Introduction

This is the sixth state of the environment report for South Australia since the first in 1988; it provides the latest assessment of the condition of the state's natural resources and trends in environmental quality.

Good-quality, up-to-date information is needed to allow us to manage and protect our environment effectively. We need to know the condition of our natural assets, about trends in condition over time, about the causes of changes in environmental quality and about the effectiveness of management responses to those changes.

Statutory state of the environment reports, produced every five years under the *Environment Protection Act 1993* (SA), are an important contribution to public information about the South Australian environment. The Environment Protection Authority (EPA) synthesises information from multiple sources to identify and describe trends in the condition of the natural environment. This information is reported to the government and to the people of South Australia, and informs policy, management and behaviour.

The role of the environment

Good information on the health of the natural environment is at least as important as information about public health and the economy because the health and wellbeing of people, the environment and the economy are inextricably linked and interdependent. The economy is dependent on finite natural resources (renewable and nonrenewable) and essential ecosystem goods and services; our quality of life is influenced by a healthy economy and also relies directly and indirectly on healthy environmental conditions and ecosystem services (Millennium Ecosystem Assessment 2005).

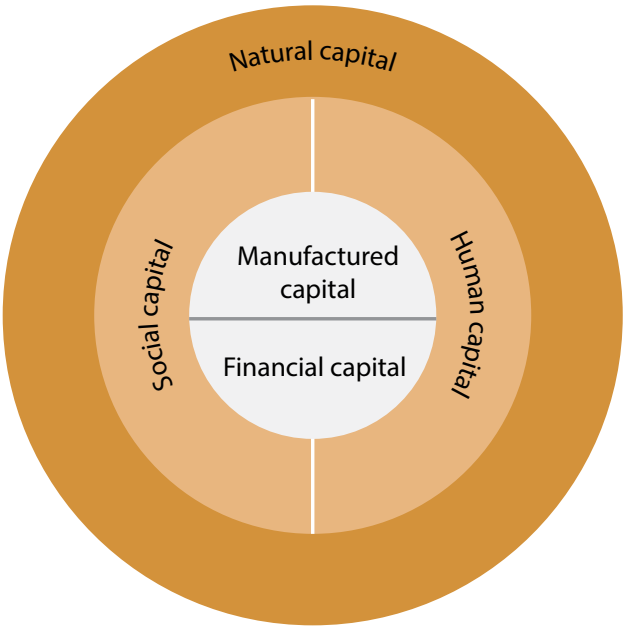
Opposite page: Currakalinga looking over St Vincent's Gulf, 1846
State Library of South Australia B15276/33

Ecosystem goods and services are the benefits arising from the ecological functions of healthy ecosystems. Ecosystem goods and services include (Costanza et al. 1997, CBD 2010):

- goods (provisioning services)
  - food, fibre and fuel
  - genetic resources
  - biochemicals (e.g. medicines)
  - fresh water
  - breathable air
- cultural services
  - spiritual and religious values
  - knowledge system
  - education and inspiration
  - recreation and aesthetic values
- regulating services
  - invasion resistance
  - herbivory
  - pollination
  - seed dispersal
  - climate regulation
  - pest regulation
  - disease regulation
  - natural hazard protection
  - erosion regulation
  - water purification
- supporting services
  - primary production
  - provision of habitat
  - nutrient cycling
  - soil formation and retention
  - production of atmospheric oxygen
  - water cycling
  - waste treatment.

The important interrelationship between the environment and human society can be viewed as a set of stocks, divided into five essential capitals: natural (ecosystem services), social (networks, consensus), human (knowledge, labour), manufactured (tradeable goods, public infrastructure) and financial (wealth). As represented in Figure 1, all of these capitals and their stocks are linked (with flows and transfers of energy, matter and information between them). For the system to operate optimally, it needs sufficient availability of, and freedom to move and price, all capitals, and trading mechanisms to facilitate exchange. The figure also reflects that there is a finite stock of natural capital within which the other capitals can accumulate.

> *People believe environmental 'bads' are the price we must pay for economic 'goods.' However, we cannot, and need not, continue to act as if this trade-off is inevitable.* (Achim Steiner, UNEP Executive Director and UN Under Secretary-General, UNEP 2011)



Source: Forum for the Future (2013)

Figure 1 Five essential capitals for human wellbeing

Overview of South Australia's environment

As context for the rest of the report, it is useful to consider the main aspects of South Australia's physical and socio-economic environment, how these have changed over time and how they relate to one another.

Natural environment

Land

South Australia has a land area of 984 221 square kilometres (of which about 4600 square kilometres are on islands) and a coastline of 5067 kilometres (3816 kilometres of mainland coastline and 1251 kilometres of island coastline). The land area is 12.7% of Australia's total and the state is fourth largest of Australian states and territories. South Australia's coastal waters cover 60 032 square kilometres. More than 80% of the state is less than 300 metres above sea level; Mount Woodroffe is the highest peak at 1435 metres. The lowest place is Lake Eyre at 15 metres below sea level. The vicinity of Lake Eyre is also the area of South Australia's (and Australia's) lowest rainfall. The area occupied by agriculture makes up 53.6% of South Australia and this increased from 49 126 square kilometres in 2009 to 52 786 square kilometres in 2011 (ABS 2012a).

