2

Biodiversity, human communities and the economy

> Biodiversity represents our biological wealth. It provides a wide variety of life supporting ecosystem services upon which we depend for our health, economy and survival. We have long been relying on the resilience of natural systems but we have now severely depleted our natural capital, leaving us with a much more uncertain future.[1]

2.1 This chapter will consider the relevance of biodiversity to human communities by looking at 'ecosystem services', including their impacts on health and the economy, as part of a holistic approach to policy making. The Committee considers how biodiversity impacts can be better measured, for example, by national environment accounts. By understanding the links between biodiversity, economies and physical and psychological health, areas for better awareness and engagement can be explored. In this chapter, conclusions and recommendations are made regarding environmental accounting and information, and education programs and citizen science initiatives.

What is the relevance of biodiversity to us?

2.2 The Committee heard extensive evidence attesting to the need to consider 'biodiversity' as encompassing more than strictly environmental themes, that it should be seen as central to human existence. According to the 2009 report by the Biodiversity and Climate Change Expert Advisory Group, commissioned by the Australian Government and prepared for the Natural Resource Management Ministerial Council ('2009 report on

1 Monash Sustainability Institute, *Submission 69*, p. 1.

Australia's biodiversity and climate change'), many believe there is inherent value in conserving biodiversity from the viewpoint of each species being a unique evolutionary product, and the rich diversity of other life forms being a core part of humanity.[2] The 2009 report on Australia's biodiversity and climate change, as well as the accompanying Summary for policy makers,[3] was often quoted in submissions to the inquiry, as it comprehensively covers many of the terms of reference. The lead author of the report, Professor Will Steffen, also gave evidence early in the inquiry process, providing a contextual framework for the Committee to analyse submissions and examine the issues in detail.

2.3 The 2009 report on Australia's biodiversity and climate change stated that biodiversity must be conserved in order to ensure options for future needs will be available, given that many biological resources that are not necessarily valuable now will become valuable in future.[4]

> Loss of biodiversity has significant impacts on human populations in a number of physical and psychosocial ways, including direct psychological impacts, loss of social connections, loss of choice and freedom, increased conflict and violence …
>
> … We underestimate the importance of having a stable, predictable environment for our mental wellbeing.[5]

2.4 The Committee heard that there is a need to increase awareness about the importance of biodiversity to health, which can be done by linking the two in policy and research.[6] Dr Paul Sinclair, Program Manager of the Healthy Ecosystems Program for the Australian Conservation Foundation (ACF) explained the need to get better at telling the stories—historically present in all cultures—about why our connection to the natural world and the way it sustains us matters.[7]

2.5 Ecosystems and biodiversity can be viewed as natural capital that yields goods and services that affect the wellbeing of humans. The Commonwealth Scientific and Industrial Research Organisation (CSIRO)

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2 W. Steffen, A.A. Burbidge, L. Hughes, R. Kitching, D. Lindenmayer, W. Musgrave, M. Stafford Smith, P.A. Werner, *Australia's biodiversity and climate change*, CSIRO publishing, Collingwood, Victoria, 2009, p. 20 ('2009 report on Australia's biodiversity and climate change').

3 Professor Will Steffen, *Exhibit 2*, 'Australia's biodiversity and climate change: Summary for policy makers 2009', 2009.

4 W. Steffen, A.A. Burbidge, L. Hughes, R. Kitching, D. Lindenmayer, W. Musgrave, M. Stafford Smith, P.A. Werner, *Australia's biodiversity and climate change*, CSIRO publishing, Collingwood, Victoria, 2009, p. 20.

