglypturus tooradin* *Trypaea australiensis*	 conservation listed conservation listed rare
Green shore crab	*Carcinus maenas*	pest
Greenlip abalone	*Haliotis laevigata*	harvested
Hydroid fan	Class Hydrozoa	
Hydrozoan	Class Hydrozoa	
Lamp shell	*Magellania flavescens*	rare

Invertebrates

Common name	Scientific name	Comment
Mollusc	*Cystiscus halli* *Eulima styliformis* *Eulima victoriae* *Liotella vercoi* Phylum Mollusca	endemic endemic endemic endemic
Mussel	*Mytilus* sp.	harvested
New Zealand screw shell	*Maoricolpus roseus*	pest
New Zealand seastar	*Astrostole scabra*	pest
Northern Pacific seastar	*Asterias amurensis*	pest
Opisthobranch	*Platydoris galbana* *Rhodope* sp.	conservation listed conservation listed
Pacific oyster	*Crassostrea gigas*	pest
Pipi	*Donax deltoides*	harvested
Polychaete worm	Class Polychaeta	
Port Phillip chiton	*Bassethulia glypta*	conservation listed
Purple sea star	*Patiriella brevispina*	
Red swimmer crab	*Nectocarcinus turberculosis*	rare
Rock lobster	*Jasus edwardsii*	harvested
Sabellid tube worms	*Euchone* sp. *Myxicola infundibulum*	pest pest
Scallops (commercial scallop)	*Pecten fumatus*	harvested
Sea cucumber	*Apsolidium densum* *Apsolidium handrecki* *Trochodota shepherdi* *Pentocnus bursatus*	conservation listed conservation listed conservation listed conservation listed
Sea horse	Family Syngnathidae	conservation listed
Sea pen	*Sarcoptilus grandis*	
Sea plume (soft coral)	Order Alcyonacea	
Sea slug	Subclass Heterobranchia	
Sea star	*Nectria macrobranchia*	
Sea tulip	*Pyura spinifera*	
Sea urchin	Class Echinoidea	

Invertebrates

Common name	Scientific name	Comment
Sea whip (soft coral)	Order Alcyonacea	
Seastar	Class Asteroidea	
Smooth shore crab	*Cyclograpsis granulosis*	rare
Snapping shrimp	*Alpheus australosulcatus* *Paraglyptus tooradin*	rare rare
Soft coral	*Pseudogorgia godeffroyi*	rare
Southern hooded shrimp (snapping shrimp)	*Athanopsis australis*	conservation listed
Spider crab	*Notomithrax* sp.	rare
Sponge	Phylum Porifera	
Squid	*Nototodarus* sp. and *Sepioteuthis* sp.	harvested
Stalked hydroid	*Ralpharia coccinea*	conservation listed
Sydney cockle	*Andara tripezia*	rare
Turban shell	*Turbo undulata*	
Velvet sea star	*Patiriella vernicina*	
Whelk	*Fax molleri*	endemic
White sea urchin	*Heliocidaris erythrogramma*	potential pest

Fish

Common name	Scientific name	Comment
Australian bass	*Percalates novemaculeata*	harvested
Australian grayling	*Prototroctes maraena*	conservation listed
Australian salmon	*Arripis trutta*	harvested
Australian snapper	*Pagrus auratus*	harvested
Banded morwong	*Cheilodactylus spectabilis*	harvested
Barber perch	*Caesioperca rasor*	
Barracouta	*Thyrsites atun*	harvested, declining
Bastard trumpeter	*Latridopsis forsteri*	
Black bream	*Acanthopagrus butcheri*	harvested
Blue-throated wrasse	*Notolabrus tetricus*	harvested
Butterfly perch	*Caesioperca lepidoptera*	