South Australia's land area is divided into eight natural resource management regions (Figure 2):

- Adelaide and Mount Lofty Ranges
- Alinytjara Wilurara
- Eyre Peninsula
- Kangaroo Island
- Northern and Yorke
- South Australian Arid Lands
- South Australian Murray–Darling Basin
- South East.

Climate

South Australia's rainfall and temperatures are highly variable, both in range and location. After an extended drought, 2010 was South Australia's third wettest year and 2011 the fifth wettest year on record. This was followed by, in 2012, the driest year since 2006, with December 2012 the driest December in 18 years. The first three months of 2011 were the wettest since records began in 1900 for South Australia as a whole. The spring of 2012 was the warmest on record; 2009 was the warmest year on record and the 17th consecutive year of above-average temperatures. Temperatures for the past decade have averaged 0.7% above the 1961–90 mean temperature, showing a steady rise in annual temperatures since the 1970s. The warmest year on record for maximum temperatures across the state was 2007, and 1956 was the coldest. The highest maximum temperature ever recorded in South Australia (and Australia) was 50.7 ºC in Oodnadatta on 2 January 1960 (BoM and CSIRO 2012).

Ecosystems and biodiversity

No species loss—a nature conservation strategy for South Australia 2007–2017 (DEH 2007), divides the state into three biomes (areas with similar climates and ecosystems): two terrestrial (arid and mediterranean) and one marine. The arid biome makes up 87% of the state, and is characterised by a warm-to-hot and dry climate with low and erratic rainfall, with mostly winter rains in the south and summer rains in the north. The mediterranean biome, which makes up the remaining 13%, has a cool-to-warm climate, tending to winter rains. There is some form of conservation protection on 28% of the arid biome and 14% of the mediterranean biome. The marine biome, of which 5% is protected, covers the equivalent of 6% of the South Australian land area. The marine biome is characterised by variable and diverse currents with low-nutrient, sheltered, salty gulf waters; warmer waters in the bight; and cooler, nutrient-rich waters in the south-east (DEH 2007).

About one-quarter (more than 1000 species) of all terrestrial vascular plants and vertebrate animals in South Australia are considered to be threatened—63% of the state's mammals and 22% of the state's vascular plants are formally listed as threatened. There are insufficient data to assess the status of some vascular plants and vertebrate animals and virtually all nonvascular plants and invertebrates (DEH 2007).

The paucity of information on a number of aspects of the natural environment is a key constraint on the effectiveness of state of the environment reporting. For 50% of the 14 indicators of natural resource condition in the state, confidence in the supporting data is described as low. The confidence in the data for six other indicators is described as medium and there are no data of high confidence (Government of South Australia 2012).