5 The Australian Psychological Society, *Submission 62*, pp. 4, 8.

6 Monash Sustainability Institute, *Submission 69*, p. 6.

7 Dr Paul Sinclair, Program Manager, Healthy Ecosystems Program, Australian Conservation Foundation (ACF), *Transcript of evidence*, 4 May 2012, p. 29.

set out in its submission the followings links between natural capital and social and economic sectors:

- the extensive areas of natural and modified pastures in which rangeland grazing is the main land use over 60% of Australia
- native forests that account for jobs in many sectors
- intact (remnant) terrestrial native vegetation (including forests and native pastures) that provide clean water and mitigate the adverse impact of natural hazards such as erosion and flooding
- biodiversity that provides important pollinators, seed dispersers, and pest control agents on which agriculture and forestry depend
- riparian and littoral vegetation are special cases of native vegetation that occur at complex interfaces between terrestrial and aquatic systems, where they protect areas from erosion, filter sediments, nutrients and pollutants, mitigate the effects of flooding and storm events, and provide supporting habitats for aquatic biodiversity
- marine life that acts in coastal defence against damaging waves and storms, processing of pollution, oxygen production and greenhouse gas regulation
- biodiversity that directly supplies ecosystem services such as: food, income and leisure activities through commercial and recreational uses (especially fishing), and income and cultural services through tourism
- the deep link between land, sea and biodiversity that is a part of the culture and identity of Aboriginal and Torres Strait Islander people.[8]

2.6 The CSIRO stated that it was likely that some valuable natural assets would change but how those changes would affect the complex interactions among social and economic systems was not clear.[9]

2.7 The Committee heard that governments will spend more on roads and desalination plants than on natural infrastructure that supports economic prosperity and human wellbeing, and that we need to ensure our economy more accurately reflects the state of our natural wealth.[10]

8 The Commonwealth Scientific and Industrial Research Organisation (CSIRO), *Submission 23*, pp. 12-13.

9 CSIRO, *Submission 23*, p. 13.

10 Dr Sinclair, ACF, *Transcript of evidence*, 4 May 2012, p. 24.

Ecosystem services

2.8 Ecosystem services are the benefits that humans receive from resources and processes supplied by ecosystems. The 2005 United Nations Millennium Ecosystem Assessment framework set out a method of categorising ecosystem services, with four categories of ecosystem services: provisioning, regulating, cultural and supporting. Examples have been added to each category to assist with interpretation:

- **provisioning**: food, fresh water, wood, fibre, fuel, genetic and medicinal resources, biochemicals and natural medicines, ornamental resources
- **regulating**: climate regulation, flood regulation, water regulation and purification, disease regulation, carbon sequestration, air quality regulation, erosion control, pest control, pollination
- **cultural**: aesthetic values, spiritual and religious values, educational values, recreation, Indigenous culture, ecotourism, psychological wellbeing, cultural diversity and heritage, knowledge systems, inspirational values
- **supporting**: nutrient cycling, soil formation, primary production, photosynthesis.[11]

2.9 Extensive evidence received by the Committee attested to the threats posed by reduced biodiversity to the ecosystem services outlined above. Evidence received with regard to each of the four categories of ecosystem services is canvassed below.

Climate change impacts on biodiversity and ecosystem services

2.10 The Committee heard from the Climate and Health Alliance that climate change is having severe adverse impacts on biodiversity, on which we depend for food, clean air, medicine and many other ecosystem services.[12] The Committee heard from the Australian Psychological Society that loss of biodiversity can threaten food security, reduce access to clean water, decrease energy security, increase vulnerability to natural disasters and limit the availability of natural resources, ultimately threatening human survival.[13]

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11 Millennium Ecosystem Assessment, 2005; W. Steffen, A.A. Burbidge, L. Hughes, R. Kitching, D. Lindenmayer, W. Musgrave, M. Stafford Smith, P.A. Werner, *Australia's biodiversity and climate change*, CSIRO publishing, Collingwood, Victoria, 2009, p. 19.

12 Climate and Health Alliance, *Submission 49*, p. 2.

13 Australian Psychological Society, *Submission 62*, p. 7.

2.11 The Committee heard from Dr Marion Carey, a Senior Research Fellow at the Monash Sustainability Institute, that a 'loss of ecosystem services can increase the vulnerability of human communities to the impacts of natural disasters'.[14]

Provisioning services

2.12 Ecosystem services provided under this category include: food, fresh water, wood, fibre, fuel, genetic and medicinal resources, biochemicals and natural medicines, and ornamental resources.

