VICTORIA'S COAST

PREPARING FOR THE FUTURE

Victorian Coastal Council

VICTORIA State Government

2018

Victorian Coastal Council Science Panel

This brochure summarises a Victorian Coastal Council Science Panel workshop to examine Victoria's coastal and marine environments under new global information about future climate change. The findings were reviewed and critiqued by experts with the Science Panel, which provides scientific advice on coastal issues in Victoria.

The Victorian Coastal Council

The Victorian Coastal Council was a statutory body advising the Minister for Energy, Environment and Climate Change on coastal issues in Victoria. Replaced in July 2018 by the Marine and Coastal Council, both councils were tasked with a range of advisory functions.

In 2017, the Science Panel of the Victorian Coastal Council held a workshop to examine the likely future impacts of climate change on the state's coastal and marine environments. Climate change is one of a number of pressures on Victoria's coast, including population growth, resource use, ageing infrastructure, input of nutrients and toxins, introduction of exotic species, and habitat change.

This publication presents the main findings on the likely impacts of climate change, including important indicators of change, and documents the monitoring and research needed to support the effective management of Victoria's coast.

Victoria's climate is changing

Victoria's climate is warmer and drier than in previous decades, and the rate of warming has increased since 1960. Average rainfall has declined since the 1950s, especially in autumn. Sea level has risen by about 225 mm since 1880.

The world's oceans are warming, with temperatures increasing the most in coastal areas. The oceans are also becoming more acidic, as they absorb increasing amounts of carbon dioxide from the air.

Our future climate

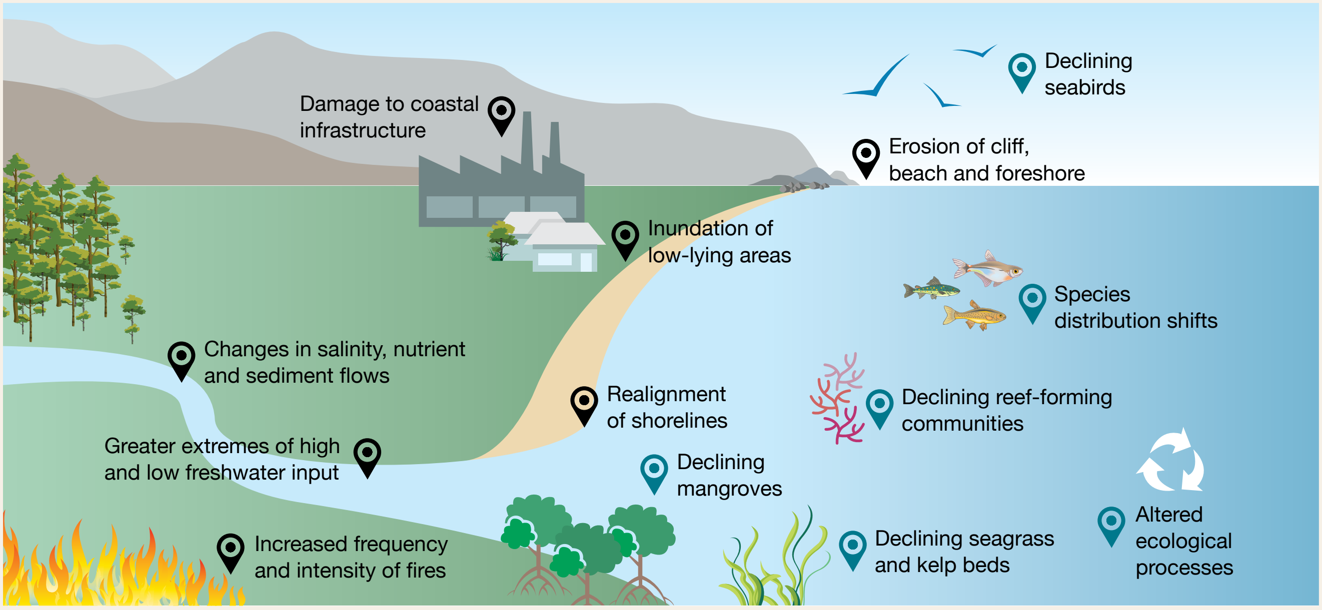
In future, Victoria's coastal regions are expected to have:

- a warmer climate year-round, with an increase in temperatures of between 0.6 °C and 1.3 °C by 2030, and between 1.1 °C and 3.2 °C by 2070 (relative to the climate of 1986 to 2005)
- more hot days and warm spells
- fewer frosts
- harsher fire weather and longer fire seasons
- less rainfall in winter and spring
- more frequent and more intense downpours
- rising sea level of between 8 and 20 cm by 2030 and between 20 and 59 cm by 2070 (relative to the 1986–2005 level), with higher levels should there be greater melting of the Antarctic ice sheet
- increased frequency and height of extreme sea-level events
- an increase in wave height in winter
- warmer oceans, with sea-surface temperatures rising by between 1.1 and 2.5 °C by 2070
- more acidic oceans.

The changes won't always happen individually. Events may compound. For example, heavy rainfall may create flooding at a time when there is a coastal storm surge resulting from strong onshore winds or reduced atmospheric pressure.

Coastal impacts of climate change

Climate change is likely to have considerable impacts on marine life, habitats, ecosystems and landforms, with flow-on effects to society and the economy. Impacts of sea-level rise are likely to include more frequent and extensive inundation of low-lying areas, and erosion of cliffs, beaches and foreshores. Changes in wave direction will cause realignment of beaches. Ocean acidification impedes the ability of calcifying organisms to form their skeletons and the ability of some reef fish to avoid predators. Higher temperatures, as well as changes in ocean currents, are likely to lead to continued species distribution shifts, and spread of invasive species and diseases.



Biological impacts
Physical and chemical impacts

Higher sea temperature | Ocean acidification | Rising sea level | Wind and wave changes | Altered patterns of wet and dry periods | More frequent and extreme storms

MEASURES	IMPACTS
Sea-level rise	● More frequent and extensive inundation of low-lying areas ● Loss of coastal habitat, such as roosting and nesting sites for shorebirds and seabirds ● Cliff, beach and foreshore erosion ● Altered saltmarsh and mangrove habitats ■ The Hooded Plover, which suffers direct impacts such as nest flooding • Declines in seagrass abundance and extent • Increased tidal ranges in locations such as Port Phillip Bay where there is a constricted opening • Damage to infrastructure, such as seawalls, jetties, roads, walking tracks, beach access, dune fencing, navigation aids and drainage systems • Loss of, and damage to, private property, and changes to land use • Altered intertidal areas, saltmarshes and coastal wetlands • Loss of significant heritage sites • Loss of coastal Crown land for tourism and recreation
Wave and wind changes	● Realignment of shorelines ● Changed beach profile and orientation
Ocean current changes	● Impacts on the diversity, distribution and abundance of species
Rainfall changes	● Changed estuaries • Changed salinity, nutrient and sediment flows • Greater extremes of high and low fresh water input • Reduc ed water clarity • Changes in water quality, in particular due to changes in stormwater runoff • Increased frequency and intensity of fires, with impacts beyond the coast
More frequent and extreme storm events	● Intense and destructive flooding of land and buildings on the coast and in areas where drainage systems lose their functionality ● Inundation of low-lying coastal environments ● Beach, foreshore and cliff erosion • Loss of, and damage to, private and public property and infrastructure • Pollution from sewer overflows
Higher sea temperatures	■ Species distribution changes ■ Spread of invasive species and diseases ■ Changes in recruitment patterns, flowering, breeding and migration, including phytoplankton blooms • Altered ocean currents
Changed patterns of wet and dry periods	• Changed salinity, nutrient and sediment flows • Changed estuaries, greater extremes of high and low fresh water input • Reduced water clarity • Increased frequency and intensity of fires, with impacts beyond the coast • More people visiting the coast in hot, dry periods
Ocean acidification	● Impacts on early life stages of species, particularly larvae and plankton ■ Loss of plankton base for food webs ■ Changes to ecological cycles • Damage to reef-building communities, such as molluscs, polychaetes (worms), corals and sponges • Damage to infrastructure

● Yellow circles indicate ‘hot spots’, representing changes that have significant impacts.
■ Blue squares indicate ‘sentinels’, representing changes that could suggest thresholds or tipping points.

