



# **Land and biodiversity at a time of climate change**

## **Marine and Coastal Submission June 2007**

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## Table of Contents

|   |                                     |
|---|-------------------------------------|
| <b>2 Introduction</b> .....   | <b>4</b>                            |
| <b>3. Background on Victoria’s Marine and Coastal Environment</b> .....   | <b>5</b>                            |
| 3.1 The importance of maintaining a healthy ocean .....   | 6                                   |
| 3.2 Biodiversity Protection .....   | 6                                   |
| <b>4. Global changes associated with climate change that are likely to impact on the marine and coastal environment and therefore on the long term sustainability of the system as a whole</b> .....                            | <b>8</b>                            |
| 4.1 Acidification of the marine environment .....   | 8                                   |
| 4.2 Melting of the polar ice-.....  | 9                                   |
| 4.3 Temperature Increases .....   | 9                                   |
| 4.4 Changes in rainfall patterns and run-off .....  | 9                                   |
| 4.5 Sea level rises and storms .....  | 9                                   |
| 4.6 Ocean stability and currents .....  | 9                                   |
| 4.7 El Niño Southern Oscillation – Some climate.....  | 10                                  |
| 4.8 Increased fire and wind .....   | 10                                  |
| <b>5. What are the environmental, social and economic values associated with a healthy land-sea biodiversity. How are the present pressures presented, what effect will climate change have, and are there solutions?</b> ..... | <b>10</b>                           |
| <b>5.1 Social and environmental values, present and potential threats</b> .....   | <b>11</b>                           |
| 5.1.2 Seagrass habitats .....   | 11                                  |
| 5.1.3 Coastal wetlands including Saltmarsh and Mangroves .....  | 11                                  |
| 5.1.4 Intertidal communities.....   | 12                                  |
| 5.1.1 Bays and Estuaries .....  | 13                                  |
| 5.1.5 Coastal dunes .....   | <b>Error! Bookmark not defined.</b> |
| 5.1.6 Sponge gardens .....  | 14                                  |
| 5.1.7 Kelp forests .....  | 14                                  |
| 5.1.9 Fish.....   | 15                                  |
| <b>6. What are the main issues affecting the long term sustainability of coastal, estuarine and marine areas</b> .....  | <b>16</b>                           |
| 6.1 Inadequate marine and coastal scientific knowledge.....   | 16                                  |
| 6.2 Healthy well managed catchment.....   | 16                                  |
| 6.3 Coastal Development .....   | 17                                  |
| 6.4 Marine and coastal pests .....  | 18                                  |
| 6.5 Protected marine and coastal ecosystem and associated management .....  | 19                                  |
| 6.6 Public knowledge and education.....   | 19                                  |
| 6.7 Aquaculture .....   | 20                                  |
| <b>7. Current policy limitations for marine and coastal biodiversity</b> .....  | <b>20</b>                           |
| 7.1 Inadequate marine and coastal governance structures .....   | 21                                  |

|   |           |
|---|-----------|
| <b>7.2 Inadequate marine and coastal capacity in management agencies and authorities.....</b> | <b>21</b> |
| <b>7.3 Lack of integration of catchment, coastal and marine management.....</b>               | <b>22</b> |
| <b>8. Conclusion.....</b>   | <b>23</b> |
| <b>9. References .....</b>  | <b>24</b> |

## 2 Introduction

Victoria National Parks Association (VNPA) recognises the right of aboriginal traditional owners to manage the land-sea country of Victoria.

There is presently a biodiversity crisis, and while it may not be noted as such, the plethora of research on individual species and habitats shows a consistent trend, that of decline. The picture shows dwindling numbers of fish and frogs, degradation of habitats and diminishing river health. Victoria's marine and terrestrial biodiversity is not in good shape.

While the VNPA congratulates the Government for recognising the urgent need to address biodiversity, the fabric upon which society exists, there are many concerns about the way this process has begun.

While the Government was certainly a leader in biodiversity management in the days of the Land Conservation Council a decade ago, this is no longer the case. The present biodiversity crisis is no surprise; it is the result of a slow but steady witting away of resources allocated to flora and fauna protection and management. The solution is an immediate investment into Victoria's marine, coastal and terrestrial biodiversity, with the development of appropriate institutional arrangements and resources.

The focus on land in the title of the document, and the complete exclusion of marine and coastal biodiversity in the objectives, has relegated the marine and coastal environment to a position of second cousin. This focus continues throughout the document, highlighting the limited resources available to provide even a basic understanding of what is happening in this area. This early approach needs to be rectified in the green paper.

The focus on land is not new. The document *Our Environment Our Future*, released in April 2005, talks about the objective of achieving healthy marine and coastal areas and yet there are no plans or interim targets mentioned in the brochure, unlike land based issues.

The initial paper calling for submissions should have begun by providing information on the status quo. It should have included an investigation into the drivers, such as the Biodiversity Strategy and *Flora and Fauna Guarantee Act 1995*, looking at what they aimed to achieve and whether they have done this. To discuss the future, we need to understand the present.

The Stern Report stated that climate change demands an urgent global response. While many nations have begun to develop adaptation strategies, few have done more than develop motherhood statements of intent. The success or failure of this biodiversity project will therefore be in the detail. The more timely, specific and detailed the plan, the more likely it is that the plan will succeed.

Planners such as Michael Buxton argue that we need to fundamentally restructure what we do and how we do it. He states that any adaptation strategy to reduce greenhouse gas emissions must recognize that we need to transport less, import and export less, grow more locally, have closed loop production cycles and change what we produce.

A similar radically new perspective will be required to protect biodiversity. A new framework that brings together communities, governments and industry in a way never done before, to work collaboratively to investigate new ways to ensure our common future, is required. The collaboration will need to look at ways to maintain the diversity of life: the sum of all of our native plants and animals, the genetic variation within them, their habitats, and the ecosystems of which they are an integral part.

Historically and for ease of management, it has made sense to separate areas within the natural landscape into parts, so we can appropriately manage and address issues of crucial importance. However, the present breakdown into water, biodiversity, forests etc will no longer serve governments and the wider society as before. To buffer society and the environment against climate change, we will have to rethink how we do everything. To do this, connections and patterns must be investigated, not ignored.

It should also be noted that in order to protect biodiversity everything needs to be investigated. It is with some concern that VNPA notes that there are areas which the Government has chosen specifically to exclude, such as the removal of native plants and animals which clearly impact on biodiversity.