2.13 The Department of Agriculture, Fisheries and Forestry (DAFF) indicated that adverse effects on agricultural productivity, profitability and viability could arise from:

- weed or pest animal migration or population increases due to climate change
- agricultural industries requiring increased pesticide or herbicide use to remain productive, possibly leading to an increase in the number of chemical tolerant weeds and pest animals, further increasing their populations
- farming practices responding to the drive to increase sustainability and biodiversity, and production outputs, which may cause unexpected interactions with weeds and pest animals.[15]

2.14 DAFF stated some general impacts on agriculture would likely include:

> … significant crop and pasture reductions by 2070 in southern Australian regions, reduced grain and grape quality, increased thermal stress on stock reducing productivity, increased incidence and distribution of weeds and increased fire risk.[16]

2.15 The Committee heard from Dr Carey that 'biodiversity supports food security and dietary health' and that approximately 50 per cent of commercially available medicines come directly from nature.[17]

2.16 The Monash Sustainability Institute discussed how food and water security is being threatened by climate change. Oceans threatened by acidification and warming, mixed with other stressors, impacts upon fisheries which provide a major source of protein and nutrients for the human diet. Native vegetation threatened by increasing fire and drought

14 Dr Marion Carey, Senior Research Fellow, Monash Sustainability Institute, *Transcript of evidence*, 4 May 2012, p. 48.

15 Department of Agriculture, Fisheries and Forestry (DAFF), *Submission 73*, pp. 10-11.

16 DAFF, *Submission 73*, p. 10.

17 Dr Carey, Monash Sustainability Institute, *Transcript of evidence*, 4 May 2012, pp. 48, 51.

risks impacts upon the hydrological cycle, which is important for fresh water production and the prevention of waterborne disease in humans.[18]

2.17 Climate-induced changes in coastal habitats, ocean temperature, currents, winds, nutrient supply, rainfall, ocean chemistry and extreme weather conditions are expected to have severe impacts on the fisheries industry.[19] The Department of Sustainability, Environment, Water, Population and Communities (DSEWPAC) and DAFF highlighted the major contribution that the Australian fishing and aquaculture industries make to the Australian economy, contributing around $2 billion per year.[20] The Tasmanian rock lobster industry also contributes around $72 million per year,[21] with seafood making up an important part of the Australian diet.[22]

2.18 The Research Centre for Applied Alpine Ecology explained that 'a large proportion of the water in the Murray River is derived from the Australian Alps', and the need to protect the catchments given the projected changes in rainfall patterns.[23] The water in the Murray-Darling Basin is estimated to contribute $10 billion per annum to the national economy.[24]

2.19 Native and planted forests are likely to be affected by changes in rainfall, temperature, associated impacts on key production species, and changes in fire frequency and intensity.[25] Climate modelling suggests that most production forest areas will experience lower rainfall and an increase in temperature by 2030.[26] The effects of climate change on forest productivity would vary across Australia, with wood yields projected to decline in most commercial forest production areas.[27]

Regulating services

2.20 Ecosystem services provided under this category include: climate regulation, flood regulation, water regulation and purification, disease regulation, carbon sequestration, air quality regulation, erosion control, pest control, and pollination.

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18 Monash Sustainability Institute, *Submission 69*, pp. 4, 5.

19 Department of Sustainability, Environment, Water, Population and Communities (DSEWPAC), *Submission 66*, p. 5.

20 DSEWPAC, *Submission 66*, p. 5; DAFF, *Submission 73*, p. 12.

21 DSEWPAC, *Submission 66*, p. 5.

22 DAFF, *Submission 73*, p. 12.

23 Research Centre for Applied Alpine Ecology, *Submission 72*, pp. 2-3.

24 International Union for Conservation of Nature World Commission on Protected Areas (IUCN WCPA), *Submission 30*, p. 6.

