Victorian Coastal Council

emerging scientific issues on Victoria's coast

2011 update

Victorian Coastal Council
Science Panel
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State Government Victoria

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PHOTOS

Front cover: **Leather Kelp, Wilsons Promontory** B. BOYLE
This page and inside back cover: **Western Victorian Coastline** VICTORIAN COASTAL COUNCIL

Contents

Executive summary

The Victorian Coastal Council has convened a Science Panel to provide advice to Council on emerging issues and knowledge gaps relevant to Victoria's coast and marine environments. This action recognises the critical role that independent and credible scientific advice has in informing evidence-based policy, particularly in the mid to long term. In 2006, the Science Panel made recommendations about emerging scientific issues, and it met in February 2011 to update this set of recommendations.

Emerging environmental issues

The Science Panel emphasized three environmental concerns. Common to each is the need to focus on processes that occur at long time scales and potentially over wide areas of the coast. Both of these dimensions will provide challenges to coastal management, as they operate at scales that cross jurisdictions and planning windows.

ISSUE 1: Understanding the effects of increased climatic variability

Although predictions for future rates of warming and sea level rise to around 2050 are well defined with little prospect of major departures from current trends, impacts cannot be predicted accurately from changes to average climate alone. The Science Panel strongly encourages the development of the scientific understanding and tools needed (including monitoring) and better harnessing of existing data and information to predict local responses of coastal ecosystems and landforms to changes in climatic variability including extreme events, taking into account synergies between climate drivers.

ISSUE 2: Understanding the importance of links between catchments, estuaries and broader coastal waters for maintaining marine ecosystem health

Catchments are a major source of sediments, nutrients, and a wide range of chemicals, which move into estuaries and potentially out into oceanic waters. An important scientific question is how estuaries influence marine environments along the coast.

ISSUE 3: Understanding the cumulative ecological consequences of coastal development to meet human needs

Understanding the cumulative ecological impacts of coastal development is important for informed planning decisions, and it will become increasingly so as we adjust our plans for new climates.

Responding to emerging environmental issues

The Science Panel highlighted three additional concerns related to Victoria's technical capacity to respond to emerging environmental issues. Failing to develop basic scientific understanding about the Victorian coast limits our ability to manage coastal and marine environments. Scientific understanding depends on the collection of appropriate data and the existence of a scientific skill base to interpret information and provide independent scientific advice in Victoria.

ISSUE 4: Understanding the condition of Victoria's coastal environments

Assessing the effectiveness of management actions requires data. Data tell us about the current condition of a particular asset, but the data alone are of little value unless they are linked to a clear decision-making framework.

ISSUE 5: Matching Victoria's technical capacity to meet scientific needs

New issues will require scientific and technical expertise that may differ from that currently available in Victoria, and it is essential that we develop and maintain expertise appropriate to our needs. The extent and availability of this expertise must also be communicated to coastal managers and other end users of science.

ISSUE 6: Continuing operation of the Science Panel

There is a strong need for a group such as the Science Panel that provides independent, strategic, scientific advice for the whole coast.

1. Introduction

1.1 Background

Victoria's coast is a precious[1], and in some locations, intensively used environment. Activity and processes on the coast, inland in the catchment and offshore in the ocean, have an influence on the health and sustainability of the coastal environment.

At a national level, the Framework for a National Cooperative Approach to Integrated Coastal Zone Management (NRM Ministerial Council 2006) sets the scene for national cooperation in managing coastal issues and achieving ecological sustainable development outcomes in the coastal zone over the next decade.

As Victoria's peak independent coastal advisory body, the Victorian Coastal Council (Council) promotes the importance of the *Victorian Coastal Strategy 2008* in establishing a framework for long-term sustainable management of the Victorian coast. The Council also recognises that trends in population growth and demographic shifts, industry development, protection of the coastal resource base and climate change will be the fundamental drivers that will affect the sustainable use of coastal resources.

Council has convened a Science Panel to provide scientific input about Victoria's coast. This action recognises the critical role that independent and credible scientific advice has in informing evidence-based policy, particularly in the mid to long term and responds to the current absence of a scientific advisory body for the coast and marine environments with a "whole of coast" perspective.

1.2 Membership

Membership consists of the Victorian Coastal Council Science and Environment sub-committee and external scientists. Members are involved as individual scientists, rather than institutional representatives, and several criteria were used in composing the Panel:

- Individuals' scientific credibility and reputation;
- The need to provide coverage of a broad range of scientific disciplines;
- Recognition of system-wide linkages and the need to keep broad perspective, including catchment to coast;
- Awareness of long-term and large-scale environmental change.

A practical limitation, given current resourcing, was that most scientists are based in Victoria.

The result is a group of 43 that included scientists based at academic institutions, within government agencies, and in the private sector (Appendix 1) and membership is revised to reflect changing scientific capacity in Victoria.

1.3 Terms of reference

- Identify emerging issues relevant to Victoria's coastal and marine environment;
- Identify knowledge gaps relevant to Victoria's coastal and marine environment;
- Provide recommendations regarding the above emerging issues and knowledge gaps to the Victorian Coastal Council.

1.4 Emerging issues in 2006

In 2006, the Science Panel produced the report *Emerging Scientific Issues on Victoria's Coast*, with the aim of highlighting future gaps in scientific knowledge and in scientific capacity in Victoria. In 2011, the Panel was convened to update that document, with a view to removing issues that were now addressed sufficiently and identifying new gaps that may have emerged since 2006 or require increased emphasis.