There is also a concern that the constant reference and adherence to the triple bottom line moves the focus away from biodiversity conservation to just social and economic factors. This methodology is diminishing environmental protection, not strengthening it. If the triple bottom line is truly something the State Government is striving for, then this principle should be accordingly adopted and integrated into all economic and social policy.

While this submission focuses on the marine and coastal environment, it will discuss connections with other areas where appropriate.

### **3. Background on Victoria's marine and coastal environment**

Victoria has an incredibly diverse marine environment, with many species endemic to the region. The coastline consists of five marine regions: the Otways, Central Victorian, Flinders, Twofold Shelf and the Bays and Inlets. These regions are like biogeographical provinces where species have originated and occur along the coast.

Victoria's marine environment is part of Australia's cool temperate region. The nearshore and open waters of Victoria contain an extraordinary biodiversity as a result of the varied physical composition of rocky and sandy shores, seagrass meadows, sponge gardens and mangroves.

Species diversity in the sediment of Victoria's nearshore waters is the highest reported in scientific literature, with a substantial number of species still undescribed. Victoria's open coast is also known for its species richness, exceeding even that of California, Chile and South Africa. About 45% of the species of brown algae found on western Victoria are found nowhere else in the world. Despite this abundance of life, little is known about our blue shores.

Pressures on marine and coastal ecosystems are increasing due to rising population, the ongoing demand by industry for resources, the public's increasing access to tourist and recreation facilities, the

development of marinas and the dredging of lagoon channels and beach groynes. All of this is increasing the degradation of coastal habitats and ecosystems<sup>1</sup>. Presently around 80% of Victoria's population resides within 50 km of the coast, with further growth anticipated.

### **3.1 The importance of maintaining a healthy ocean**

To define an ecologically sustainable seascape, it is important to first take a global perspective. The marine, coastal and terrestrial system is highly interconnected; degradation in one area will affect another. While some degradation may, for a time, go unnoticed, there will come a point where the system's stress reaches a point from which it will not longer return.

Marine and coastal scientists note that there is sparse, or in some instances no, data in many areas of the marine environment, making it even more difficult to determine the impact climate change will have. However, what little is known has shown that changes in the ocean's pH will reduce the ability of many organisms to produce shells from calcium carbonate. These small creatures make up most of the ocean's biomass and without them fish stocks will crash.

The Southern Ocean also acts as an important carbon 'sink', containing about 40% of the total anthropogenic CO<sub>2</sub> stored in the global ocean. Southern Ocean processes are important regulators of atmospheric CO<sub>2</sub> and the stability of global climate patterns. Changes in the physical, chemical, and biological processes unique to the Southern Ocean due to future climate change may greatly alter the uptake of CO<sub>2</sub> by the global ocean and could have major regional and global consequences<sup>2</sup>.

Phytoplankton provide half of the oxygen on the planet and zooplankton are the main oceanic secondary producers. Plankton directly and indirectly support all of the world's fisheries and play a central role in the global carbon and nutrient cycles, removing large quantities of carbon from the surface layers of the ocean and distributing it to the deep ocean. Much of the socioeconomic value of the oceans – estimated at US\$21 trillion/year globally – depends on plankton<sup>3</sup>.

Many areas of the marine environment act as fish nurseries, such as kelp forests, estuaries and mangroves. Kelp forests are highly sensitive to change in temperature and estuaries and mangroves are highly sensitive to increases in sea level. While the increase in sea level in itself will not be a problem, development will prevent these systems from migrating inland.

### **3.2 Biodiversity protection**

Protecting Victoria's marine and coastal biodiversity will require a comprehensive strategy to address numerous environmental and social influences and impacts. In 1997, Victoria's biodiversity strategy was released. *The Environment and Conservation Act 1997* stated, amongst other things, that the Council must have the regard:

‘To protect and conserve biodiversity’.

To protect biodiversity is to protect the natural diversity of all life. This means the protection of species, their habitat, and the ecosystems of which they are an integral part.

The ability to protect and appropriately manage marine and coastal areas depends largely on the information available. While some habitat research is being done inside and outside Marine National Parks and on saltmarsh along the Victorian coast, there is still a shortage of biological and environmental data on Victoria's waters. This area should be a priority for biodiversity protection.

There is a view that animals and plants are closely associated with their habitat and therefore that their survival is directly dependent on the condition of this habitat. As a result, the protection of species has generally been focused on habitat protection in the belief that protecting where they live will be sufficient. However, this may not always be the case, as external factors may directly impact on species population dynamics. A pest species may out-compete that of a native species, a disease such as the virus presently attacking the abalone population may take hold or industrial fishing practices may reduce population numbers of a species by either excessive take or simply as result of high by-catch.

As a result, some species may require targeted protection. In the marine and coastal areas, this is complicated, as so little is known about this environment. Species found in Victoria may need targeted protection, either because of their vulnerability, rarity or because they have specific species needs eg seagrass beds, giant kelp, sea-dragons, certain species of shark and marine mammals. Appendix 6 in the Environment Conservation Council's report of August 2000 lists a number of invertebrates requiring protection.

The maintenance of biodiversity requires the understanding of ecological processes, the protection of habitats and, in certain instances, specific species. How these areas are managed will largely impact on their ability to survive present and future threats from pollution, recreational and commercial fishing and effects of climate change such as storm surges, sea level rise, acidification and temperature change.

Throughout this submission, recommendations will be made. These individual solutions, if combined, will provide a robust solution from which to begin protecting Victoria's marine and coastal biodiversity from present and future threats.

**Recommendation 1:** An assessment should be done to identify and develop strategies to protect vulnerable or threatened marine species and communities, using the provisions of the *Flora and Fauna Guarantee Act 1988*, as appropriate. Potential for the use of the "protected aquatic biota" provisions of the *Fisheries Act 1995*, and the *Flora and Fauna Guarantee Act 1998*.

**Recommendation 2:** Further research should be undertaken on biological community composition and structure, both within and external to marine protected areas, with an emphasis on assessing the impacts of harvesting practices on marine flora and fauna.