25 DAFF, *Submission 73*, pp. 12, 13.

26 DAFF, *Submission 73*, p. 13.

27 DAFF, *Submission 73*, p. 13.

2.21 In its submission, DAFF stated that water supply and quality are likely to be affected by higher temperatures, increased evaporation rates and changes in amount and patterns of rainfall.[28] DAFF commented that:

- projected changes in rainfall patterns, outlined in the 2007 Intergovernmental Panel on Climate Change report, will see northern Australia receive more rainfall while southern and south-eastern Australia will likely receive less rainfall
- reduced rainfall and increased evaporation in southern and eastern Australia will intensify water security problems by 2030
- 'annual stream flow in the Murray Darling Basin is likely to fall 10 to 25 per cent by 2050'.[29]

2.22 DAFF also stated that 'reduced water supply and quality are likely to affect agricultural production'.[30]

2.23 The Australian Alps performs a very important ecosystem service by providing water of a high yield and of exceptional quality to lowland rivers. The Committee heard that impacts of climate change on this ecosystem service could reduce 'groundwater recharge and summer base-flows as a consequence of reduced winter snowpack' and degrade 'water quality due to contraction or loss of alpine peatlands'.[31]

2.24 DSEWPAC stated that the effects of rising sea levels and extreme weather events on coastal communities include the threat of inundation, erosion and effects on water quality and supply.[32]

2.25 The Committee heard from Dr Carey of the Monash Sustainability Institute that ecosystem disturbance has implications for human disease.[33] DSEWPAC stated that changes to temperature and rainfall patterns in areas like Kakadu National Park could lead to an increase in transmission of disease by insects, and increase in the occurrence of food and waterborne diseases.[34]

2.26 DAFF outlined that increasing temperatures directly impact on changes in animal health risks.[35] It is estimated that up to 75 per cent of newly

28 DAFF, *Submission 73*, p. 10.
29 DAFF, *Submission 73*, p. 10.
30 DAFF, *Submission 73*, p. 10.
31 Research Centre for Applied Alpine Ecology, *Submission 72*, p. 4.
32 DSEWPAC, *Submission 66*, p. 5.
33 Dr Carey, Monash Sustainability Institute, *Transcript of evidence*, 4 May 2012, p. 48.
34 DSEWPAC, *Submission 66*, p. 5.
35 DAFF, *Submission 73*, p. 13.

recognised infectious diseases of humans can be transmitted between animals to humans.[36]

2.27 The Committee heard of a disconnect between understanding the benefits of locally sourced sustainable food and understanding the ecosystem services behind food production.[37] The Committee heard that many crops are dependent upon natural pollinators for fertilisation, and of the importance of natural vegetation for bees in providing essential nectar and pollen. The Committee was further informed that bee populations in many countries have been decimated,[38] and that Australians do not well appreciate the role of pollinators.[39] The Committee heard from Mr Dale Park, Senior Vice President of the Western Australian Farmers Federation, that 'there is a possibility that we could lose our bee population, and I think a lot of broadacre growers do not actually realise that, if it does come about, it is going to have an incredible impact on growing various crops.'[40]

Cultural services

2.28 Ecosystem services provided under this category include: aesthetic values, spiritual and religious values, educational values, recreation, Indigenous culture, ecotourism, psychological wellbeing, cultural diversity and heritage, knowledge systems, and inspirational values.

2.29 The Committee heard that healthy ecosystems contribute to our quality of life, are integral to human health and wellbeing and important for people's connection with nature, a sense of identity, restoration, stress reduction and recreation.[41] Further, that biodiversity plays a key role in proper mental functioning.[42]

2.30 The Committee heard of the importance of enhancing the resilience of the natural environment and human communities at the same time. Dr Susie Burke, a Senior Psychologist in the Australian Psychological Society, presented two examples of how this can be achieved. Dr Burke described the work of Landcare groups as being about sustaining local biodiversity, with human community resilience emerging through the sense of wellbeing and meaning they have.[43] Dr Burke also described the inclusion

36 DAFF, *Submission 73*, p. 13.

37 Dr Carey, Monash Sustainability Institute, *Transcript of evidence*, 4 May 2012, p. 52.

38 Monash Sustainability Institute, *Submission 69*, pp. 4-5.

39 Dr Carey, Monash Sustainability Institute, *Transcript of evidence*, 4 May 2012, p. 52.

40 Mr Dale Park, Senior Vice President, Western Australian Farmers Federation, *Transcript of evidence*, 7 November 2011, p. 16.