Fish

Common name	Scientific name	Comment
Common gurnard perch	*Neosebastes scorpaenoides*	rare
Dusky morwong	*Dactylophora nigricans*	harvested, declining
Eel	*Anguilla* sp.	harvested
European carp	*Cyprinus carpio*	pest
Flathead	Family Platycephalidae	harvested
Flounder	Families Rhombosoleidae and Bothidae	harvested
Garfish	Family Hemiramphidae	harvested
Herring cale	*Olisthops cyanomelas*	harvested
King George whiting	*Sillaginodes punctatus*	harvested
Kingfish	*Seriola lalandi*	harvested
Leafy sea dragon	*Phycodurus eques*	conservation listed
Leatherjacket	Family Monacanthidae	harvested
Long-finned pike	*Dinolestes lewini*	
Magpie perch	*Cheilodactylus nigripes*	
Moonlighter	*Tilodon sexfasciatus*	
Morid cod	Family Moridae	
Mulloway	*Argyrosomus japonicus*	harvested
Parrotfish	Family Labridae	
Pilchard (sardine)	*Sardinops sagax*	harvested
Purple wrasse	*Notolabrus fucicola*	harvested
Rock flathead	*Platycephalus laevigatus*	harvested
Sea dragon	Family Syngnathidae	conservation listed
Short-finned eel	*Anguilla australis*	harvested
Silver trevally	*Pseudocaranx dentex*	harvested
Southern bluefin tuna	*Thunnus maccoyii*	both conservation listed, harvested
Whiting	Family Sillaginidae and Odacidae	harvested
Wrasse	Family Labridae	harvested

Chondrichthyans

Common name	Scientific name	Comment
Cat shark	Family Scyliorhinidae	
Elephantfish	*Callorhinchus milii*	harvested
Great white shark	*Carcharodon carcharias*	conservation listed
Grey nurse shark	*Charcharias taurus*	conservation listed
Gummy shark	*Mustelus antarcticus*	harvested
Port Jackson shark	*Heterodontus portusjacksoni*	
School shark	*Galeorhinus galeus*	both conservation listed, harvested
Shark	Class Chondrichthyes	
Thresher shark	*Alopias vulpinus*	

Birds

Common name	Scientific name	Comment
Australasian bittern	*Botaurus poiciloptilus*	conservation listed
Australasian gannet	*Morus serrator*	
Australian pelican	*Pelecanus conspicillatus*	
Australian white Ibis	*Threskiornis moluccus*	
Banded stilt	*Cladorhynchus leucocephalus*	
Bar-tailed godwit	*Limosa lapponica*	conservation listed
Black swan	*Cygnus atratus*	
Black-browed albatross	*Thalassarche melanophris*	
Black-faced cormorant	*Phalacrocorax fuscescens*	conservation listed
Blue-billed duck	*Oxyura australis*	
Caspian tern	*Hydroprogne caspia*	
Chestnut teal	*Anas castanea*	
Common diving-petrel	*Pelecanoides urinatrix*	
Crested tern	*Thalasseus bergii*	conservation listed
Curlew sandpiper	*Calidris ferruginea*	conservation listed
Double-banded plover	*Charadrius bicinctus*	conservation listed
Eastern curlew	*Numenius madagascariensis*	conservation listed

Birds

Common name	Scientific name	Comment
Fairy prion	*Pachyptila turtur*	conservation listed
Fairy tern	*Sternula nereis*	conservation listed
Great knot	*Calidris tenuirostris*	conservation listed
Grey plover	*Pluvialis squatarola*	conservation listed
Hooded plover	*Thinornis rubricollis*	conservation listed
Kelp gull	*Larus dominicanus*	conservation listed
Little penguin	*Eudyptula minor*	conservation listed
Musk duck	*Biziura lobata*	conservation listed
Orange-bellied parrot	*Neophema chrysogaster*	conservation listed
Pacific golden plover	*Pluvialis fulva*	conservation listed
Pacific gull	*Larus pacificus*	conservation listed
Peregrine falcon	*Falco peregrinus*	
Pied cormorant	*Phalacrocorax varius*	conservation listed
Pied oystercatcher	*Haematopus longirostris*	
Red knot	*Calidris canutus*	conservation listed
Red-capped plover	*Charadrius ruficapillus*	
Red-necked stint	*Calidris ruficollis*	conservation listed
Sanderling	*Calidris alba*	conservation listed
Sharp-tailed sandpiper	*Calidris acuminata*	conservation listed
Short-tailed shearwater	*Puffinus tenuirostris*	conservation listed
Shy albatross	*Thalassarche cauta*	conservation listed
Silver gull	*Chroicocephalus novaehollandiae*	
Sooty oystercatcher	*Haematopus fuliginosus*	conservation listed
Southern giant petrel	*Macronectes giganteus*	conservation listed
Straw-necked ibis	*Threskiornis spinicollis*	
Wandering albatross	*Diomedea exulans*	conservation listed
Whimbrel	*Numenius phaeopus*	conservation listed
White-bellied sea eagle	*Haliaeetus leucogaster*	conservation listed
White-faced storm-petrel	*Pelagodroma marina*	conservation listed