The 2006 document highlighted three emerging environmental concerns (Understanding the effects of increased climatic variability, the nature of links between catchments, estuaries and marine environments along the coast, and improving our understanding of the ecological effects of coastal development) and three aspects of Victoria's capacity to respond to emerging issues (the nature of our scientific database, the scientific capacity in Victoria and the operation of the Science Panel), and the Science Panel developed 12 recommendations around these issues. This set of recommendations was the starting point for the 2011 review.

1.5 Emerging issues in 2011

The Panel considered that six issues were still important, and warranted inclusion, Of these issues, one, regarding the operation of the Science Panel, did not require substantial revision, while the other five required modification to reflect new scientific knowledge. No additional major issues were identified during the meeting or as a result of follow-up email contact with all Science Panel members.

The Science Panel identifies six issues as requiring attention over the next five to ten years if we are to enhance our stewardship of coastal and marine environments.

2. Emerging environmental issues

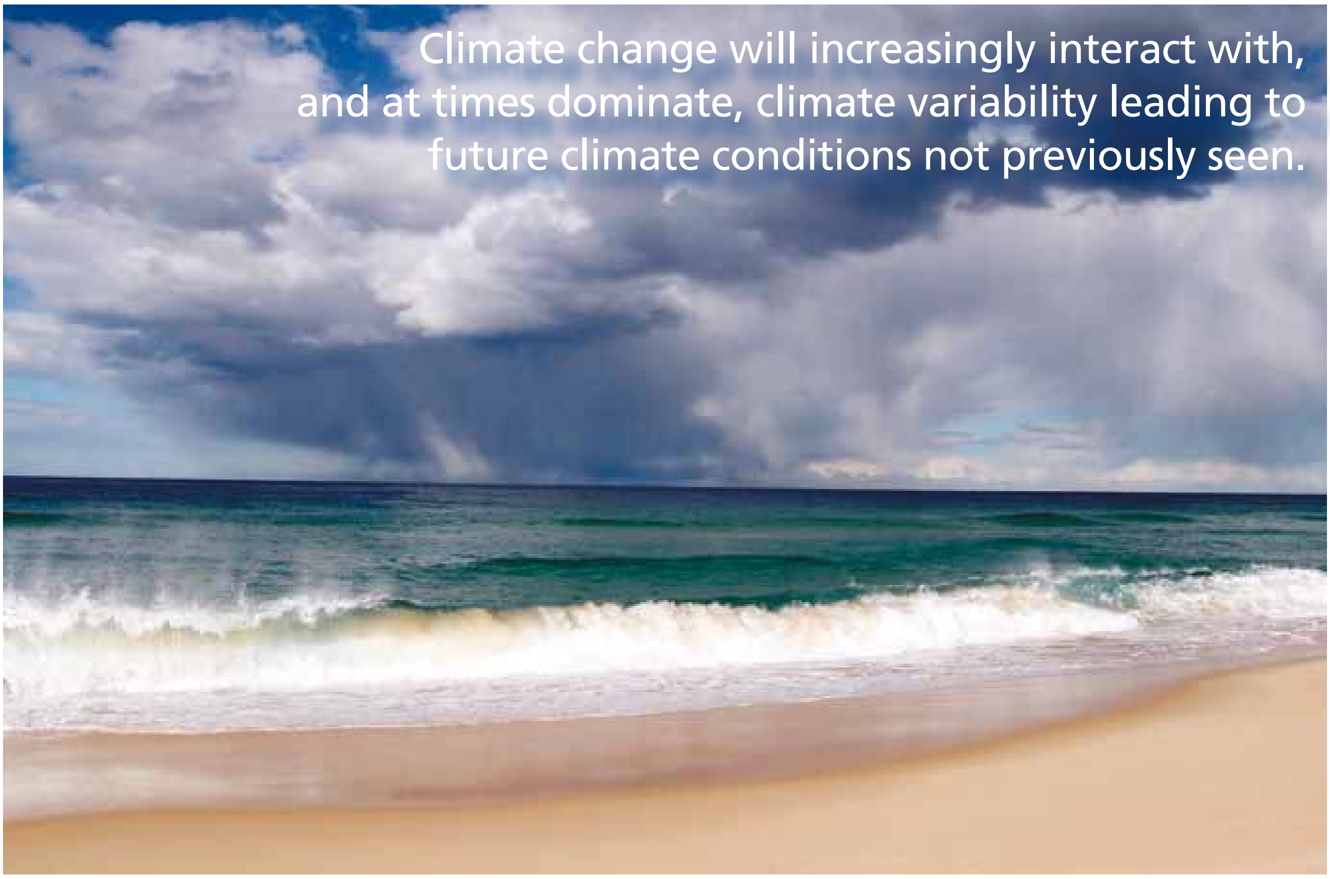
2.1 Understanding the effects of increased climatic variability

Coastal regions have experienced substantial climate change with significant warming, a decline in autumn into winter rainfall, reductions in mid-latitude storminess and significant increases in sea level. These changes will continue through the course of the current century, and are likely to accelerate. Climate change will increasingly interact with, and at times dominate, climate variability leading to future climate conditions not previously seen.

Climate change is now a focus of attention for coastal managers — planners need to know how rising sea levels will alter coastal and marine planning, catchment managers need to predict how estuarine discharges will change, and natural resource managers must understand the new ecosystem states that will occur in coming years. As a community, we can only make informed decisions about Victoria's coast with a sound knowledge of the changes that are likely to occur, the extent to which they can be mitigated, and, perhaps most importantly, how we will need to adapt and what new opportunities may arise. To do this, we need a robust understanding of the physical processes involved and how natural ecosystems will respond to these physical changes – we can not have a discussion about how we will adapt unless we know what we are adapting to. This knowledge must be at the spatial scale at which decisions are made.