## 4. Global changes associated with climate change that are likely to impact on the marine and coastal environment and therefore on the long term sustainability of the system as a whole

The Victorian marine and coastal environment is likely to be affected by global changes in climate. While many of these changes are inevitable, the extent of the change will depend on what global strategies are put in place now. The CSIRO Mk 3.5 model notes some of the projected changes likely to be experienced by 2070:<sup>4</sup>

- an increase in 1-2 °C of ocean temperatures around Australia with the greatest warming around SE Australian/Tasman Sea due to strengthening of Eastern Australian Current,
- at depths of 500m an increase in 0.5-1 °C is likely to be experienced,
- there will be an increase of incident solar radiation on the sea's surface in Australian waters, expected to be in the range of 2-7 units  $W m^{-2}$ ,
- surface winds will increase by 0-1.2  $ms^{-1}$ ,
- a decline in pH in 0.2 units is expected.

Some of the large scale effects of climate change are discussed in the following section.

**4.1 Acidification of the marine environment** - As the volume of greenhouse gases emitted into the atmosphere increases, due to human induced activities, more  $CO_2$  will be absorbed by the oceans, particularly in oceans experiencing cooler temperatures. The increase in  $CO_2$  levels in the oceans will have a corresponding effect on the pH level. Research has already found that the ocean's pH levels are decreasing and slowly becoming more acidic. This change in ocean chemistry will have a profound effect on marine organisms and ecosystems.

A more acidic ocean poses a serious threat to marine organisms that secrete skeletal structures. Evidence suggests that acidification will affect the process by which animals such as zooplankton, tropical corals and molluscs make shells and plates from calcium carbonate<sup>5</sup>. The loss of plankton, which makes up nearly half of the ocean's biomass and is the starting point in the food chain, will have dire implications for fish stocks around the world.

The change in pH will also affect the availability of phytoplankton to absorb nutrients and metals. This will inhibit their ability to photosynthesize, thereby reducing  $CO_2$  absorption levels<sup>5</sup>.

Larger organisms are also likely to be affected, particularly species like fish and squid which have high oxygen demands. Research has shown that a decrease in pH by 0.25 units will cause a reduction of 50% in their oxygen-carrying capacity, affecting growth and survival. Such changes may have important flow-on effects for fisheries<sup>5</sup>.

Life will continue in the oceans, whatever the conditions. However, given the combined effects of declining pH and other environmental pressures, such as pollution or extraction, major changes are likely to occur in species composition and ecosystem structure.

**4.2 Melting of the polar ice-** In the open ocean, all carbon in the food web comes from photosynthesis by phytoplankton. Together with protozoa and bacteria, phytoplankton make up most of the Southern Ocean biomass. Globally, phytoplankton may account for as much as 40% of primary productivity<sup>6</sup>.

Much of the phytoplankton production in the Southern Ocean is associated with the seasonal formation and decay of sea ice. During autumn, microorganisms become concentrated due to a combination of factors and combine to form algal communities which become trapped when the ocean freezes.

These microbial communities are an important food source for Antarctic krill in winter and early spring. As the microorganisms and algae are released when the spring melts, dense populations of krill congregate, providing food for large vertebrates such as whales, seals and penguins.

Changes in sea ice could have a significant effect on krill populations. If the ice is no longer formed, previous dense concentrations of microorganisms and algae would be dispersed along large stretches of ocean along with the krill which feed upon them. Dispersed krill distribution would in turn affect species higher up the food chain which require dense populations of krill in order to support themselves.

**4.3 Temperature increases** – Since the 1940s, there has been a mean sea surface temperature increase off the Tasmanian east coast of more than 1°C. During this time, there have been corresponding changes in habitat types that have resulted in population gains for warm-temperate biota such as barren-forming sea urchins, and population loss for cool-temperate species such as the giant kelp forests. It is estimated that suites of cool-temperate organisms are likely to disappear from south-eastern Australian waters, an area particularly renowned for high proportions of endemic species<sup>7</sup>. Many of the kelp forests which cannot live in temperatures above 19 °C will disappear along with the plants and animals that require them as nurseries.

**4.4 Changes in rainfall patterns and run-off** - Warmer ambient temperatures will increase evaporation, the severity of drought and rainfall patterns. Changes in climate over the land will in turn affect the run-off reaching coastal and marine systems. The reduced rainfall will alter availability and quality of freshwater with implications for productivity and ecosystem function of coastal and estuarine environments. Coastal estuaries may experience higher concentrations of nutrient or pollutant loads and in some instances the reduced volume of water may result in the connection with the marine closing. [Don't understand this sentence].

**4.5 Sea level rises and storms** - Sea-level rises from thermal expansion of the ocean, and glacial melt, and increased frequency or intensity of extreme storms, will lead to the higher risk of inundation and flooding. As a result of shoreline erosion and realignment, damage to human and natural amenities and assets is likely to occur. Rocky shores, estuaries and wetlands will be submerged along with coastal dune systems. While this in itself is not problematic, the problem will occur when coastal development strips block the natural migration of these habitats inland as the change in sea level occurs.

**4.6 Ocean stability and currents** - Changes to wind and water temperatures will affect water column stratification and stability, which in turn will lead to changes in the upwelling of

nutrient-rich deeper waters and the productivity of surface waters. The change to ocean currents will affect dispersal and distribution patterns of marine organisms and biodiversity.

**4.7 El Niño Southern Oscillation** – Some climate models suggest global warming may lead to an increase in the frequency or intensity of El Niño events. If this is so, Australia may have more intense droughts and La Niña floods, particularly in the east. These droughts will have flow-on effects for volumes of freshwater entering estuaries and wetlands.

**4.8 Increased fire and wind** – The increased frequency and/or intensity of aeolian dust and fire-born particulates will affect coastal productivity and may in certain instances promote algal blooms.

**4.9 Conclusion** - While the State Government may not be able to stop these large scale consequences of climate change, more appropriate planning, protection and management may help to prevent a population crash in certain areas. Areas most likely to be affected along the Victorian coast are intertidal areas, which will be submerged. While this can be argued to be a natural process which has occurred many times before, the situation is now substantially different. Now when sea levels rise, communities which would normally follow the water inland will be restricted by coastal development. This barrier will prevent the movement of habitats such as saltmarsh and mangroves. The construction of sea walls will be required and rocky shores will cease to exist in some areas.

**5. What are the environmental, social and economic values associated with a healthy land-sea biodiversity.** How are the present pressures presented, what effect will climate change have, and are there solutions?