Marine mammals

Common name	Scientific name	Comment
Australian fur seal	*Arctocephalus pusillus*	conservation listed
Australian sealion	*Neophoca cinerea*	conservation listed
Blue whale	*Balaenoptera musculus*	conservation listed
Bottlenose dolphin	*Tursiops truncatus*	conservation listed
Burrunan dolphin	*Tursiops australis*	conservation listed
Common dolphin	*Delphinus delphis*	conservation listed
Fin whale	*Balaenoptera physalus*	conservation listed
Humpback whale	*Megaptera novaeangliae*	conservation listed
Killer whale	*Orcinus orca*	conservation listed
Leopard seal	*Hydrurga leptonyx*	conservation listed
Long-finned pilot whale	*Globicephala melas*	conservation listed
Long-nosed fur seal	*Arctocephalus forsteri*	conservation listed
Minke whale	*Balaenoptera acutorostrata*	conservation listed
Pygmy blue whale	*Balaenoptera musculus brevicauda*	conservation listed
Sei whale	*Balaenoptera borealis*	conservation listed
Southern elephant seal	*Mirounga leonina*	conservation listed
Southern right whale	*Eubalaena australis*	conservation listed
Subantarctic fur seal	*Arctocephalus tropicalis*	conservation listed

Marine reptiles

Common name	Scientific name	Comment
Green turtle	*Chelonia mydas*	conservation listed
Hawksbill turtle	*Eretmochelys imbricata*	conservation listed
Leatherback turtle	*Dermochelys coriacea*	conservation listed
Loggerhead turtle	*Caretta caretta*	conservation listed

APPENDIX 2
Biotope complex descriptions

The following list of biotope complexes and descriptions has been taken from the CBiCs catalogue available on the CoastKit website at http://dev-coastkit.cbics.org/

Level 4 Biotope complex name (short name)	Description	Level 3 Habitat complex	Level 2 Broad habitat
Amphibolis antarctica on moderate energy rock with sandy veneer (*Amphibolis*)	*Amphibolis* stands characterised by horizontal rhizomes attached to low profile reef or gravel buried in a sandy veneer. Patches may partially extend into sand. Emergent rock typically supports sub-canopy browns and sandy veneer seaweeds. Stems and canopy may be associated with high diversity of epiphytes, from encrusting coralline algae to large sub-canopy brown seaweeds, including *Cystophora* species and the introduced *Undaria pinnatifida*. Stands usually interspersed with bare sand patches in reef hollows or at the deeper edges of the reef extent.	Moderate energy	Infralittoral rock
Campbells Cove shallow sand (Campbells-sand)	Offshore from the Werribee region, Portarlington and other shallow environments. Very high species richness.	Sand 2	Sublittoral sediment
Capel Sound intermediate muddy sand (Capel-inter-muddy sand)	Intermediate moderate abundance and diversity infauna with distinct epifauna. From Capel Sound to south of Hovel Pile, but not including Sound Spoil Ground or the Hurricane. Differentiated on sediment type, microphytobenthos, infauna and epibiota.	Sand 2	Sublittoral sediment
Caulerpa assemblages on low energy rock (*Caulerpa*)	Reef *Caulerpa* mats and assemblages on low energy rock.	Low energy	Infralittoral rock
Caulerpa beds on sediment (*Caulerpa*)	*Caulerpa* beds on sediment.	Seaweeds	Sublittoral sediment
Centrostephanus grazed barrens (*Centrostephanus* barrens)	*Centrostephanus* grazed barrens.	High energy	Infralittoral rock
Circalittoral coarse sediment (Circalittoral)	Tide-swept circalittoral coarse sands, gravel and shingle generally in depths of over 15-20 m. This habitat may be found in tidal channels of marine inlets, along exposed coasts and offshore. This habitat, as with shallower coarse sediments, may be characterised by robust infaunal polychaetes, mobile crustacea and bivalves.	Coarse	Sublittoral sediment
Circalittoral fine sand (Circalittoral fine)	Clean fine sands with less than 5% silt/clay in deeper water, either on the open coast or in tide-swept channels of marine inlets in depths of over 15-20 m. The habitat may also extend offshore and is characterised by a wide range of echinoderms, polychaetes and bivalves. This habitat is generally more stable than shallower, infralittoral sands and consequently supports a more diverse community.	Sand	Sublittoral sediment