The first steps have focused on changes to average climate at broad scales – changes to average temperatures, mean sea level, catchment precipitation, etc., and some of these averages are already incorporated into coastal planning. However, it will not just be the "average" climate that changes; there will also be changes in the variability of particular weather events leading to changes in extreme events. For example, the change to average annual rainfall may be small, but with rain falling in fewer, more intense rain events. This will alter the frequency of opening and closing of some estuaries. Sediments, nutrients, and toxicants may be flushed from estuaries to the ocean less often, but at higher concentrations. At present, we have only a limited understanding of how these extreme events influence natural ecosystems.

We also know that understanding changes to mean sea levels are only a first step towards predicting coastal risk[2]. The rise in mean sea level is modulated by large scale shifts in ocean currents and weather patterns, but there is also regional variation around the world (including around Australia[3, 4]), and local variation as land subsides or rises[5] along the coast. For coastal areas, the risk of inundation comes from the combination of higher mean sea level, storm surge, and high rainfall events, particularly when storms and flooding coincide with high tides[6]. The exact risks will depend on the synergies between these factors (i.e., whether their combined effect is more than simply the sum of their individual effects) and how they combine with



Storm over Ninety Mile Beach, Gippsland

local coastal geomorphology. In this case, their combined effects are much more than the sum of their individual contributions. There will be other changes, such as ocean acidification and possibly alterations to major ocean circulation patterns, that may alter our coasts profoundly, but although our understanding of the physical changes has developed rapidly, we lack even the most fundamental information to accurately predict the changes to marine ecosystems and implications for our use of the coast.

As we develop this scientific understanding, we need to characterize the physical processes and understand how ecosystems respond to changing environments. Both of these steps are difficult, with some serious knowledge gaps for single aspects of climate, even before we consider synergies. For example, projections of sea level rise use mean sea levels as a starting point, and there are acknowledged uncertainties about the relative contribution of melting ice sheets to this rise and the speed of melting.

Predicting ecosystem responses is an even more daunting task, because the complexities of physical changes are combined with the biological complexities of the combined responses of individual species. For single species, there are important questions about whether climate change will be too rapid for species to adapt or evolve or if the changes will exceed species' capacities. It is particularly unclear how temperate marine organisms will respond to ocean acidification. Marine and coastal ecosystems are already challenged by a range of human activities, and we also need to know how current stressors interact with climate change, and whether it is possible to make natural ecosystems more resilient[7]. This information will be important for biodiversity conservation, for managing fisheries (and associated coastal communities) and for maintaining the large number of ecosystem services that are derived from marine environments[8, 9].

Adaptation to climate change impacts will depend on our ability to measure how coastal landforms and ecosystems change through time, and the extent to which these changes can be reduced. This information is necessary for developing realistic aspirations for coastal environments and for setting formal targets for management. Most current monitoring programs are designed to detect two kinds of environmental change. "Trends" monitoring detects long-term change in environmental variables, and (ideally) uses long time series. "Impact" monitoring is generally aimed at detecting discrete changes associated with particular activities. Neither of these approaches will be appropriate for measuring the effects of climatic variability, and it may be necessary to design new monitoring programs. A good first step will be determining the data that are needed and then to examine the capacity of our current monitoring activities to meet this need. To do this it will be necessary to increase observational infrastructure through national initiatives and better harnessing of existing data and information[10, 11].

Coastal flooding at Lakes Entance in 2007

R. CANDY, EAST GIPPSLAND CATCHMENT MANAGEMENT AUTHORITY

2.2 Understanding the importance of links between catchments, estuaries and broader coastal waters for maintaining marine ecosystem health

Catchments are a major source of sediments, nutrients, and a wide range of chemicals, which move into estuaries and potentially out into oceanic waters. An important scientific question is how estuaries influence marine environments along the coast. This is not a simple question, and the answer may vary along the coastline.

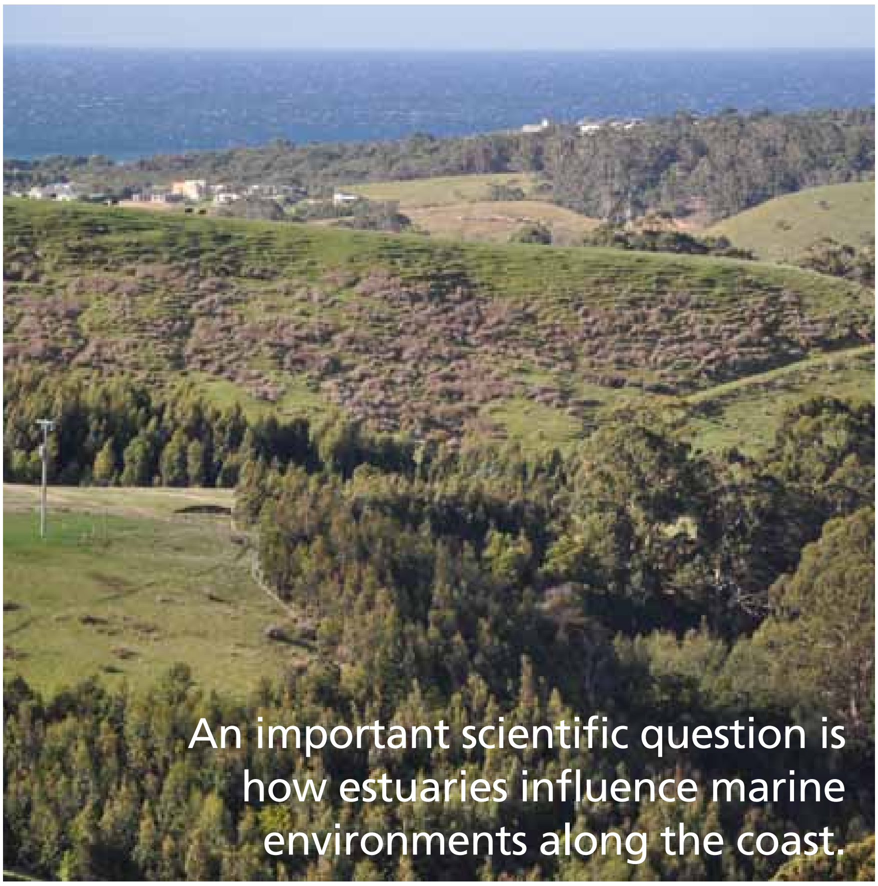
Estuarine (and catchment) influences will vary widely along the coast. At its simplest, there are long sections of coast with no major estuaries, but there are major differences in the estuaries themselves. Many of the smaller estuaries in eastern and western Victoria are closed for much of the time, limiting the movement of material into the ocean, and acting as barriers for migratory species . Others are permanently open, and the volumes of water leaving the estuary vary dramatically. Large human populations surround some catchments, some drain relatively unmodified land, and most are agricultural. Differences in land use strongly influence the nature of the estuarine discharge, particularly water yield from surrounding catchments[12]. Land use type, e.g. the kind of agriculture, will also influence the mix between sediments, nutrients and toxicants discharging into estuaries. We expect that this variation among catchments will translate to wide variation in how strongly estuaries influence surrounding coasts, and how far their effects spread.