While many benefit from marine and coastal biodiversity, little is known about just how stressed these areas are as a result of unsustainable use. The compounding effect of climate change is likely to be severe for both individual species and global ecological processes. Only when the status quo is understood can appropriate future plans be undertaken. While this information is being compiled, the State Government should employ the precautionary principle when it comes to the development of policy and management plans for the marine and coastal environment.

Close to 96% of Victoria's coastline is public land with around 50% managed by National Parks. Presently around 85% of Victorian's live on the coast with consequential impacts from sewage pollution, stormwater run-off, industrial waste and nutrients from agricultural land, and direct habitat alternation for the construction and upgrade of ports, housing estates and other services.

In addition, commercial and recreational fishing has caused major changes in marine ecosystems. The decline in Victoria's fisheries has been directly linked to overfishing. In some cases it is not only that too many fish are taken, it is the method of extraction that may prove equally or in some cases more destructive.

Climate change will compound existing pressures on Victoria's marine and coastal biodiversity and will in itself require a coordinated state-wide response. The State needs to ameliorate present impacts while developing strategies to cope with projected sea level rise. According to the 2007 IPCC Fourth

Assessment Report, these are projected to be between 0.18 and 0.59 metres by 2100 (allowing for different emissions scenarios and uncertainty ranges). There are also likely to be an increasing number of storm surges experienced along the coast that must be adequately considered and factored into such a plan.

## **5.1 Social and environmental values, present and potential threats**

The following section will investigate both present and future threats and their corresponding impact on marine and coastal biodiversity. For ease of discussion, habitat types or geographical areas are discussed independently with each section investigating the environmental and/or social values provided.

### **5.1.2 Seagrass habitats**

Seagrass are highly productive and diverse habitats, providing food, shelter and living areas for small marine animals, at the same time as stabilising sediment and shorelines, being significant fish nurseries and important feeding areas for wader birds. These ecologically significant areas occur in sheltered bays or inlets. Seagrass habitats are rapidly being lost and nigh impossible to rehabilitate.

**Present impacts:** Seagrass beds are impacted by high levels of nutrients and sediment loads that wash in from catchments. Direct disturbance from dredging, trawling and boat anchors, as well as indirect impacts from coastal development, increased turbidity, sedimentation and nutrients in coastal waters, are severely impacting on these vitally important communities.

**Impact of climate change:** Scientists predict that climate change may result in more El Niño events. These events can be associated with more extreme tides. These tidal changes will increase the exposure period of seagrass beds, resulting in desiccation and death.

**Recommendation 3:** The biodiversity paper should investigate how catchment-to-coast management plans can be undertaken and overseen by the most appropriate body. Specific management plans are also required to protect seagrass beds from the adverse affects of sedimentation, dredging and trawling.

### **5.1.3 Coastal wetlands including saltmarsh and mangroves**

Saltmarsh occurs on sheltered coastlines throughout Victoria with extensive areas occurring in the Barwon estuary, Western Port Bay and Corner Inlet. The co-existence of saltmarsh and mangroves in Victorian bays is significant, as globally the two are normally separated into temperate and tropical regions<sup>8</sup>. Saltmarsh and mangroves are key habitats for many migratory birds as well as some endangered birds such as the Orange Bellied Parrot<sup>9</sup>. Unfortunately these areas have been severely degraded as a result of grazing, clearing and coastal development.

Coastal wetlands are critical for the health of adjacent coastal and marine waters. They play a significant role in reducing nutrient, sediment and pollutant loads to the coast, as well as providing breeding areas for marine animals, and feeding areas for both local and migratory wader birds.

**Present issues:** These areas are subjected to increased pressures from adjacent developments, land reclamation, catchment inputs, recreational activity, dams, irrigation, coastal urban development and pollution of waterways.

**Impact of climate change:** As sea levels rise, areas previously inhabited by mangroves and saltmarsh will be flooded. This in itself is not a problem as changes in sea level have occurred over time and species have simply migrated inland. However, migration is no longer possible because coastal development now acts as an often impenetrable barrier. Coastal freshwater wetlands will also be inundated with saltwater as a result of a rise in sea level.

**Recommendation 4:** The biodiversity paper needs to develop Coastal Plans that investigate how species that will need to migrate inland can be accommodated. Such planning should be included in the Coastal Spaces Strategy and in Local Town Planning regulations. In certain situations, the acquisition of land will be required.

#### **5.1.4 Intertidal communities**

Diverse communities living between the high and low tide levels are important for maintenance of biodiversity (especially for migratory birds), shoreline stabilisation, and recreation. This area is vulnerable to increases in sea level.

**Present impacts:** Intertidal rocky shores are subjected to trampling from high visitation pressure, particularly during summer, and many areas not protected in Marine National Parks are regularly used for collection of bait such as limpets and sea snails. This competes with migratory waders and other species that use the areas.

**Impact of climate change:** Decreases in stream flow will impact on coastal underground water and intertidal habitats, and increased salinity will be a critical issue for management. These areas will also be affected by the change in water level and temperature. Increased CO<sub>2</sub> levels may also affect certain species. As sea level rises, intertidal communities will be unable to migrate inland as a result of barriers created by coastal development.

**Recommendation 5:** The biodiversity paper should extend the *Fisheries Act 1995* and *National Parks 1975 Act* to include the protection of intertidal marine ecosystems.

**Recommendation 6:** The collection of bait should be prohibited in Marine National Parks and along intertidal zones, with strong penalties imposed on offenders.

**Recommendation 7:** Coastal planning regulations need to take into account intertidal changes; accordingly, land will need to be appropriated to enable migration of ecosystems as the sea level rises.

**Recommendation 8:** In the case where sea walls are required, investigations should begin to identify where they will be needed and what type of walls will be able to accommodate intertidal communities, where possible.

### 5.1.5 Bays and estuaries

Estuaries provide some of the most important ecosystems services, such as filtering pollutants from water, regulating hydrological processes, mixing nutrients, and providing a range of habitats for diverse plants and animals. Relatively little is known about the exact ecological processes of Victorian estuaries, but they are vital nursery areas for fish, and also link marine, coastal and freshwater systems.

**Present impacts:** Estuaries are important components of the marine environment; however they have little protection from catchment impacts and recreational activity, even when located within National Parks. They are affected by changes in inputs of fresh water, pollutants from upstream rivers, alteration in connection with ocean due to volumes of fresh water input, changes in salinity and changes in nutrient levels which can affect algal blooms and result in fish kills.