Level 4 Biotope complex name (short name)	Description	Level 3 Habitat complex	Level 2 Broad habitat
Circalittoral mixed sediments (Circalittoral mixed)	Mixed (heterogeneous) sediment habitats in the circalittoral zone (generally below 15-20 m) including well mixed muddy gravelly sands or very poorly sorted mosaics of shell, cobbles and pebbles embedded in or lying upon mud, sand or gravel. Due to the variable nature of the seabed a variety of communities can develop which are often very diverse. A wide range of infaunal polychaetes, bivalves and echinoderms and burrowing anemones often present in such habitat and the presence of hard substrata (shells and stones) on the surface enables epifaunal species to become established. The combination of epifauna and infauna can lead to species rich communities.	Mixed	Sublittoral sediment
Circalittoral rock and other hard substrata	Circalittoral rock is characterised by animal dominated communities (a departure from the algae dominated communities in the infralittoral zone). The circalittoral zone can itself be split into two sub-zones; upper circalittoral (foliose red algae present but not dominant) and lower circalittoral (foliose red algae absent). The depth at which the circalittoral zone begins is directly dependent on the intensity of light reaching the seabed; in highly turbid conditions, the circalittoral zone may begin just below water level at mean low water springs (MLWS). The biotopes identified in the field can be broadly assigned to one of three energy level categories: high, moderate and low energy circalittoral rock (used to define the habitat complex level). The character of the fauna varies enormously and is affected mainly by wave action, tidal stream strength, salinity, turbidity, the degree of scouring and rock topography. It is typical for the community not to be dominated by single species, as is common in shore and infralittoral habitats, but rather comprise a mosaic of species. This, coupled with the range of influencing factors, makes circalittoral rock a difficult area to satisfactorily classify; particular care should therefore be taken in matching species and habitat data to the classification.		Circalittoral rock
Coastal dry saltmarsh (Dry saltmarsh)	Herbland to low shrubland of upper saltmarsh, subject to relatively infrequent or rare tidal inundation. Floristics: variously dominated by *Sarcocornia blackiana, Frankenia pauciflora, Disphyma crassifolium, Angianthus preissianusor* very rarely *Sebaea albidiflora. Sarcocornia quinqueflorais* often present, with associated species variously including *Samolus repens, Hemichroa pentandra, Triglochin striata, Suaeda australis* and *Distichlis distichophylla.* A wide range of annual species can be present in relatively intact sites, but since the 1980s these have been largely displaced by invasions of introduced species, notably *Hordeum marinum.* The range of the indigenous annual flora in the data variously included *Angianthus preissianus, Sebaea albidiflora, Isolepis marginata, Apium annuum, Triglochin mucronata, Triglochin minutissima, Senecio halophilus, Cotula vulgaris* var. *. australasica, Hymenolobus procumbens* and *Hydrocotyle capillaris.* Structure: low shrubland or herbland, usually less than 0.3 m in height. Habitat: upper zones of saltmarsh in lower rainfall areas, subject to infrequent or rare tidal inundation and including sustained dry periods. Can also occur in remnant near-coastal lacustrine sites which no longer have direct access to tidal inundation events.	Saltmarsh	Littoral sediment