In recent years, there has been an increasing focus on integrating catchments and downstream sections of rivers and streams into coastal management. This is reflected, for example, in Catchment Management Authorities extending their focus into estuaries and out to the limits of State waters. A result of these shifts has been a better understanding of the contributions to estuaries from catchments, and a sharp increase in the perception of estuaries as important parts of coastal management. In order to focus our management, an important step is to ask in which situations will catchment management play a major role in marine ecosystem health, and when will purely marine management actions be important?

An understanding of the accommodation space within an estuary, that is, the vertical and horizontal areas available for shoreline adjustment to sea level rise varies greatly between different estuarine types. For example the space available for salt marshes to move depends on floodplain area and the presence of anthropogenic structures. Accommodation space will also influence the capacity for sediment deposition within the system and therefore its capacity to catch and store nutrients and toxicants.

While there has been considerable progress in understanding estuarine ecosystem health and its catchment influences, there remain considerable knowledge gaps, including:

- Knowledge of the sources and fates of toxicants, particularly newer compounds;
- Understanding of nutrient cycling, particularly processes controlling nutrient fates and the possible synergistic effects of other anthropogenic activities;
- The effect of current and future estuary opening and closing rates on species that rely on estuaries for all or part of their life cycle;
- Whether there is "hidden" estuarine biodiversity, in the form of species that may be unique to particular estuaries, isolated by frequent closure, rather than distributed across a range of estuaries, and whether this isolation will increase under climate change;
- The dynamics and processes driving estuarine closure; and
- Cycling of sediments within and out of estuaries.



Barnham River valley in western Victoria CORANGAMITE CATCHMENT MANAGEMENT AUTHORITY

2.3 Understanding the cumulative ecological consequences of coastal development to meet human needs

Coastal developments are changing the demographic picture of Victoria, from a few large urban areas with smaller developments in nearby coastal areas, to a substantial number of mid-sized developed areas.

Coastal development has several important direct effects including:

- Roads and other infrastructure, which affect runoff, input of toxicants, change access for wildlife, influence patterns of recreational use of undeveloped areas, etc;
- Development places new demands on nutrient management, with an increase in the volume of nutrients that must be accommodated;
- Use of undeveloped land (recreation, access by pets, etc.) and potential impacts on biodiversity (species that use particular coastal habitats, such as dune-or beach-nesting birds);
- Biosecurity issues with transport of marine pest species by recreational activities (boats, trailers, wet gear, etc.);
- Increased pressure on marine resources (e.g. recreational fish stocks);
- Potential impacts to marine environments from increased off-shore activities (e.g. off-shore oil and gas, marine renewable energy); and
- Increased exposure to risk associated with greater population densities being located in current and future hazardous areas.

Some of the local consequences of coastal development are addressed through current regulatory frameworks (EES, EPA licences, planning permits, etc.), but these activities typically focus on direct effects of each development. There are potentially important cumulative or diffuse effects. With increased use of the coast for human needs, the mosaic of natural and developed habitat is changed. This may alter the ways in which plants and animals move across the landscape. There may also be cumulative impacts from several activities that by themselves are not of concern, with the result that larger developments may have impacts that extend well beyond their boundaries.

An additional impact is the increase in exposure to risk as more people move to the coast. Even with no change in future hazard related to climate change, increasing coastal development will still increase the overall ecological risk.

Understanding the cumulative ecological impacts of coastal development is important for informed planning decisions, and it will become increasingly so as we adjust our plans for new climates. In the short term, there may also be new activities occurring on the coast (e.g. energy development), each with their own specific costs and benefits, which need to be incorporated into existing "footprints".

Western Port

3. Responding to emerging environmental issues

The three environmental issues all share a need for more scientific research – our ability to adapt to climate change or to see new opportunities is limited by uncertainties in our understanding of just what our future environment will be, our capacity to manage coastal environments in an integrated way is restricted by uncertainty about the strength of catchment-marine links, and without a holistic approach to the impacts of coastal benefits, we risk the death of 1000 cuts, as individual pressures increase and combine in unexpected ways. The Panel considers that these issues require a commitment to new research that will deepen our understanding of these issues, with the aim of developing better predictive tools, an improved capacity to monitor and respond to change and an ability to develop integrated catchment-to-marine models. Developing this understanding will involve a combination of new research and data collection specific to locations along the Victorian coast and the incorporation of international research into a local context. The details of the research must be developed through a dialogue between research providers (i.e. the scientists) and agencies responsible for managing Victoria's coast, with the goal of providing international standard research that directly improves management. There is a critical role for scientifically literate "translators" of science within Victoria's management agencies.