**Impact of climate change:** Reduced rainfall will result in reduced freshwater flowing from rivers into estuaries and sea connections may become permanently closed.

The Bays have been profoundly changed by human activities and several fish species found in Port Phillip Bay have declined in number probably as a result of overshooting<sup>9</sup>.

The bays are quite young; in fact, Port Phillip bay is only 8,000 years old (pers. comm. Tim O'Hara June 2007). They are dynamic systems and species located within them cannot locate to other areas when changes occur. These systems, along with the intertidal zone, are likely to be most severely affected by pollution and climate change. In Victoria, two of the Bays are listed under the Ramsar Convention and are designated international importance.

**Present impact:** Bays around Victoria are already experiencing a large number of stresses as a consequence of human activity such as dredging, trampling, pollution from towns and cities and the introduction of pest species. Bays and inlets have already suffered from a major loss of species biodiversity according to scientists.

**Recommendation 9:** Specific water quality standards for coastal water needs to be further established through State Environment Protection Policies.

### 5.1.5 Coastal dunes

Most beaches are backed by vegetated sand ridges called dunes, which are built up by dry beach sand blown inland and trapped by plants and other obstructions. As sand accumulates, the dunes become higher and wider.

Coastal dunes act as vital buffers protecting coastal areas from winds, storms and tides. They often contain middens that are significant indigenous cultural sites. Dune vegetation binds the sand and provides habitat for native fauna. Dunes act as sediment reserves, stabilize coastlines, and provide breeding and feeding sites for seabirds and other coastal species. Dunes support high species diversity in certain taxonomic groups, including endangered bird, plant, and invertebrate species.

**Present issues:** Frontal sand dunes are vulnerable. The vegetation can be destroyed by natural causes such as storms, cyclones, droughts or fire, or by human interference such as clearing, grazing, vehicles or excessive foot traffic. If the vegetation cover is damaged, strong winds may cause 'blowouts' or

gaps in the dune ridge. Unless repaired, they increase in size and the whole dune system sometimes migrates inland covering everything in its path. Meanwhile, with a diminished reservoir of sand, erosion of the beach may lead to coastal recession.

Encroachment in dune areas often results in shoreline destabilization, resulting in expensive and ongoing public works projects such as the building of breakwaters or seawalls and sand renourishment. Although dunes are dynamic environments, their erosion is being exacerbated through tracks and trampling, development, mining, and weed invasions from adjacent developments<sup>10</sup>.

**Impact of climate change:** Sea level rise may result in shoreline displacement, incorporating a shift of the water-land boundary through encroachment of the sea and accompanying sediment loss<sup>11</sup>. As dune movement occurs, this will impact on plant vegetation and the dune movement rate will have a direct effect on species composition. The movement of these systems will be effectively blocked by coastal development.

**See Recommendation 7.**

### 5.1.6 Sponge gardens

Like all temperate life forms in Victorian waters, the habitat-forming invertebrates in sponge gardens rely on clean water and sufficient nutrients and food particles to survive. Many of the animals are permanently attached to the rock and will die if food sources become scarce. Sponge gardens are made up of delicate creatures. Many are very slow to grow and some live for decades.

**Present impacts:** Sponge gardens are susceptible to physically damaging processes, such as storms, and human activities, such as trawling and dredging. Fishing, spearing and collecting are major human impacts on sponge garden communities. Removal of key species such as abalone, rock lobster, and wrasses can upset the balance in these communities by allowing populations of prey or food items to proliferate<sup>12</sup>.

**Impact of climate change:** Changes in ecosystem structure as a result of changes in acidity and temperature are all likely to have corresponding effects on sponge gardens, particularly if change occurs rapidly.

**Recommendation 10:** Marine management plans need to investigate excluding damaging fishing practices, such as bottom trawling, around sponge gardens.

### 5.1.7 Kelp forests

Kelp forests occur in cold, nutrient-rich water and are among the most beautiful and biologically productive habitats in the marine environment. They are found throughout the world in shallow open coastal waters. These large forests are restricted to temperatures below 20°C, extending to both the Arctic and Antarctic Circles. A dependence upon light for photosynthesis restricts them to clear shallow water and they are rarely much deeper than 15-40 m. Kelp forests have a capacity for some of the most remarkable growth rates in the plant kingdom<sup>13</sup>. The productivity of kelp forests rivals that of the most productive land systems.

Individual giant kelp plants can grow up to 30 m tall and the forests are not only a tourist attraction; they provide a vital habitat for marine life, notably rock lobster and abalone fisheries.

**Present impacts:** These forests have decreased in distribution. Presently the biological communities of many kelp forests have been so destabilized by fishing that they retain only a fraction of their former diversity. Sea urchins are having a severe impact in certain areas. Although they are normally passive grazers of algae, when ocean waters warm up, as in El Nino events, urchins graze kelp instead. The third force reducing kelp numbers is pollution, particularly sediments, sewage and run-off from the land. Fine sediments disrupt the giant kelp's unusual life cycle by preventing fertilisation of microscopic male and female plants on reef surfaces.

**Impact of climate change:** Changes in sea temperature will have dramatic effects on kelp forests as they are only able to live in water below 20 °C.

**Recommendation 11:** Protect as a minimum 20% of kelp forest that occurs along the Victorian coastline.

### 5.1.9 Fish

According to ABS data, Australia's coastal and marine regions support a large variety of species, many of which are only found in this country's waters. Since 1992 some interesting trends have started to develop amongst the 74 principal species classified: the number of stocks that are over fished is at a record high, the number of primary stock not over fished has declined and the number classified as uncertain has increased<sup>14</sup>.

Fishing causes changes at three levels of biodiversity organization: (1) at the genetic level, where it increases mortality and acts as a directional selection, affecting age distribution, age length and maturity, growth rates and other life history characteristics; (2) at the species level, where it affects species composition and relationship between prey and predator and where fishing can start to favour fish with early maturation levels or ones experiencing high fecundity; (3) at the habitat level, where habitats are adversely affected as a result of trawling and by-catch.