Level 4 Biotope complex name (short name)	Description	Level 3 Habitat complex	Level 2 Broad habitat
Coastal saltmarsh-Wet saltmarsh herbland	Low herbland dominated by succulent salt-tolerant (halophytic) herbs or semi-shrubs that occupies low-lying areas subject to regular inundation. Often very few species occur in this community and beaded glasswort dominates. This community is widespread but confined to restricted areas of suitable habitat in sheltered parts of the Victorian coast.	Saltmarsh	Littoral sediment
Coastal saltmarsh-Wet saltmarsh shrubland	Dominated by halophytic species and subject to regular tidal inundation. Often very few species occur in this community and shrubby glasswort dominates. It is largely confined to the area between Breamlea and Corner Inlet pieces and subject to regular tidal inundation.	Saltmarsh	Littoral sediment
Coastal tussock saltmarsh (Tussock saltmarsh)	Upper saltmarsh zones dominated by robust tussock-forming grasses or graminoids. Floristics: dominated by either *Gahnia filum* or *Austrostipa stipoides* with a range of halophytic species at lower covers. *Sarcocornia quinqueflorais* typically present, with *Samolus repens, Suaeda australis* and *Distichlis distichophylla* also relatively frequent associates. Structure: tussock sedgeland to around 2 m or tussock grassland to around 1.5 m high. Habitat: less frequently inundated zones of coastal saltmarshes. *Gahnia filumis* apparently dominant on heavier soils with a higher salt content, with *A. stipoides* occurring on peaty soils or where some leaching of salt occurs from the upper soil layers.	Saltmarsh	Littoral sediment
Corio Bay silty-muds (Corio-silty muds)	Corio Bay muddy sediments. Low species richness. Based on infauna and epibiota.	Sublittoral mud 2	Sublittoral sediment
Crustose coralline algal communities with combinations of thallose red algae and scattered sponges on high energy circalittoral rock (Crustose corraline)	High energy open coast circalittoral rock with a pominence of crustose coralline algae and various combinations of thallose red algae, trapped sand, bushy bryozoans and scattered low erect and small seabed covering sponges. Tall erect sponges uncommon. Occurs on sandy veneer, low complexity and high complexity reef.	High energy	Circalittoral rock
Elwood/Seaford shallow sand (Elwood/Seaford-sand)	Shallow water off Ormond, Brighton and Seaford. Also at Capel Sound Spoil Ground in the south. Based on infauna, epibiota and infauna/microphytobenthos.	Sand 2	Sublittoral sediment