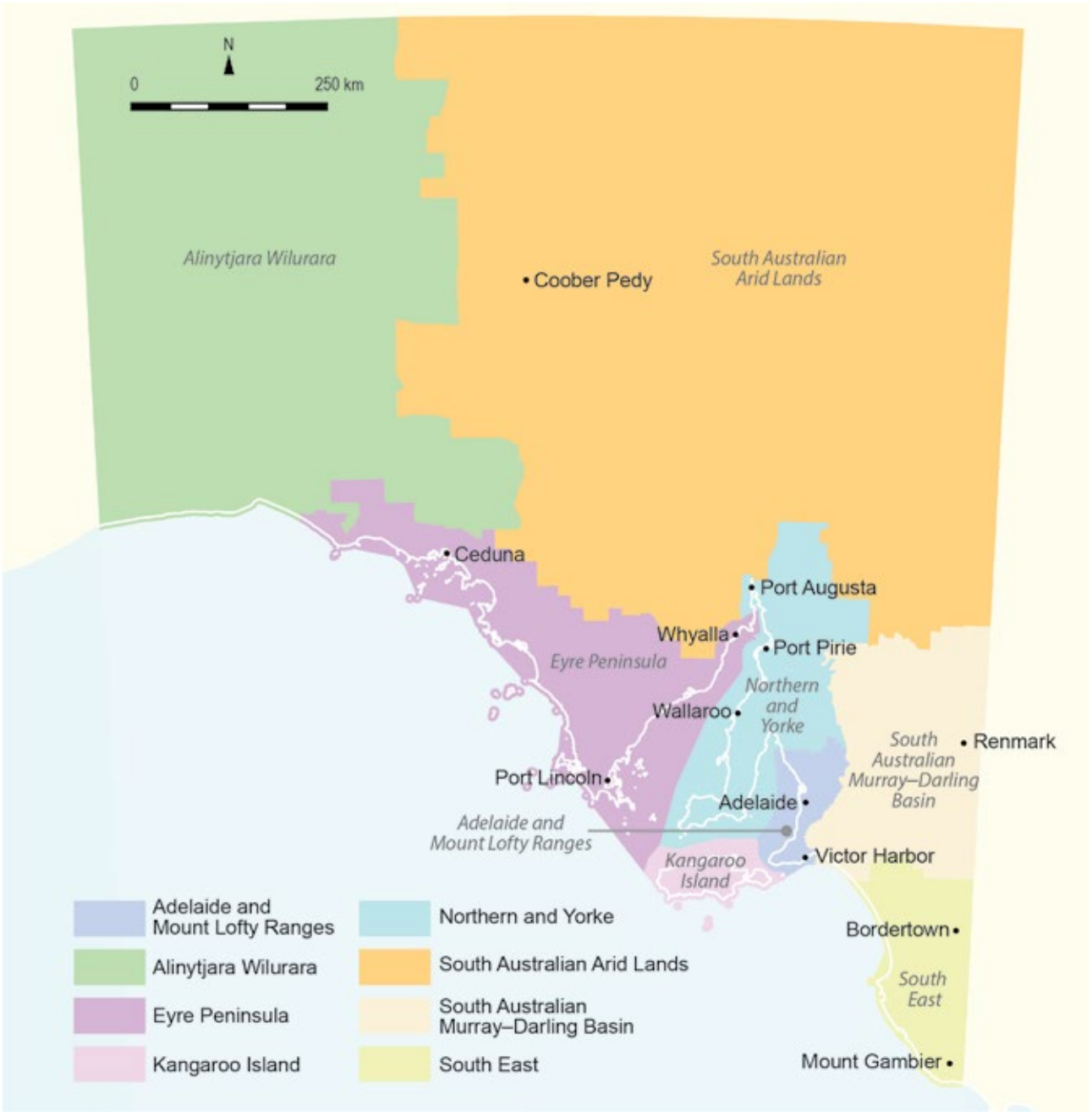


Figure 2 South Australia's eight natural resource management regions

Sand monitor
Angus Kennedy

People

Aboriginal Australians lived in Australia and South Australia for at least 40 000 years before the arrival of European settlers. The Kaurna people, who occupied the Adelaide Plains, used the natural resources efficiently and had a skilled pattern of guardianship of the land that included the effective use of fire to hunt game and to promote the growth of particular types of vegetation. The first migrants arrived in South Australia in 1836, and at the end of the first year the estimated migrant population was 546. The first census held in 1844 showed a population of 17 366. By 1921 the state's population passed 500 000 and in 1963 it passed 1 000 000 (Atlas South Australia 2012). In June 2011 the state's population was 1.64 million—an increase of 4.5% since 2006 (ABS 2012b).

Impact on the environment

The main interactions between people and the environment come from the direct and indirect use of natural resources such as air, land (especially its geological assets), water and energy, and from the generation of waste and pollution.

In spite of limitations of the methodology, human impact on the environment is often described in terms of an 'ecological footprint', which estimates the amount of land and ocean area required to sustain human consumption patterns and absorb human wastes. The footprint provides a measure of the extent to which humanity is using nature's resources faster than they can regenerate. When human resource extraction and waste generation exceed an ecosystem's ability to regenerate resources and to absorb the generated waste, it leads to a depletion of Earth's life-supporting natural capital and a build up of wastes.

The ecological footprint is typically expressed in global hectares per person. Earth's biological capacity (the capacity of an area to provide resources and absorb wastes) to sustain the world population was estimated as 1.8 global hectares per person in 2008. At the same time the average global ecological footprint was 2.7 global hectares per person, which means that we are depleting the planet's future ecological stocks faster than they can regenerate.