**Present impacts:** Unsustainable harvesting of marine species negatively affects important ecological resources as well as industry. The cumulative effect of fishing or harvesting can dramatically alter entire ecosystems. The major threats are:

- over-fishing and bycatch in certain commercial fisheries,
- inappropriate and destructive fishing techniques eg. trawling,
- excessive recreational fishing bag limits and lack of enforcement,
- resource theft (poaching) and lack of compliance with existing regulations,
- lack of research funds to identify the impact of what is happening,
- inconsistency of government policy,
- recreational fishing bag limits lacking scientific basis.

**Impact of climate change:** Changes in plankton as a result of increased water temperature will occur. pH decline will impact on food available for fish stocks.

**Recommendation 12:** Research sustainable recreational bag limits and develop appropriate ways of monitoring, regulating and managing identified limits.

**Recommendation 13:** Investigate introducing penalties for volume of by-catch caught during commercial fishing practices.

**Recommendation 14:** Investigate the impact that present commercial fishing methods are having on ecosystems and individual species. Work with industry to improve methods, and introduce regulations, to protect ecosystems and species from large scale destruction associated with particular techniques.

**Recommendation 15:** Introduce tighter regulations with corresponding legislation to combat poaching and apprehend and convict perpetrators. Investigate the employment of marine and coastal rangers.

**Recommendation 16:** Where data collection, research and monitoring is required as a result of resource use, apply the user-pays principle.

## **6. What are the main issues affecting the long term sustainability of coastal, estuarine and marine areas**

It is imperative that nations and countries urgently investigate sustainable methods of meeting humanity's increasing demands on natural resources, as present extraction methodologies are changing marine and coastal environments beyond repair. The biodiversity paper must investigate, as a matter of urgency, the use of a suite of tools such as protection, management and planning to ensure Victoria's sea health.

### **6.1 Inadequate marine and coastal scientific knowledge**

There are enormous gaps in the scientific literature. This information vacuum limits the ability to properly manage and care for the marine and coastal environment. The loss or overharvesting of one species may eventually result in critical changes to entire ecosystems. This is particularly true of rare, sensitive or vulnerable habitats such as estuaries and sponge gardens. The recent habitat mapping in marine national parks found square kilometres of rhodolith beds at Pt Addis that were previously thought to only exist in small areas in Western Port Bay. This new knowledge has had implications for the management of Pt Addis and surrounding areas.

While there will always be inevitable gaps in scientific knowledge, it is important that protection is not be hindered by this. Decisions must be based on best available knowledge on habitats, ecosystems and species requirements and further protection must go hand in hand with ongoing research, as highly protected areas along the coast are vital to maintaining the biodiversity of Victoria's waters.

**Recommendation 17:** The State Government, in consultation with research, community and industry organizations, should establish a framework for acquiring data relating to Victoria's marine, estuarine and coastal resources and co-ordinating a program of integrated data collection. The research already in existence should be appropriately catalogued and archived, gap analysis undertaken and a future plan provided.

**Recommendation 18:** Extensive research investigating habitat mapping, population dynamics and ecosystem processes both within and outside national park areas should be done.

### **6.2 Healthy well managed catchment**

The Senate inquiry into Marine and Coastal Pollution (1997) concluded that the most serious threat to Australia's marine environment stems from catchment activities. This is as a result of diffuse sources

of sediments, nutrients and toxicants draining from catchments to the coast, posing a significant risk to the environmental quality of estuaries and shallow embayments<sup>15</sup>.

**Present impacts** - Uncontrolled runoff from catchments, urban or agricultural areas has a negative impact on water quality and marine and coastal habitats, particularly on important bay and estuarine habitats such as seagrass. These inputs include:

- agricultural runoff containing high sediment, fertilisers, pesticides and other pollutant loads,
- urban stormwater containing litter, oil, animal droppings, fertilisers, pesticides, sediment from erosion or construction works,
- ocean outfalls from sewerage treatment plants with high nutrients, freshwater and potentially harmful bacteria,
- sediments that smother seagrass, macroalgae and other substrates; block sunlight for photosynthesis of marine flora through turbidity; cause uncontrolled epiphytic algae growth and eutrophication of water from nutrients,
- litter that can kill or injure birds, fish and marine mammals when they are strangled by it or mistake it for food.

Catchment management has traditionally been focused on water supply and extraction for human needs. This means that economically important coastal resources are often ignored.

**Recommendation 19:** Develop guidelines and plans for the protection of Victorian estuaries. The EPA and DSE should be lead agencies responsible for ensuring water quality and sediment monitoring, as well as doing audits of licensed point source discharges which should be reported on regularly and readily available to the public.

**Recommendation 20:** Increase investment into improving the State's capacity to deal with water quality issues that impact on marine and estuarine environment, as recommended in Victorian Coastal Strategy.

**Recommendation 21:** Require Catchment Management Authorities and boards to ensure that reviews of regional catchment strategies specifically address the impacts of land use and management on the marine and estuarine environment, particularly where physical or biological features may be affected. Develop catchment to coast action plans through CMAs and NRMs in coordination with Coastal Boards.

## 6.3 Coastal development

Victoria has the highest population to coastline ratio of all states and territories<sup>15</sup>. As with all coastal areas around Australia, Victoria is undergoing extraordinary increases in the number of people who live, holiday, and visit the coast. This is leading to high rates of often unplanned, unrestricted and inappropriate development.

Development pressures change the aesthetic of coastal towns, often expanding into the green spaces in between coastal settlements and leading to strip or ribbon development. Creeping urban development and expansion of coastal towns compromises the value of coastal spaces, through habitat loss and fragmentation, and changes the character of coastal towns. It also decreases water quality due to urban

runoff and impacts on significant marine and coastal habitats, particularly estuaries, seagrass habitats, coastal wetlands and dunes.

The biodiversity paper needs to investigate what is required to protect biodiversity in the face of increasing coastal development.

**Present impacts:** Victorian coasts are in danger of being ‘loved to death’ by visitors and residents. As more people visit the coast, impacts on terrestrial and marine environments increase. This is not only through issues such as trampling of dunes, dune vegetation, and intertidal reef biota, collection of bait species from reefs, beaches and mudflats, recreational fishing and litter, but also through increased demands on often inadequate coastal infrastructure such as toilets, waste removal, and water. This incurs environmental and economic costs, but also puts pressure on social resources such as volunteer groups who bear the brunt of short-term visitors and day trippers who have less incentive to look after the coast.