41 Australian Psychological Society, *Submission 62*, pp. 4, 6.

42 Australian Psychological Society, *Submission 62*, p. 7.

43 Dr Susie Burke, Senior Psychologist, Australian Psychological Society, *Transcript of evidence*, 4 May 2012, p. 49.

of walking tracks through nature parks as protecting nature and enabling people to use the natural environment for recreation and exercise, giving them a sense of peace, and activating values of caring for the natural environment.[44]

2.31 The Committee heard that biodiversity should be preserved for our mental and physical health, and that public awareness of the importance of biodiversity to human health should be improved.[45]

2.32 The importance of engaging and educating the community on the importance of the risks to human health posed by the loss of biodiversity was raised by Ms Fiona Armstrong, Convenor of the Climate and Health Alliance.[46] The Committee heard that the more biologically diverse our natural environment, the greater the psychological value and the greater protection it offers for humans in the transmission of infectious diseases.[47]

2.33 The Committee was interested to hear that human relationships with animals illustrate the importance we place on connections to nature and other species, as demonstrated by human interest in and interaction with wildlife through bird watching, and zoo and national park attendance—further underscoring the importance of healthy biodiversity to human quality of life.[48] These benefits to our mental health can also be demonstrated through other outdoor activities including gardening, snorkelling, diving, bushwalking, whale watching, and nature retreat.[49]

2.34 The Committee heard that a loss of biodiversity can result in a loss of sense of place in local residents and Indigenous people. DSEWPAC stated that the impact of climate change on Indigenous people's sacred sites and traditional lands may adversely affect the mental and physical well-being of Indigenous communities.[50] Further, that a loss of biodiversity can harm relations and create tension and conflict between groups of people if one group profits from the losses of another; for example, the logging of native forests may be seen as a loss of biodiversity to one group but a profit to another group.[51]

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44 Dr Burke, Australian Psychological Society, *Transcript of evidence*, 4 May 2012, p. 49.

45 Dr Carey, Monash Sustainability Institute, *Transcript of evidence*, 4 May 2012, p. 48.

46 Ms Fiona Armstrong, Convenor, Climate and Health Alliance, *Transcript of evidence*, 4 May 2012, p. 54.

47 Dr Burke and Ms Armstrong, Climate and Health Alliance, *Transcript of evidence*, 4 May 2012, p. 54.

48 Australian Psychological Society, *Submission 62*, p. 7.

49 Monash Sustainability Institute, *Submission 69*, p. 4.

50 DSEWPAC, *Submission 66*, p. 6.

51 Australian Psychological Society, *Submission 62*, p. 8.

2.35 DSEWPAC stated that 64 per cent of international visitors to Australia participate in a nature-based experience and that any changes to biodiversity are expected to have a direct impact on the tourism industry. The CSIRO gave some examples of the effects that damage to marine biodiversity could have on tourism:

- loss of coral diversity due to ocean acidification and coral bleaching of the Great Barrier Reef could make it a less desirable tourist destination
- inundation of near-coastal freshwater systems with sea water at the floodplains at Kakadu National Park may change the Park's appearance and would likely affect tourism numbers.[52]

2.36 The value of the Great Barrier Reef to the economy is approximately $51 billion, with total coral mortality potentially removing $38 billion of that value.[53] DAFF stated that any reduction in marine biodiversity as a result of climate change and ocean acidification will impact on Australia's economy and communities, as recreational fishing is a multi-billion dollar per year industry and an important leisure activity for millions of Australians, whilst the Great Barrier Reef and Ningaloo Reef ecosystems are important for tourism.[54]

2.37 The Great Barrier Reef Marine Park Authority reiterated the above points made by the CSIRO, DSEWPAC and DAFF, highlighting that reef-based industries and communities are expected to be seriously affected by climate changes, including tourism, commercial fishing and small coastal settlements.[55] Extreme weather events, like Tropical Cyclone Yasi, can have major consequences for areas such as commercial fishing in the Great Barrier Reef region, which contributed $139 million to the economy in 2006-07.[56] The Committee heard that tourism expenditure in the Great Barrier Reef Catchment Area totalled over $5.8 billion in 2006-07.[57]

2.38 Climate change impacts on the Australian Alps will have flow on effects for tourism in the area. The Research Centre for Applied Alpine Ecology stated that local tourist economies will be under pressure with the expected downturn in winter skiing tourism as a result of climate change,

52 CSIRO, *Submission 23*, p. 13; DSEWPAC, *Submission 66*, p. 6.

53 DSEWPAC, *Submission 66*, p. 6; In 2009, the total present economic value of the Great Barrier Reef, excluding Indigenous values, was valued at $51.4 billion: Oxford Economics, *Valuing the effects of Great Barrier Reef bleaching*, Great Barrier Reef Foundation, Newstead, 2009, p. 2.