Level 4 Biotope complex name (short name)	Description	Level 3 Habitat complex	Level 2 Broad habitat
Estuarine wetland	Vegetation dominated by sea rush, variously with a component of small halophytic herbs, occurring in regularly inundated wetlands of estuarine flats or other intertidal areas subject to freshwater inputs associated with seepage or local runoff. Distinguished from estuarine reedbed by the smaller stature and reduced dominance of *Phragmites australis* (and greater diversity), from coastal saltmarsh by the dominance of *Juncus kraussii* (sea rush) and from estuarine scrub by the general absence of woody species. Floristics: dominated by *Juncus kraussii*, often with stunted and sub-dominant *Phragmites australis* (common reed) and, infrequently in marginal sites, *Bolboschoenus caldwellii* (salt club-sedge). The most frequent associated species include *Samolus repens* (creeping brookweed), *Selliera radicans* (shiny swamp-mat), *Sarcocornia quinqueflora* (beaded glasswort), *Distichlis distichophylla* (Australian salt-grass), *Triglochin striata* (streaked arrowgrass) and *Suaeda australis* (austral seablite). While poorly represented in the quadrat data, *Disphyma crassifolium* ssp. *clavellatum* (rounded noonflower) is also a common associated species, and appears to have increased under prolonged drought conditions. The most frequent introduced species recorded from this vegetation type are *Atriplex prostrata* (hastate orache), *Aster subulatus* (aster-weed) and *Plantago coronopus* (buckthorn plantain). *Juncus acutus* (spiny rush) can also be a serious environmental weed in this habitat. Structure: rushland, generally less than about 1 m in height. Habitat: estuarine wetlands of estuarine flats and portions of saltmarshes subject to freshwater inputs associated with seepage or local runoff.	Saltmarsh	Littoral sediment
High energy circalittoral rock with seabed covering sponges (Covering sponges)	Moderate to high complexity circalittoral rock, including ramp /slope geoforms, with a predominance of seabed covering sponges and other cushion fauna. Erect forms may be common but mostly low in height, less than 40 cm. There is often trapped sand amongst the sponges but does not form veneer patches.	High energy	Circalittoral rock
High energy *Durvillaea* communities (*Durvillaea*)	*Durvillaea* dominated communities, usually associated with highly scoured substrata colonised by crustose coralline algae or intertidal biota if occurring in the swash zone.	High energy	Infralittoral rock
High energy *Ecklonia* (Ecklonia)	High energy *Ecklonia radiata* communities.	High energy	Infralittoral rock
High energy *Ecklonia-Phyllospora* communities (*Ecklonia-Phyllospora*)	Mixed *Ecklonia radiata* and *Phyllospora comosa* dominated communities where both species have an appreciable proportion of the canopy structure, but varying in relative dominance. Occurs in less than extremely exposed conditions. Often associated with sand-affected reef and behind surf breaks. Note: *Ecklonia radiata* may be a minor component in the *Phyllospora* biotope complex.	High energy	Infralittoral rock
High energy lower infralittoral zone (Lower infralittoral)	Red algal dominated communities ranging from *Ecklonia* park to mixed red and browns to mixed reds and sessile invertebrates. Excludes *Centrostephanus* grazed barrens.	High energy	Infralittoral rock

Level 4 Biotope complex name (short name)	Description	Level 3 Habitat complex	Level 2 Broad habitat
High energy *Phyllospora* communities (*Phyllospora*)	*Phyllospora* dominated communities, often associated with highly scoured substrata colonised by crustose coralline algae and with low to moderate abundance of thallose algal understorey species.	High energy	Infralittoral rock
High energy sandy veneer and scour turf communities (Sandy scour)	Seaweed communities on reef with sandy veneer or with considerable trapped sand and subject to scouring.	High energy	Infralittoral rock
High energy sub-canopy brown seaweed communities (Sub-canopy browns)	High energy sub-canopy brown seaweed communities	High energy	Infralittoral rock
Infralittoral bare mixed sediments (Infralittoral mixed)	Shallow mixed (heterogeneous) sediments in fully marine or near fully marine conditions, supporting various animal-dominated communities, with relatively low proportions of seaweeds. This habitat may include well mixed muddy gravelly sands or very poorly sorted mosaics of shell, cobbles and pebbles embedded in mud, sand or gravel. Due to the quite variable nature of the sediment type, a widely variable array of communities may be found.	Mixed	Sublittoral sediment
Infralittoral fine sand (Infralittoral fine)	Clean sands which occur in shallow water, either on the open coast or in tide-swept channels of marine inlets. The habitat typically lacks a significant seaweed component and is characterised by robust fauna, particularly amphipods and robust polychaetes.	Sand	Sublittoral sediment
Infralittoral rock and other hard substrata	Infralittoral rock and other hard substrata		Infralittoral rock
Littoral rock	Littoral rock includes habitats of bedrock, boulders and cobbles which occur in the intertidal zone (the area of the shore between high and low tides) and the splash zone. The upper limit is marked by the top of the lichen zone and the lower limit by the top of the laminarian kelp zone. There are many physical variables affecting rocky shore communities wave exposure, salinity, temperature and the diurnal emersion and immersion of the shore. Wave exposure is most commonly used to characterise littoral rock, from extremely exposed on the open coast to extremely sheltered in enclosed inlets. Exposed shores tend to support faunal-dominated communities of barnacles and mussels and some robust seaweeds. Sheltered shores are most notable for their dense cover of fucoid seaweeds, with distinctive zones occurring down the shore. In between these extremes of wave exposure, on moderately exposed shores, mosaics of seaweeds and barnacles are more typical.		Littoral rock
Low complexity circalittoral rock with non-crowded erect sponges (Low complexity sparse erect)	Low complexity circalittoral rock with predominant covering of small colonies < 10 cm and occasional to prominent but well spaced or non-crowded erect sponges. Larger seabed covering sponges mostly absent.	High energy	Circalittoral rock