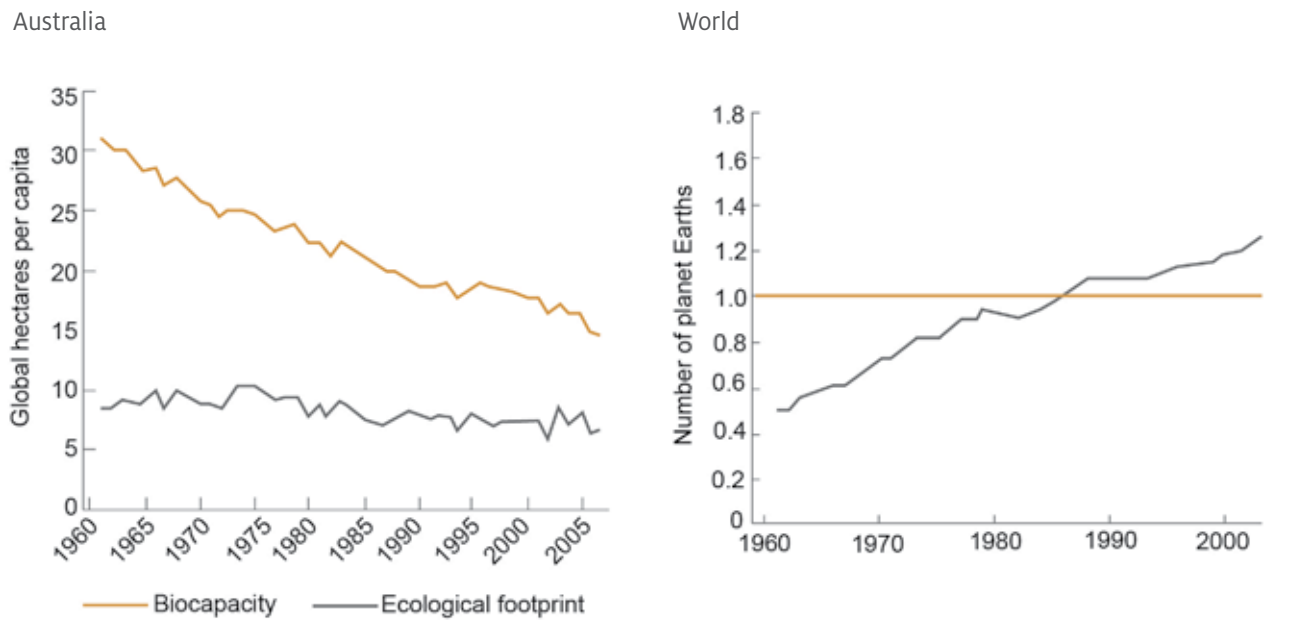
Australia's footprint is estimated at 6.7 global hectares per person—the seventh highest of all nations (Figure 3; GFN 2012). If everyone in the world consumed the same as the average Australian, we would need the natural resources of 3.76 Earths. There is some variation between states, with the average, footprint in Victoria estimated to be somewhat higher than the national average at 6.8 global hectares, and the Australian Capital Territory estimated at 9.2 global hectares (OCSE 2011). In comparison, the footprint of the average person in India is less than 1 hectare; in China, 2.1 hectares; and in New Zealand, 4.3 hectares. Australia's, including South Australia's, large footprint is caused by our lifestyles, which use large amounts of natural resources in an inefficient way (State of the Environment 2011 Committee 2011), and, significantly, for export rather than our own use.

Seen in isolation from the rest of the world, the large Australian footprint does not seem to be a major concern considering that Australia's biological capacity is estimated at 14.6 hectares per person (GFN 2012). However, there is a steady convergence of Australia's ecological footprint and its biological capacity. The footprint is increasing as the population increases and becomes more affluent, and the capacity is decreasing with environmental changes—it has more than halved since 1960. Also, because of globalisation of trade, markets and economies, it is not practical to take a single-country perspective on the sustainable use of resources.

Australia's comparatively poor global environmental performance in terms of the ecological footprint is also evident from the Environmental Performance Index (EPI), which ranks 132 countries on 22 environmental performance indicators. The 2012 EPI (the seventh iteration of this measurement project) ranks Australia 48th in current performance and 79th in trend performance over the past decade. This ranking becomes of greater concern if divided into its two main components: environmental health (effects on human health) and ecosystem vitality. Australia is ranked 10th on environmental health's effects on human health but 106th on ecosystem vitality (Yale University 2012).

Environmental understanding

To reduce depletion of the world's natural resources and to make our lifestyles more sustainable requires an awareness of the relationships between production, consumption and natural resources. From 2007–08 to 2011–12 there was no discernible change in environmental conditions other than improved rainfall, and evidence pointed to an ongoing declining trend in key environmental indices. Yet Australians were about 20% less concerned and more optimistic about the environment in 2011–12 than they were in 2007–08 (ABS 2012c).In that four-year period, the percentage of people who think the environment is in good condition has more than doubled (Figure 4a). The percentage of people who think it is in bad condition has more than halved. The same is true for the perception of the trend in the condition of the environment (Figure 4b). Interpretation



Source: GFN (2012)

Figure 3 Australia's ecological footprint versus its biocapacity, and that of the rest of the world

of these findings should consider that perceptions are influenced by a number of factors and can change quickly (ABS 2012c).