Urban creep eg. in city ‘growth corridors’ and some rural shires (eg South Gippsland), while not necessarily located on the coast, are often in coastal catchments and have a huge impact on receiving bays and water bodies. Large-scale industrial developments such as port expansions can be inappropriate or damaging to coastal and marine environments.

**Recommendations 22:** Introduce robust local government planning regulations that protect marine and coastal natural values and strategically address key threats to these values including poor water quality, visitor pressure, habitat fragmentation and climate change. Develop firmer coastal planning schemes eg. Coastal Spaces in LAW & appropriate planning controls applied at a state-wide level. Legislate coastal overlays with setbacks and height limits in accordance with climate change.

## 6.4 Marine and coastal pests

Pest plants and animals, both terrestrial and marine, have the potential to dramatically alter ecosystems, reducing biodiversity and productivity, and threatening native species. In marine environments, over 175 introduced marine species have been recorded in Victoria, including a number have become serious marine pests, such as the Northern Pacific Seastar. According to many scientists, these pests are more likely to take hold in an environment which is disturbed and where native species numbers are reduced as a result of overfishing, increased turbidity, changes in temperature and so forth.

All natural systems are vulnerable to invasion by exotic species. Disturbance by more frequent extreme events such as storm surges, rising sea-levels, occasional reductions in salinity due to river outflows, increased cloudiness of water, chemical pollutants, local fishing practices, changes in water temperature and increases in acid levels is likely to increase vulnerability by increasing the stress on established systems.

**Present impacts:** In Victoria, a few pest species have taken hold and continue to adversely affect large areas along the coast and within the marine environment. Little is known about the spread, present and future impact and methods of eradication.

**Recommendation 23:** Investigate the status quo, present impact and means of removal. Follow up the research with a comprehensive eradication plan.

## 6.5 Protected marine and coastal ecosystem and associated management

It is inaccurate to refer to our parks as pristine. Many contain a high number of pests, while others still exhibit signs of past damaging extraction.

The overall management of marine and coastal areas should reflect a balance of uses, optimising social, economic and environmental benefits for the whole community. In 2002, nearly 5% of Victorias coastal waters were protected. The balance is still skewed in the direction of commercial use for mining potential or present extraction of fish and other marine species.

At the World Parks Congress in 2003, Australia led and signed off on the decision to increase the representation of ecosystem protection to 20% along Australia's coast. While Victoria has made a significant start, there is still a long way to go. By protecting these values now, future social and economic values will be maximized.

The increased protection needs to go hand in hand with ecosystem based management which consists of highly protected marine protected areas that have multiple use zones. Such a framework must consist of corridors linking habitats. Fish have often been observed moving along 'fish highways', it is therefore not sufficient to protect isolated habitats if they can be killed when they move between them.

**Recommendation 24:** Set priorities to undertake comprehensive research on the state of the marine national parks, to determine whether the protection has achieved its aims and how it can be improved.

**Recommendation 25:** Investigate the next steps required to meet international agreements signed off at the World Parks Congress in 2003 to achieve a minimum comprehensive, adequate and representative protection of a least 20-30% of Victoria's marine and coastal ecosystems. These highly protected areas should sit within a framework of multiple-use zones and be managed according to the principles of ecosystem based management. Multi-use zones should contain special management areas that contain:

- breeding nurseries
- haul-out areas for marine mammals such as seals
- breeding and roosting areas for sea and shorebirds
- include areas that contain threatened or endangered species
- isolated areas of habitats
- stressed ecosystems
- intertidal areas
- coastal wetlands
- estuaries
- areas of particular significance for wildlife such as offshore islands
- protection of fish species that are less mobile.

## 6.6 Public knowledge and education

A lack of marine knowledge and community engagement with marine values is leading to unsustainable and destructive practices, particularly in terms of marine and coastal recreational activities.

During the previous Labor government, there were dedicated marine and coastal education officers. To educate the increasing number of people living and using the coastal and marine areas, there needs to be a structured education process that provides the community with an understanding of the importance of the marine environment and its fragile ecology.

More resources are often put into repairing damage after it has been done rather than educating the public about sustainable use practices and preventing damage. While education is recognised as being critical in the *Coastal Management Act* of 1995, little has been done in this area.

**Recommendation 26:** Provide funding for dedicated marine education extension officers who can assist Coast Action/ Coast Care facilitators to educate the community.

## 6.7 Aquaculture

Marine aquaculture is the cultivation and harvesting (or farming) of fish, shellfish and other aquatic species, including seaweeds, and the use of seawater as a growing medium.

The ECC report of 2000 recommended that aquaculture should not be practiced near areas of ecological importance. There is also a need for ongoing reporting on existing operations to determine their effect on the marine and coastal environment.

**Present impact:** Global production of farmed fish and shellfish has more than doubled in the past 15 years. While many believe that this reduces pressure on wild stocks, this is not the case, as carnivorous farmed fish are fed with wild fish. Further to this, practices such as the collection of seed stock result in habitat modification and destruction.

**Recommendation 27:** To sustain itself, the aquaculture industry must investigate ways to reduce its dependence on wild fishstocks and adopt more ecologically sound management practices.

**Recommendation 28:** Introduce strict regulations and penalties to prevent the introduction of exotic and often harmful pest species and diseases into the marine environment.

## 7. Current policy limitations for marine and coastal biodiversity

The current situation is not good. There is only a cursory understanding of marine baseline species. Ecosystem data and monitoring and management of fish species outside marine national parks is focused solely on fish species that are extracted commercially.

Another central issue is knowing what information is available when developing protection, policy and/or management plans. Strategies need to be formulated according to complex environmental issues which often cut across vastly different areas. For example, to usefully inform on an issue such as salinity, a researcher would need to collate data relating to soils, agricultural activities, water, biodiversity, and vegetation; data on drinking and irrigation water may also be relevant<sup>1</sup>. The government must facilitate this information gathering, possibly through a central location.

## 7.1 Inadequate marine and coastal governance structures

Victoria has no decision making and planning framework for the marine environment outside of Marine National Parks and Sanctuaries. The default management falls back onto Fisheries which focuses on single species with little or no focus on ecosystem or habitat health.

The overarching act, the *Victorian Coastal Management Act 1995*, requires certain amendments to make it more functional. For example, a definition of ‘the coast’ is nowhere to be found in the Act. Such a definition needs to be included. It needs to be clearer that the Act also includes the marine environment within three nautical miles of the coast.