Recommendation 1

Develop the scientific understanding of the emerging environmental concerns described above, incorporating new research, development of better predictive tools and the identification of targeted monitoring that will assist adaptive management of Victoria's coast. This scientific understanding will include better understanding at a local scale, particularly a detailed understanding of how changing climates will influence local coastal environments, the degree to which local marine environments depend on nearby catchments, and a holistic understanding of coastal development and its impacts.

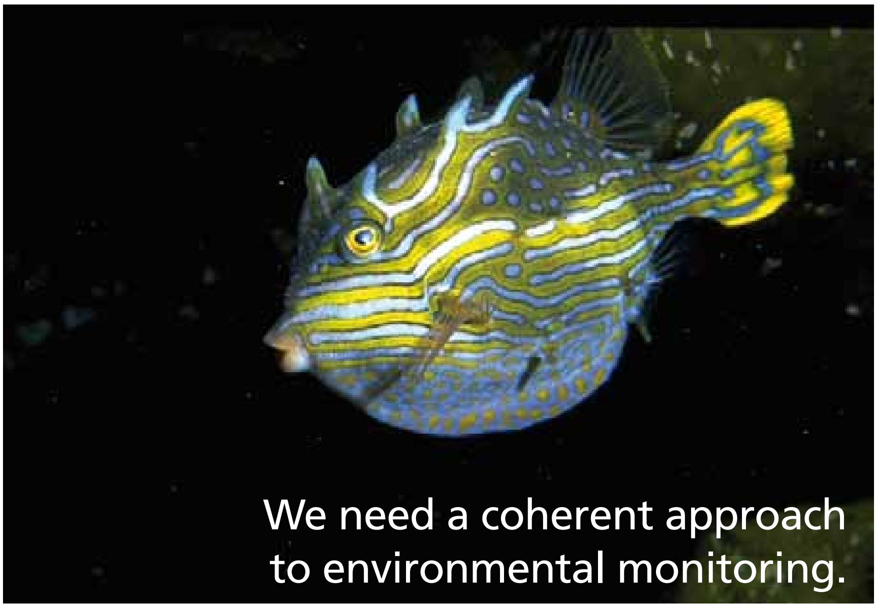
Yellow zoanthids B. BOYLE

3.1 Understanding the condition of Victoria's coastal environments

Effective management of marine and coastal environments involves enhancing natural assets and their associated ecosystem services, while at the same time encouraging a range of beneficial human uses. This inevitably involves prioritizing some activities over others, and making decisions about where to invest most productively in local management activities. When such decisions are made there will be pressure, particularly from those disadvantaged by a particular action, to demonstrate that those actions are effective.

Assessing effectiveness means that, in most cases, we need data — if we are to undertake costly catchment remediation work, what improvement would we expect to see in estuary condition? Would it occur? If we restrict recreational bag limits for a particular fish species, will the stock be enhanced? Data tell us about the current condition of a particular asset, but the data alone are of little value unless they are linked to a clear decision-making framework, which uses the target or "aspiration" for a particular environmental asset, together with its condition, to adjust management, i.e., as part of an adaptive management framework.

Aspirations for natural environments can be difficult to define precisely; they are not pristine states, which may be problematic[13], but a consideration of what is the best condition possible given the irreversible changes that may have already occurred (e.g. due to land use changes, invasive species) and the consequences of those activities that we value highly enough to continue. In the future, we also expect Victorian marine environments to change in ways that are beyond the control of local management agencies. The combination of warmer, more acidic oceans, with altered current patterns, is likely to bring substantial ecological change, and we are already seeing examples of such changes along the coast of Tasmania[14, 15]. If there is no mitigation possible for some of these changes, we will need to change our management targets.



▲ **Shaws Cowfish** B.BOYLE

The Panel in 2006 expressed concerns that there is no coherent approach to environmental monitoring (evaluation and reporting) across the state and that some review of data collection needs was warranted. Its view is that this situation has not changed. Most of the monitoring is short term, often associated with particular local threats or activities or it may be done to discharge statutory obligations. For the longer term monitoring programs (e.g. Port Phillip Bay, Gippsland Lakes, Western Port), the (original) design is often limited to detect long-term trends. They have not been designed to address the success of specific management actions or provide an integrated assessment of ecosystem health. As a result, for much of the Victorian coast, there are few (and often inconsistent) measures of current condition or the degree to which natural assets have changed. Consistent information from purpose designed monitoring evaluation and reporting programs creates an opportunity to set management targets and encourages adaptive management.

The Panel recognizes that broad, state of the environment style monitoring will not be a priority for many governments, unless they have a statutory obligation to do so, or a convincing case is made for such data collection. Advocating a coordinated approach to monitoring will need close cooperation between scientists and resource managers, to develop explicit logical pathways between management actions, data collection and community benefits. When these links are clear and compelling there will need to be sustained advocacy for funds to be allocated to these actions.

Recommendation 2

Undertake a systematic review of existing coastal monitoring needs for Victoria, focusing on links between data, decision-making, and community benefit.

Historically, monitoring has generated large volumes of data that are archived locally, and rarely used for any other purpose. The Panel in 2006 encouraged the use of centralised data "warehousing", to maximise reach and utilisation of data, and highlighted several new initiatives in this area. Some of these initiatives have flourished at a national level, and the volume of data held has increased dramatically[16], and the data are readily accessible. The Panel supports the greater engagement of the Victorian marine community in these national initiatives, although they are no longer an "emerging" issue.