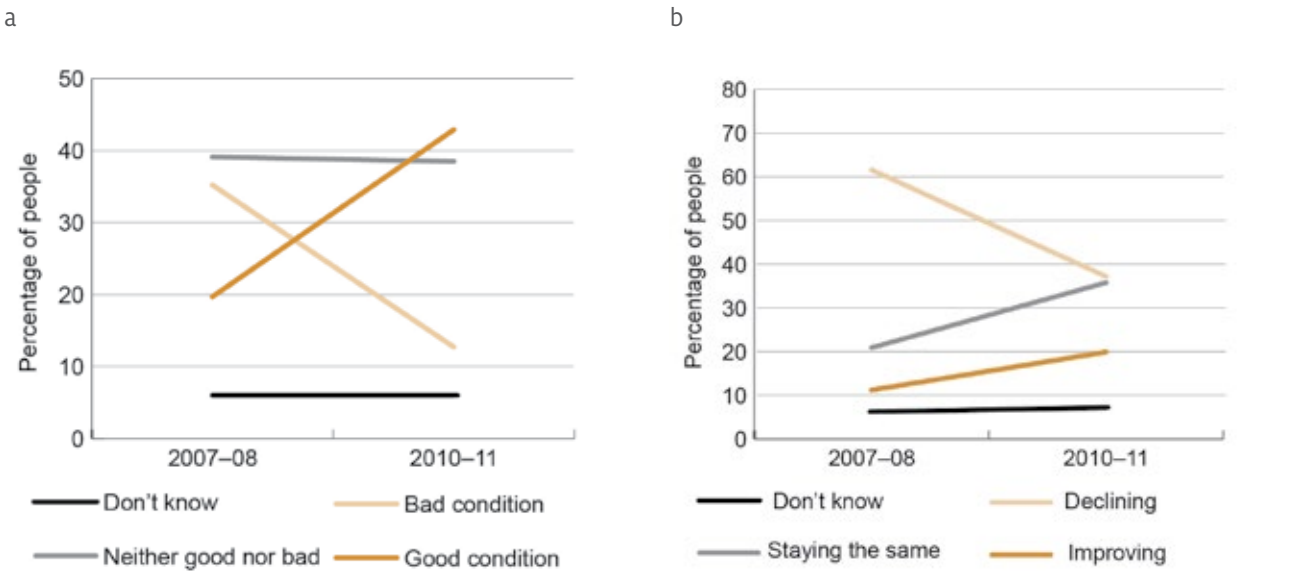
In spite of this increased optimism, more than 60% of Australians were still concerned about environmental issues. This apparent concern and awareness of environmental decline is, however, not reflected in our behaviour (Macquarie University 2010). Environmental considerations seem to play a relatively small part in decisions about what and how much we consume. The reasons for this disconnect include:

- the 'economic invisibility of nature' (the general lack of monetary values of natural resources)
- the effects of marketing and consumer attitudes
- a lack of science education and consumer information
- a growing separation between an increasingly urbanised and affluent society and its awareness of, and connection to, the natural world.

Economy

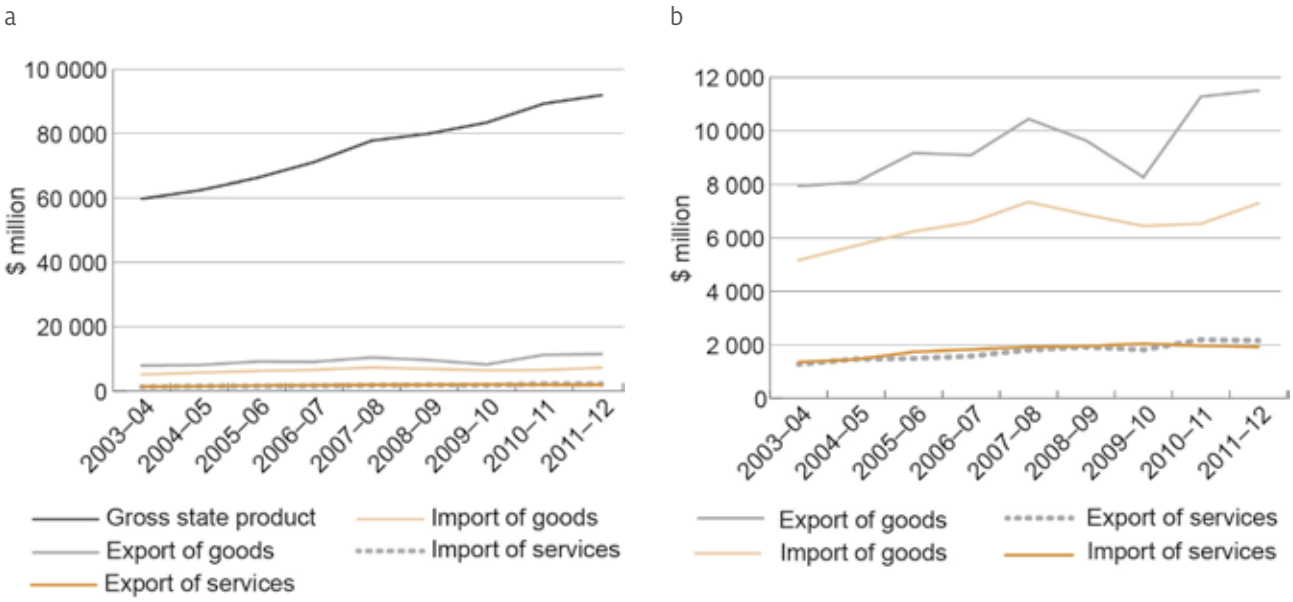
Mining and agriculture have played a key role in South Australia's economic development since the start of settlement. Following the discovery of copper in Kapunda in 1842 and subsequent discoveries in what became known as the Copper Triangle, mining contributed significantly to the prosperity of the state in its early days. Soon after settlement, the first pastoral leases were granted and the first winery in the Barossa Valley started operating. Both mining and agriculture continue to grow, with South Australia's mineral exports earning $4.22 billion in 2010–11 (up from $2.85 billion in 2009–10) and agriculture contributing close to $5 billion (almost half) of the state's overseas exports annually. However, today about 45% of the state's economy is based in services, while traditional economic sectors of mining and agriculture collectively make up about 10%. The remainder is made up of construction, housing and utilities (19%), manufacturing (9%), and retail and wholesale trade (9%). The food and wine industry, agricultural exports and tourism rely on a healthy environment. More than 30% of South Australia's exports consist of agricultural products (EDB 2013).