Knowledge gaps

Our climate is changing now, and projections show the range of likely changes in future. Physical impacts are more readily measurable and visible than biological impacts, which are more complex and have greater uncertainty. However, the more we know about the likely changes and their mechanisms, the better we will be able to cope with these changes.

The Science Panel lists some important questions, the answers to which will help manage our coastline, the services it provides, and the plants and animals that it supports:

1 How will the coastal environment (sea level, wind, waves, storm surge, ocean currents and circulation patterns) change in future?

2 How will the distribution and abundance of marine species and communities alter with climate change?

3 Which species are candidate indicators, or sentinels, of climate change impacts?

4 How will ocean productivity alter with climate change?

5 How would reduction in non-climate related stressors increase ecosystem resilience to climate change?

Recommended projects to fill these gaps

To help answer these and other important questions, the Science Panel recommends a number of practical research activities. These activities include physical science projects that will help coastal management, and biological projects that will help reveal how changing conditions influence ecological processes. All are aimed at supporting decision-making.

These activities represent discrete, manageable pieces of work that can significantly improve our understanding and capacity to manage the impacts of climate change on Victoria's coast. The recommended research projects are based on the workshop findings, expert interviews and a literature review.

Each activity is designed to lead to action by the relevant coastal and/or marine manager or regulator. Each will require collaboration across marine and coastal science disciplines. Additionally, each will require active translation of the outcomes by researchers into the day-to day decision-making of coastal and marine managers.

General project

- Provide practical advice and support for conservation managers and planners to modify their practices to reduce or manage climate change risks and enhance adaptation options

Physical science projects

- Monitor and model changes to wave direction and strength, and their impacts
- Analyse available sea-water temperature data to provide a baseline at local scales
- Project changes in coastal currents

Biological projects

- Determine invaders of concern under climate change, and the likely early signals of their arrival
- Establish which species are candidate bio-indicators of the impacts of climate change on coastal and marine ecological communities
- Determine the critical thresholds (for example, warming and acidification) to ecosystem change
- Determine how ecosystem function changes when key species are affected by climate change impacts (especially sea level rise, changes in sea surface temperatures or ocean acidification)

Coordination and resourcing

A coordinated approach to marine research is critical. A strategic future program for marine research must include understanding of the main habitats (seagrass, sediment, mangrove, saltmarsh, rocky reefs and water column) and how the habitats interact, as well as the key processes. A systems approach to ecosystems will provide the evidence base for improved decision-making and management interventions.

Long-term data are needed to understand and predict how climate change will affect marine and coastal resources. There is an urgent need to establish – and consolidate existing – long-term monitoring programs.

MORE INFORMATION

Victorian Coastal Council: http://www.vcc.vic.gov.au

Marine and Coastal Act: https://www.coastsandmarine.vic.gov.au/marine-and-coastal-act

Marine and Coastal Council: https://www.coastsandmarine.vic.gov.au

Victoria's coastal and marine environments under projected climate change: impacts, research gaps and priorities: http://www.vcc.vic.gov.au

State of the Bays, 2016 report, Commissioner for Environmental Sustainability Victoria: http://www.ces.vic.gov.au/sotb

CSIRO – Bureau of Meteorology climate change projections: https://www.climatechangeinaustralia.gov.au

CoastAdapt: A changing climate in coastal Australia – build knowledge, take action: https://coastadapt.com.au/

Coastal Risk Australia: Predicted coastal flooding resulting from climate change: http://coastalrisk.com.au

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ACCESSIBILITY

This document is also available in PDF format at http://www.vcc.vic.gov.au

PHOTOS

Cover: Marcia Riederer.

Page 2: (Pier) Marcia Riederer.

Page 3: (Inundation) Moyne Shire Council.

Page 4: (Seawall) Simon Torok;
(Pier) Parks Victoria;
(Sea Dragon) Marcia Riederer;
(Waves) Werner Hennecke.

Page 6: (Wilson's Promontory NP) Chris Pape; (Boat) Parks Victoria.

Page 7: (Tagged chicks) Mike Weston, Deakin University.