3.2 Matching Victoria's technical capacity to scientific needs

New issues will require scientific and technical expertise that may differ from that currently available in Victoria, and it is essential that we develop and maintain expertise appropriate to our needs. This expertise must also be made known to coastal managers and other end users of science. In 2006, the Panel identified three particular areas for concern:

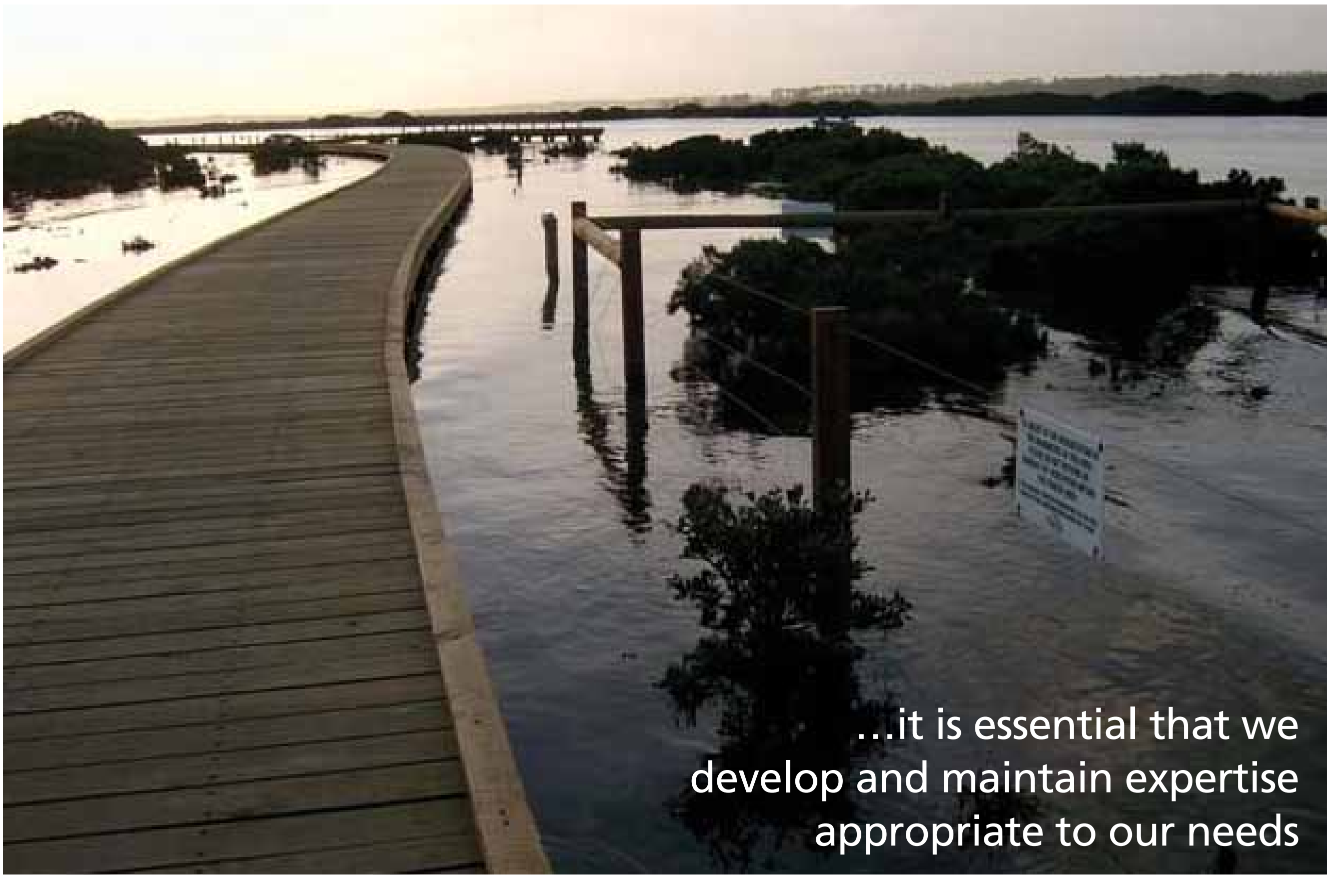
- Staff turnover in science providers, leading to loss of corporate memory and lack or awareness of available expertise, and greater dependancy on external providers;
- Major gaps in disciplinary coverage, because there is little expertise available in Victoria (e.g. physical oceanography, coastal geomorphology, marine chemistry), or where skills exist those with skills are in very high demand (e.g. modelling and geographic information systems);
- Erosion of the skills base through attrition (e.g. environmental chemistry, taxonomy).

The Panel considered that this is still a pressing issue, with no improvement, and possibly a net loss in technical expertise since 2011, with slight gains in the tertiary sector, but losses in government science capacity[17]. The sustainability of scientific capacity, particularly within government, is also a serious concern.

Emerging issues, particularly climate change, will require additional skills, and effective local delivery of sound science will require access to quality, independent science advice. It is not clear whether it will be possible to maintain the full range of scientific disciplines in Victoria alone, and there are some areas of science and some areas of management in which regional or national delivery modes are used. These modes involve maintenance of expertise at these larger scales, with "hubs" or centres of expertise. These centres provide the necessary critical mass for scientists, and are charged with delivering expertise throughout the region, with other scientific needs delivered by other hubs outside Victoria[18]. This approach has been successful elsewhere, but has not been pursued in Victoria. There would appear to be considerable advantages in bringing together the range of expertise across state and federal government and academic organisations are included.

Recommendation 3

Critically analyse future technical needs, the strengths and weaknesses of the current scientific base and the best model for delivery of sound science.