Figure 5 shows the growth in the South Australian economy measured in changes in gross state product (Figure 5a), and in the import and export of goods and services between 2003–04 and 2011–12 (Figure 5b). Export of goods is clearly the largest proportion of trade and is growing. South Australia's average annual goods and services export growth over the last five years was 3.3%.



Source: ABS (2012c)

Figure 4 Perceptions of the condition of the environment, (a) 2008 and (b) 2011



Source: ABS (2012d)

Figure 5 South Australia's (a) gross state product and (b) international trade, 2003–04 to 2011–12

As international trade increases, the production of goods can become increasingly detached from direct consumption. Goods exported carry with them embodied consumption of materials such as water, minerals, metals and chemicals, as well as carbon emissions.

In 2011–12, South Australia had 4.3% of Australia's exports in goods and 3.8% of Australia's exports in services (Table 1).

Table 1 South Australia's trade, 2011–12

	Goods ($m) % share of Australian trade	Services ($m) % share of Australian trade	Total ($m) % share of Australian trade
Exports	11 416	1 927	13 343
	4.3	3.8	4.2
Imports	7 261	2 198	9 459
	3.0	3.6	3.2

Source: DFAT (2012)

South Australia's major exports in 2011–12 were (DFAT 2012):

- wheat $1627 million
- wine $1146 million
- copper $1140 million
- copper ores and concentrates $960 million
- iron ores and concentrates $945 million
- meat (excluding beef) $499 million
- lead $408 million
- vegetables $272 million
- passenger motor vehicles $272 million
- seeds and vegetables $206 million.

Approach to State of the Environment reporting

The approach and processes for preparing the 2013 state of the environment report for South Australia had a number of key features.

Content development

Authors were nominated by key government agencies that are the main custodians of data required for the report. These authors drafted content with the support of their own and other agencies based on guidelines prepared by the EPA, and under the guidance of a senior-level government reference group. Final editorialising of content was undertaken by the Chief Executive under delegation from the EPA Board.

Inter-agency coordination

A five-member senior-level government committee supported the project with advice and direction, and promoted consistency and links across themes. The committee reviewed draft chapters, identified potential peer reviewers, contributed to the terms of reference for peer review and facilitated approval of draft content for the theme chapters by their heads of department.

Peer review

Each chapter was reviewed by two external peer reviewers with expertise in the particular areas. This resulted in a number of revisions and generated valuable additional information that was incorporated into the final version of the report. The peer review process confirmed the importance of considering information and perspectives from a broad range of sources to ensure a balanced and complete picture.

Edit and design

Biotext, a company with expertise in drafting, editing and publishing science-based publications, professionally edited, proofread and designed the final report. We hope that the editing and design of the report demonstrates the value of presenting scientific information in an easy-to-understand and accessible language and format. This includes the addition of assessment summaries at the start of each chapter, which are based on judgments of the overall trend and condition of selected aspects covered in the report. The topics in the assessment summaries are composed of a number of related elements, some with a positive trend and others with a negative trend, reflecting the complexity of the many environmental interactions.

Format

The content of the report has been organised under five broad themes reflecting the key environmental issues for South Australia. All themes follow the same structure, reporting on the driving forces, pressures, state, impact, response and outlook (DPSIRO) model (Figure 6) to meet the requirements of the South Australian *Environment Protection Act 1993*.

For efficiency, consistency and alignment, the EPA used existing information reported under key environmental policies, strategies and plans, wherever available.