Level 4 Biotope complex name (short name)	Description	Level 3 Habitat complex	Level 2 Broad habitat
Medium to low density ascidian clumps (non-reef forming) (Ascidian clumps)	Medium to low density ascidian clumps. Associations include sponges and agglomerated shell fragments on banks and sparse clumps on sandy shell sediments. Ascidian clumps usually have epiphytic red thallose and/or fine algae or *Caulerpa.*	Epibenthos	Sublittoral sediment
Moderate to high complexity circalittoral rock with covering of small colonies and well spaced erect sponges (Small-sparse erect)	Moderate to high complexity circalittoral rock with predominant covering of small colonies < 10 cm and prominent but well spaced erect sponges. Larger seabed covering sponges mostly absent.	High energy	Circalittoral rock
Moderate to high complexity circalittoral rock with prominent sea plumes, sea tulips and hydroid fans (Plumes-tulips-fans)	Assemblages on moderate to high complexity circalittoral rock with prominence of sea tulips such as *Pyura spinifera,* sea plumes such as *Pteronisis* and hydroid fans such as *Solanderia fuscus* and *Clathrozoan wilsoni.* Sponges are the predominant substratum cover.	High energy	Circalittoral rock
Mud channel Port Phillip Bay intermediate muddy sand (PPB-inter-muddy sand)	Intermediate depth sediments surrounding the central basin plus an area at the entrance to the Geelong Arm. High species richness. Based on infauna.	Sand 2	Sublittoral sediment
Port Phillip Bay northern central muds (Northern-cent)	Northern central basin with silty-mud sediment communities at depths greater than 15-20 m. Low species richness. Based on infauna and epibiota.	Sublittoral mud 2	Sublittoral sediment
Port Phillip Bay northern deep lower muds (Northern-deep lower)	Present to the west of the Port Melbourne DMG.Silty mud. Community is based on infauna and microphytobenthos observations.	Sublittoral mud 2	Sublittoral sediment
Port Phillip Bay southern central muds (Southern-cent)	Southern basin with mud sediments. Differentiated on sediment type and infauna and epibiota.	Sublittoral mud 2	Sublittoral sediment
Port Phillip Heads coarse tidal sand (Heads coarse sand)	Southern coarse sands in the Portsea region. Based on infauna.	Sand 2	sublittoral sediment
Posidonia beds (*Posidonia*)	*Posidonia* beds	Seagrass	Sublittoral sediment
Pt Wilson/Altona shallow sand (Wilson/Altona-sand)	Shallow water east and north of Point Wilson and into Geelong Outer Harbour and in the Altona region. High species richness.	Sand 2	Sublittoral sediment
Rye shallow sand (Rye-sand)	Similar to infauna group 7 but differentiated by the epifauna.	Sand 2	Sublittoral sediment