Boardwalk at Barwon Heads

3.3 Continuing operation of the Science Panel

The Science Panel has provided independent advice to the Victorian Coastal Council and (via request to Council) to the Department of Sustainability and Environment (DSE) that has been used to:

- Create policy and action statements within the *Victorian Coastal Strategy 2008* ;
- Provide feedback on the draft *Victorian Coastal Strategy 2008*;
- Provide advice on reef priorities for a Reef and Seagrass Program that commenced in 2011;
- Support Council position on planning for sea level rise; and
- Assist with planning of Council/ Regional Coastal Board marine forums.

The Science Panel was enthusiastic about this role continuing and expanding, a position that is supported by the Council.

There is a strong need for a group such as the Science Panel that provides independent, strategic, scientific advice for the whole coast.

Members of the Panel were enthusiastic about providing high-level technical advice about specific issues, by convening sub-groups with relevant expertise, and about raising the Panel's profile. They also provided several ideas for improving science communication and advocacy, focusing on communication between the Council and Science Panel members, communicating the work of the Science Panel, and enhancing links between the Science Panel and other relevant networks/groups.

The Victorian Coastal Council could enhance communication by:

- Hosting regular meetings of the Science Panel (annually as a minimum frequency) in order to maintain continuity and momentum;
- Publishing a newsletter to all members of the Science Panel to report on activities and issues;
- Connecting Science Panel advice to key people in government and other relevant groups;
- Reporting on Science Panel activities to government in the Victorian Coastal Council Annual Report;
- Dedicating a page on the Council website on marine and coastal science issues, including a Science Panel membership list and Science Panel documents;
- Hosting the Marine Forum to communicate significant coastal and marine science research to industry, community and government groups; and
- Preparing media releases as appropriate.

Hooded Plover chicks FRIENDS OF THE HOODED PLOVER, FAR SOUTH WEST

Recommendation 4

Opportunities for improving science communication and advocacy should be further championed by the Victorian Coastal Council.

At its inception the Science Panel was given terms of reference to define its scope as well as criteria for membership. More detailed terms of reference might bolster the effectiveness of the Science Panel.

The Victorian Coastal Council could improve the effectiveness of the Science Panel by:

- Further development of a clarity of purpose for convening the Science Panel with the Council taking a lead on defining key priorities;
- Tightening up terms of reference in order to maintain focus on providing independent, credible scientific advice to Council and government;
- Further developing a process to ensure the Science Panel has full representation across the breadth of scientific disciplines required; and
- Bolstering Council's commitment to the Science Panel by allocating a suitable annual budget to meet the resource requirements of the Panel.

Recommendation 5

The Victorian Coastal Council should review the Science Panel's terms of reference.

Appendix 1

Current membership of Science Panel, together with broad area of expertise.

Prof. Sam Adeloju
School of Applied Sciences and Engineering
Monash University
Expertise: Chemistry

Assoc. Prof. John Arnould
School of Life and Environmental Sciences
Deakin University
Expertise: Marine mammals

Dr John Beardall
School of Biological Sciences
Monash University
Expertise: Climate, marine botany

Prof. Ian Bishop
Centre for Geographic Information Systems and Modelling
University of Melbourne
Expertise: Remote sensing

Mr Gerry Byrne
Vantree Pty Ltd
Expertise: Coastal engineering

Assoc. Prof. Sean Connell
Marine Biology
The University of Adelaide
Expertise: Reef ecology

Dr Michael Coughlan
Climate-Insights
Expertise: Climate impacts

Dr Peter Dann
Phillip Island Nature Parks
Expertise: Birds

Assoc. Prof. Rob Day
Department of Zoology
University of Melbourne
Expertise: Fisheries, particularly abalone

Dr Tim Dempster
Department of Zoology
University of Melbourne
Expertise: Aquaculture-environment interactions

Prof. Peter Gell
School of Science and Engineering, University of Ballarat
Expertise: Palaeoecology of coastal areas

Prof. Barry Hart
Water Studies Centre
Monash University
Expertise: Water quality, catchment inputs

Prof. Chad Hewitt
National Centre for Marine Conservation and Resource Sustainability
University of Tasmania
Expertise: Marine pests

Dr Jeremy Hindell
Arthur Rylah Institute
Department of Sustainability and Environment
Expertise: Estuarine biology

Dr Greg Jenkins
Fisheries Victoria Research
Department of Primary Industries
Expertise: Marine Ecology, fish

Prof. Craig Johnson
Institute for Marine and Antarctic Studies
University of Tasmania
Expertise: Marine Ecology, fish

Prof. David Karoly
Earth Sciences
University of Melbourne
Expertise: Climate change

Dr David Kennedy
School of Resource Management and Geography
University of Melbourne
Expertise: Coastal geomorphology

Prof. Michael Keough
Department of Zoology
University of Melbourne
Expertise: Marine ecology

Assoc. Prof. Spas Kolev
School of Chemistry
University of Melbourne
Expertise: Chemistry

Prof. John Langford
Melbourne Water Resource Centre
University of Melbourne
Expertise: Water quality, catchment inputs

Dr Randall Lee
Environment Protection Authority Victoria
Expertise: Oceanography

Dr Brett Light
Environment Protection Authority Victoria
Expertise: Chemistry, microscopic algae, nutrient management

Mr Andrew Longmore
Fisheries Victoria Research
Department of Primary Industries
Expertise: Chemist, nutrient management

Prof. Amanda Lynch
Geography and Environmental Sciences
Monash University
Expertise: Climate Change

Dr Andrew McCowan
Water Technology Pty Ltd
Expertise: Oceanography

Assoc. Prof. Mark McDonnell
Australian Research Centre for Urban Ecology
Expertise: Terrestrial ecology