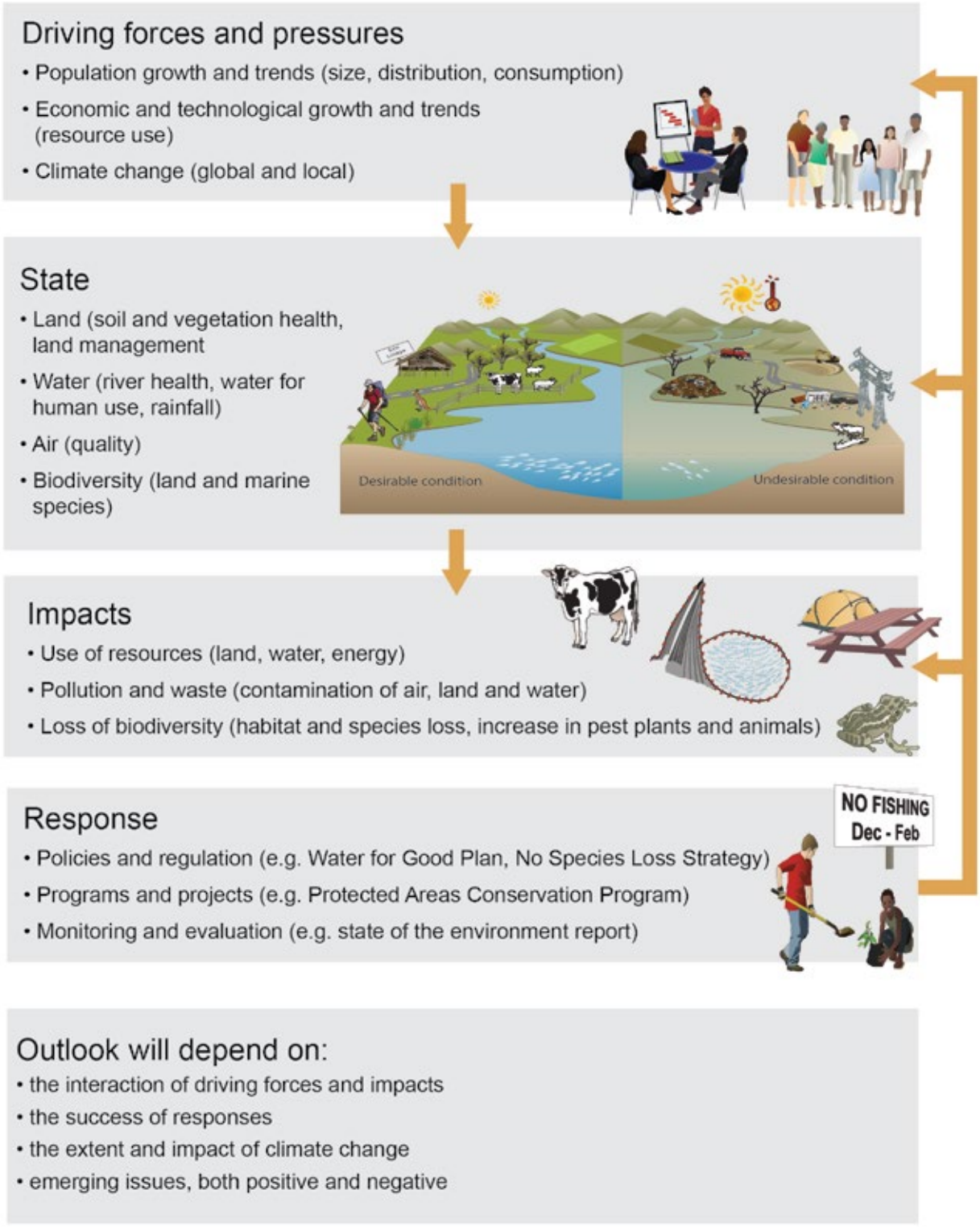


Figure 6 State of the environment reporting framework—driving forces, pressures, state, impact, response, outlook (DPSIRO)

Improving reporting effectiveness

Consecutive reports on the environment in South Australia and for the whole of Australia have highlighted areas for improvement. For environmental reporting to inform and help shape environmental management and sustainable behaviour more effectively, there is a need for better coordination and integration of the substantial amount of environmental data collected by governments at federal, state, regional and local levels, and by the private sector, universities, researchers and nongovernment organisations. Such changes would not just improve environmental reporting, but would also make meaningful information available on long-term trends in priority areas and assess the effectiveness of the significant investment in conservation and natural resource management. There are increasing opportunities to benefit from developments in crowdsourcing (the practice of obtaining services, ideas or content from a large group of people, and especially from an online community), citizen science and other forms of open data generation and sharing.

There is also a need for improvements in the synthesis and communication of available data to a broad audience on a more regular basis, and for better integration of environmental data with relevant socio-economic data. This requires agreement on clear indicators, including for sustainability and wellbeing, and commitment to the maintenance of core datasets required to measure progress against those indicators. It also requires improvement in communicating complex scientific information in a coherent and easy-to-understand manner.