Level 4 Biotope complex name (short name)	Description	Level 3 Habitat complex	Level 2 Broad habitat
Saline aquatic meadow (Aquatic meadow)	Saline aquatic meadow	Saltmarsh	Littoral sediment
Sandy low profile reef wave surge communities (Sandy low profile)	Deep communities on low profile, flat or sandy veneer reef adjacent to or affected by sand inundation and resuspension with considerable sand trapped around base of sponge colonies and clumps.	High energy	Circalittoral rock
Sea whip and tall branching sponge communities on open coast circalittoral rock (Whip-tall branching)	Communities characterised by the presence of sea whips and tall erect branching sponges and an absence of sea plumes. Includes patch reef and sandy veneer communities.	High energy	Circalittoral rock
Seaford intermediate muddy sand (Seaford-inter-muddy sand)	Similar to Infauna group 2 but differentiated by the epifauna.	Sand 2	Sublittoral sediment
Seagrass meadow on littoral sediments (Seagrass)	Sward-forming aquatic herbland of sheltered marine shallows, intertidal flats and lower estuarine habitats. Floristics: dominated by grass-wracks or sea grasses (*Zostera muelleri* ssp. *muelleri* and *Z. muelleri* ssp. *capricornii* and/or *Zostera nigricaulis* and *Z. tasmanica s.l.*), often monospecific and sometimes in close extends into lower estuarine proximity to *Avicennia marina* (white mangrove) stands. *Zostera muelleri* s.l. conspicuous on intertidal mudflats. A localised variant of intertidal habitats, with *Zostera tasmanica* s.l. mudflats of western Port Phillip Bay and Mud Islands includes *Lepilaena marina* (sea water-mat). Structure: herbland. Habitat: sheltered marine shallows, intertidal flats and lower estuarine habitats.	Seagrass	Littoral sediment
Southern *Avicennia marina* mangrove (Mangrove shrub)	Extremely species-poor shrubland vegetation of intertidal zone, dominated by mangroves. Floristics: Characteristically occurs as monospecific stands of *Avicennia marina* (white mangrove). In some marginal stands, species from adjacent coastal saltmarsh or seagrass meadow can also be present e.g. *Sarcocornia quinqueflora* (beaded glasswort), *Suaeda australis* (austral seablite), *Tecticornia arbuscula* (shrubby glasswort), *Zostera muelleri* s.l. (dwarf grass-wrack). Structure: Low shrubland, usually less than 2 m in height. Habitat: Sheltered embayments and tidal creeks.	Mangrove	Littoral sediment
Southern tidal sand (South tidal-sand)	Southern sands, shallow tidal coarse sands. Holdgate et al. describes the shallow banks as having fine grained sand and the channels as fine grained with a coarse biogenic fraction. Based on infauna Group 5 and infauna/microphytobenthos.	Sand 2	Sublittoral sediment
Sublittoral mud in variable salinity (estuaries) (Variable salinity mud)	Shallow sublittoral muds, extending from the extreme lower shore into the subtidal in variable salinity (estuarine) conditions. Such habitats typically support communities characterised by oligochaetes, and polychaetes. In lowered salinity conditions the sediments may include a proportion of coarser material, where the silt content is sufficient to yield a similar community to that found in purer muds	Mud	Sublittoral sediment

Level 4 Biotope complex name (short name)	Description	Level 3 Habitat complex	Level 2 Broad habitat
Sublittoral sediment	Sediment habitats in the sublittoral near shore zone (i.e. covering the infralittoral and circalittoral zones), typically extending from the extreme lower shore down to the edge of the bathyal zone (200 m). Sediment ranges from boulders and cobbles, through pebbles and shingle, coarse sands, sands, fine sands, muds, and mixed sediments. Those communities found in or on sediment are described within this broad habitat type.		Sublittoral sediment
Werribee /St Leonards/ Mornington shallow sand (Werribee-St Leonards-Mornington-sand)	Similar to infauna group 9 but differentiated by the epifauna.	Sand 2	Sublittoral sediment
Zostera and *Ruppia* beds (*Zostera-Ruppia*)	Beds of seagrass, including *Zostera muelleri*, *Zostera tasmanica*, *Zostera nigricaulis*, *Ruppia* spp. and *Lepilaena* spp. in shallow sublittoral sediments. These communities are generally found in sheltered embayments, marine inlets, estuaries and lagoons, with very weak tidal currents. They may inhabit low, variable and full salinity marine habitats. Whilst generally found on muds and muddy sands they may also occur in coarser sediments, particularly marine examples of *Zostera* communities. Sparse *Zostera* beds can also be present in exposed and moderately exposed sediments on the open coast.	Seagrass	Sublittoral sediment

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