Dr Kathleen McInnes
Marine and Atmospheric Research
CSIRO
Expertise: Climate Impacts

Dr Mark Norman
Sciences
Museum Victoria
Expertise: Biodiversity

Prof. Dayanthi Nugedoda
School of Applied Sciences
RMIT University
Expertise: Effects of pollutants

Dr Neil Plummer
Climate Information Services
Bureau of Meteorology
Expertise: Climate

Dr Gary Poore
Sciences
Museum Victoria
Expertise: Crustacea, biodiversity

Prof. Gerry Quinn
School of Ecology and Environment
Deakin University
Expertise: Marine ecology and estuaries

Prof. Ian Rae
Department of History and Philosophy of Science
University of Melbourne
Expertise: Environmental chemistry

Mr Neville Rosengren
Department of Civil Engineering and Physical Sciences
Latrobe University
Expertise: Coastal geomorphology

Honorary Assoc. Prof. John Sherwood
School of Ecology and Environment
Deakin University
Expertise: Chemistry, marine

Dr J. David Smith
Expertise: Chemistry

Dr David Smith
Marine Ecosystems and Resources
CSIRO
Expertise: Fisheries and ecosystem based management

Assoc. Prof. Stephen Swearer
Department of Zoology
University of Melbourne
Expertise: Marine ecology and oceanography

Mr Dale Tonkinson
Greening Australia (Victoria)
Expertise: Soils and contaminants in soils

Prof. Di Walker
School of Plant Biology
University of Western Australia
Expertise: Marine botany; seagrass

Dr Mike Weston
School of Life and Environmental Sciences
Deakin University
Expertise: Birds, shore birds

Dr Penny Whetton
Marine and Atmospheric Research
CSIRO
Expertise: Climate Impacts

Notes

1. In addition to the intrinsic value of marine biodiversity, coastal environments support a wide range of fisheries (valued for the whole Australian coast at >$2 billion in 2007–8: ABARE) and a tourism industy of around $6 billion annually. They also provide a range of ecosystem services, including coastal protection, removal of nutrients and carbon storage. Ecosystem services were valued in 2007 at $US 222 billion (Martinez et al. 2007 Ecological Economics), and even these figures are probably underestimates (Barbier et al. 2011)
2. *Victorian Coastal Strategy 2008* made use of 0.8m as a defensible change in mean sea level for 2100
3. J. Church, P. L. Woodworth, T. Aarup, S. Wilson, Eds., *Understanding sea-level rise and variability*, (Wiley, UK, 2010), pp. 456.
4. Climate Commission, *The critical decade. Climate science, risks and responses*. (Department of Climate Change and Energy Efficiency, Canberra, 2011), pp. 69.
5. K. L. McInnes, Macadam I., O'Grady J., "The effect of climate change on extreme sea levels along Victoria's coast. " (CSIRO, 2009).
6. J. Church et al., in *Transitions: pathways towards sustainable urban development in Australia*, P. Newton, Ed. (CSIRO Publishing, 2008).
7. There is an emerging, but largely untested, theory that "healthy" ecosystems will be more resilient to climate change.
8. Millenium Ecosystem Assessment, *Millennium Ecosystem Assessment Synthesis Report*. (2005), vol. 1.
9. E. B. Barbier et al., *The value of estuarine and coastal ecosystem services*. Ecological Monographs 81, 169 (2011).
10. For example, Victoria is poorly serviced by in situ wave observations although some monitoring has been undertaken by private companies that are not generally available or even known about to potential researchers.
11. Observational ocean prediction systems introduced by the Australian government in the last 5 years offer skilful predictions for a broad spectrum of non-tidal coastal processes. This provides many opportunities to enhance sea level forecast and warning services. Multi-decadal ocean reanalyses provide a basis for understanding the link between recent climate variability and the Victorian coast conditions. A review should be made on how these new technologies can be exploited and integrated into the coastal management framework. Observing facilities through the Integrated Marine Observing System and remote sensing also provide new opportunities to design and test integrated monitoring systems for the coastal and marine environment.
12. The discharge volume is also affected by the type of land use. For example, WatLUC (2005) *Water and Land Use Change Study: Stage 2 Community Report* completed by Water and Land Use Change Study Steering Committee and Sinclair Knight Merz. The study found that predicted flow generation capacity between 1990 and 2030 under base case land use change scenarios showed a mean annual flow generation decrease of up to 50% in subcatchments of southwest Victoria. Across all catchments flow decreased by a total of 600– 750 GL under the various scenarios modelled.
13. "Pristine" environments are hard to define, and could be taken to mean pre-human or pre-European, or the "baseline" could be any other important event, such as a coastline reaching its current geomorphology.
14. S. D. Ling, C. R. Johnson, S. Frusher, C. K. King, Reproductive potential of a marine ecosystem engineer at the edge of a newly expanded range. *Global Change Biology* 14, 907 (Apr, 2008).
15. P. R. Last et al., Long-term shifts in abundance and distribution of a temperate fish fauna: a response to climate change and fishing practices. *Global Ecology and Biogeography* 20, 58 (Jan, 2011).
16. For example, IMOS (imos.org.au) and its associated Ocean Data Portal makes large amounts of oceanographic data available.
17. In an extreme case, staffing levels for what is currently Fisheries Research Branch (Department of Primary Industries) have fallen by >50% over the past decade. This decline has not been accompanied by substantial increases in any other agency.
18. Several models for this exist currently around Australia. Regional hubs have been adopted as a model for fisheries management, and most states have formed alliances between government agencies and universities to deliver marine science, with WAMSI, MISA and IMAS along the southern Australian coast. There are well established collaborations between federal agencies and also examples of state level research centres, such as the Centre for Aquatic Pollution Identification and Monitoring.

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