The following points made in the 2011 Australia state of the environment report (State of the Environment 2011 Committee 2011) about the future of environmental reporting are equally applicable to South Australia:

- Improved data collection and use of alternative data sources are vital for understanding and effectively managing important aspects of Australia's environmental systems.
- Of particular value would be partnerships with the resources sector, which collects rich datasets on coastal and marine environments (where publicly available data are particularly scarce) as part of its environmental approvals and compliance processes; and the agricultural sector, where industry consultants collect a wide variety of environmental datasets on soil, water and pests.
- Collecting information is not enough. Creating and using systems that allow efficient access to environmental information remain a great challenge. Such systems would allow scientists and managers to analyse and make connections in the data, so that they can begin to understand the links among various aspects of ecological processes. It is also important that socio-economic data relevant to environmental issues are available, so that connections between the environment and society can be understood. Finally, the usefulness of environmental and related data will be magnified if they can be effectively transformed into information products and transferable knowledge likely to be meaningful to a broad audience and relevant to the issues and policy needs of today and tomorrow.
- There is a need for
  - more intelligent and powerful (quicker, integrated, open) monitoring
  - increased standardisation of measurement and reporting systems
  - better data management and environmental modelling platforms
  - standardisation and sharing environmental data between jurisdictions and industry
  - tracking changes in environmental conditions through community-based environmental accounting, or through benchmarks and standards for environmental sustainability
  - innovation and commitment to increase the value derived from environmental monitoring and reporting against agreed benchmarks and standards.

Measuring sustainability

There has been a growing recognition of the need for new measures of wellbeing that better reflect environmental costs and benefits and their sustainable use. Economic valuation of ecosystem services and environmental assets is notoriously difficult and controversial in spite of its obvious and significant value.

Measurement of sustainability or sustainable development has been an issue of public interest since at least the 1992 Earth Summit in Rio de Janeiro, and has been raised in a number of significant reports in recent times (Stiglitz et al. 2009, UNEP 2011, The Royal Society 2012, WWF 2012).

Measuring sustainability is a challenging concept because it requires modelling an unknown future and integrating information about widely divergent aspects with complex interactions. Other challenges in measurement are cause-and-effect relationships spanning multiple geographic and time scales. This complexity is reflected in the

multiple attempts to develop indices, as well as different versions, of sustainability indicators, including the Genuine Progress Indicator, Ecological Footprint, Human Development Index, Environmental Sustainability Index and, OECD Better Life Index (Stiglitz et al. 2009).

In response to the 2008 state of the environment report, the South Australian Government announced a project 'to determine economy-wide measures of sustainability that may be applicable to the assessment of Government policy, enabling consistent measurement and providing a more inclusive assessment of sustainability' (Government of South Australia 2009). In its 2011–12 Budget, the Australian Government provided $10.1 million for a program to develop a set of sustainability indicators to measure Australia's progress towards sustainability. The Australian Government committed to indicators than can be factored in at a regional level, and with data regularly released at national, state and, where available, regional level (DSEWPaC 2012).

The development of South Australia–specific sustainability measures is likely to benefit from the outcomes of the national process; coordination with that process is likely to maximise advantages of consistent indicators and related efficiencies in data collection.

Internationally, to contribute to the integration of environmental science into economic and political decision-making, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) was established in April 2012. IPBES is an independent body similar to the Intergovernmental Panel on Climate Change and is made up of 92 nations, including Australia. IPBES brings together the International Mechanism of Scientific Expertise on Biodiversity and various follow-up processes to the 2005 Millennium Ecosystem Assessment, including a growing number of subglobal assessment initiatives (IPBES 2012).

Juvenile central netted dragon near Stuart Creek Station

Angus Kennedy

Progress

Since the start of South Australian state of the environment reporting more than 20 years ago, there have been significant changes in the amount, quality, nature and sources of environmental information, in how it is used, in the way the information is and can be communicated, and its potential value. There have also been significant advances in reporting methods and approaches, such as sustainability reporting and environmental accounting. At the same time, the requirements for good reporting are still as important today as they were 20 years ago, such as a robust set of indicators supported by good science, good data collection, proper trend analysis, and systematic evaluation of the effectiveness of responses to environmental challenges. The EPA is committed to continual improvement of state of the environment reporting, taking into account these essential requirements and the changing context in which reporting takes place.

In this spirit, the EPA has initiated a program to improve the effectiveness of future state of the environment reporting, both in terms of content and its communication. The program includes a new reporting model, improved quality of data (including consistent, robust, longitudinal datasets and use of citizen science), and more effective communication and engagement (including improved accessibility and visualisation). It also promotes the development of a whole-of-government environmental information strategy and plan, which coordinates comprehensive, trusted, timely and high-quality environmental information to assist decision-making by government, industry and the community. We expect that, collectively, these changes will deliver better and more regular information on the environment.

> *Better information on the state of the environment, ecosystems and biodiversity is essential for both private and public decision-making that determines the allocation of natural capital for economic development.* (UNEP 2011)

Ultimately, the objective is not to report environmental information, but to use the information to help us prevent, reduce and repair environmental harm and risk through good policy and regulation, targeted programs and projects, and changing culture and behaviour.

> *Our challenge is to understand, explain and indeed act to ensure that environmental risk and environmental challenges are tackled in a sustainable manner.* (Gemmell and Scott 2012)

This report

The following five chapters of the 2013 state of the environment report provide a detailed assessment of the South Australian environment. The first two chapters reflect key drivers of environmental change, namely population and climate change, and the subsequent three chapters cover three critical aspects of the environment: water, biodiversity, and the coastal and marine environment.

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