The coastal actions plans also need to be clearly defined in the legislation. These plans were developed to be powerful expansive plans that dealt with the increasing issues experienced in marine and coastal regions. The Act should also be amended to include Integrated Coastal Zone Management, which is now included in Victorian Coastal Strategy documents. It should also be more clearly articulated that the Victorian Coastal Council (VCC) is responsible for covering water quality and education and should be funded appropriately so these important tasks can be undertaken.

The VCC was set up to be an independent advisory committee to the minister. In order to do this, the Council needs sufficient funding, which it currently does not receive. Presently they are required to get funding from other departments, which is not always forthcoming where there is a conflict.

**Recommendation 28:** Provide appropriate funding to the VCC to ensure biodiversity protection in the marine and coastal environment.

### Recommendations 29:

- Develop a marine governance structure that includes stakeholder and community input to protect and manage marine areas (including MPAs), legislation and appropriate policy,
- Assess vulnerable/valuable habitats and areas and include them in future policy making decisions, such as the asset based framework being developed by the DSE,
- Map and assess MNP’s and Sanctuaries as high value habitat for inclusion in the CAR system. In particular, implement all of the ECC’s recommendations eg. inliers within MNPs and special management areas.
- Develop and apply firmer coastal planning schemes eg. Coastal Spaces in LAW & appropriate planning controls, at a state-wide level,

**Recommendation 30:** Define coast in the *Coastal Management Act 1995* as: Coastal areas, both public and private, including the marine area which stretches three nautical miles out to sea.

## 7.2 Inadequate marine and coastal capacity in management agencies and authorities

There is a tendency for low marine and coastal capacity in agencies, authorities or institutions involved or responsible for marine and coastal planning and management. (This is particularly evident in Catchment Management Authorities). Marine and coastal issues are complex and require an understanding of social, ecological and economic factors. Community engagement in marine and coastal conservation is difficult to maintain without knowledgeable and informed decision makers and managers. The Victorian Coastal Strategy notes that, while there are reasonably well developed

coordination arrangements for terrestrial issues, consideration needs to be given to future governance arrangements for marine areas.

A lack of permanent government funded employees in Coastal Management creates a reliance on volunteers.

The marine environment and coast is important for Victoria's community, economy and ecology. Many people like to live on or near the coast and take holidays at the beach. It is therefore a conundrum as to why so few resources and funding is being spent on understanding this system and ensuring it is appropriately protected and managed.

**Recommendation 31:** Employ fully "qualified" i.e. not just "trained" marine rangers (increased capacity) who are responsible for managing and coordinating coastal and marine education, engaging in catchment management process, and implementing water quality strategies relevant to their particular coastal and marine location.

**Recommendation 32:** Investigate effective mechanisms to coordinate decisions that have cross sectoral impacts to ensure coordination of planning and management frameworks.

### **7.3 Lack of integration of catchment, coastal and marine management**

The coastal environment is the interface between the forces of the sea and those of the land. It is a dynamic environment, which is constantly evolving. The management of each of these broad environments needs to take into account their connections and associated threats that may be transported from one area to the next. For example, native flora and fauna along the coast are threatened not only from fragmentation and degradation but also because of inland pests such as cats and foxes which impact on small mammals and birds<sup>16</sup>.

Other impacts that require joint management are the catchment to coastal issues of water quality and environmental flows that are often required to maintain sea openings in estuaries. This requires integration of coastal boards and catchment management authorities. Parks Victoria is starting to look at how this might be achieved and have four projects underway.

CMA's need to have plans that link Catchments to coast to ensure water entering estuaries does not contain high sediment, nutrient or pollution loads.

Recommendations from Victorian Coastal Strategy need to be integrated into other agencies.

#### **Recommendations:**

- Develop integrated NRM policy for coasts to include marine, including a commitment to implement,
- Coordinate protection between public and private coastal locations,
- Improve integration between VCS and regional catchment management strategies,
- Reform PV, DSE, DPI, EPA, CMA's, Coastal Boards et al into integrated system that can manage, monitor and assess marine areas,
- Develop an Accord or other agreement for the State Government and local governments to work together to better share the responsibility and funding for coastal management (particularly around funding agreements for beach protection in the PPB and reform of the

NHT arrangements) to improve funding for coastal and marine issues (as recommended in the evaluation of NHT investment that was undertaken by Geoff Westcott for DEH in 2006)

- Improve integration of coastal and marine management with overall NRM – while there are a number of bodies established to deal with integration issues ( VCC and Coastal Boards), they often do not achieve real integration of agency / industry / community effort for protecting coastal and marine natural and cultural values,
- Amalgamate foreshore committees rather than having many small ones,
- Clarify decision-making power for coastal crown land, especially estuaries; integrate as stated, in particular private with public.
- Clarify responsibilities for managing water and estuaries among DSE, CMAs, EPA, Councils, Parks Victoria and DPI. Investigate the possibility of integrating river and estuary management.
- Encourage partnerships between community, government, research facilities, and corporations to share knowledge. Ensure they are effective and don't just look good on paper.
- Obtain EPA representation on the VCC,
- Revitalise Coast Action and develop closer links with friends groups etc,
- Improve integration between VCS and regional catchment management strategies,

## 8. Conclusion

In the marine and coastal environment, the biodiversity crisis often goes unnoticed. Species may become extinct before they are even identified. It is crucial that more research is undertaken to investigate not only habitat type – which has been the tendency in the past - but also the movement of species between habitats. The interaction between species is also critical, as the loss or decline of one species may have catastrophic implications for the ecosystem as a whole. Such information will give custodians of the environment appropriate information to protect, manage and ameliorate present and future threatening processes.

The biodiversity paper needs to investigate the status quo, what has worked and what hasn't before a plan for the future can be formulated. This is a significant and substantial task and must be undertaken thoroughly if the present loss of habitats and species is to be understood. Victoria is the most cleared state in Australia and, as a result, protection and management plans will need to look outside the present paradigm if solutions are to be found.

While many people are doing a great job, planting trees, counting fish or undertaking species samples in the marine environment, it is important that these efforts are structured and coordinated effectively to ensure not only that the maximum benefit is achieved but also that gaps that exist become visible. The future success of biodiversity management will depend on the integration of resources, improved funding for research of commercial and non commercial marine species, coastal planning and management, improved marine protection, changes to legislation and improved management models based on ecosystem based management methods.

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