54 DAFF, *Submission 73*, p. 12.

55 Great Barrier Reef Marine Park Authority, *Submission 28*, p. [2].

56 Great Barrier Reef Marine Park Authority, *Submission 28*, p. [3].

57 Australian Institute of Marine Science (AIMS), *The AIMS Index of Marine Industry*, AIMS, Canberra, 2012, p. 9.

with many operators perhaps looking to summer tourism for survival.[58] The Australian Seed Bank Partnership's Alpine and Montane Research Program is developing knowledge on combating the expected loss of biodiversity through seed based research to determine climatic thresholds, collections to identify resilient populations with the potential for restoration or translocation, and seed collection for conservation.[59]

2.39 The Committee gathered evidence throughout the inquiry relating to different traditional and scientific knowledge systems used for managing land and biodiversity, including the cultural information management system being developed for Kakadu National Park, as discussed in the second interim report.[60] The Australian Institute for Aboriginal and Torres Strait Islander Studies (AIATSIS) outlined the Yorta Yorta cultural mapping project, developed in partnership with Monash University 'to assist the Yorta Yorta people of the Barmah-Millewa floodplain to adapt to the challenges of climate change by drawing on traditional knowledge known only to them'.[61] The project would see Indigenous knowledge recorded and entered, along with scientific data, into 'a unique database … used to combine traditional knowledge with more conventional forms of information (climate, vegetation etc.) to improve the way natural resources are managed' and help Indigenous people, managers and policymakers make better management decisions.[62]

2.40 AIATSIS further outlined a climate change monitoring and evaluation project to create a seasonal calendar database that captures Traditional Ecological Knowledge to 'describe the interactions between changing weather patterns and flora and fauna behaviour'.[63] This information can be used by rangers and Indigenous Protected Area managers to inform conservation activities. The results of the project, which is in development, will help to identify 'culturally appropriate land management strategies in response to climate change'.[64]

Supporting services

2.41 Ecosystem services provided under this category include: nutrient cycling, soil formation, primary production, photosynthesis. There was little

58 Research Centre for Applied Alpine Ecology, *Submission 72*, p. 3.

59 Australian Seed Bank Partnership, *Submission 19*, p. 5.

60 House of Representatives Standing Committee on Climate Change, Environment and the Arts (CCEA Committee), *Case studies on biodiversity conservation: volume 2*, November 2012, p. 50.

61 Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS), *Supplementary Submission 34.1*, p. [4].

62 AIATSIS, *Supplementary Submission 34.1*, p. [4].

63 AIATSIS, *Supplementary Submission 34.1*, p. [4].

64 AIATSIS, *Supplementary Submission 34.1*, p. [5].

specific evidence on supporting services, and discussion on relevant areas has been included with other ecosystem services.

Incorporating ecosystem services into decision making

2.42 The Committee agrees with the view that 'the value of biodiversity and of ecosystem services should be recognised in public policy decision making'.[65]

2.43 The Committee heard of the importance of studying human health and environmental health as a single, complex system, so that when looking to improve the resilience of the natural environment and human communities they are considered together.[66]

2.44 The Committee heard that all biodiversity policy development processes must include human health impact assessments to evaluate the implications for human health.[67]

2.45 The Climate and Health Alliance recommended that investment in research that looks at the costs and benefits of the risks to human health posed by the loss of biodiversity be undertaken and shared with the community in order to help build understanding and increase support for public policy in that area.[68]

Measuring the economic value of biodiversity

2.46 The Committee acknowledges the view that 'much of the value of biodiversity as an ecosystem service is not captured in markets, and consequently is not included in national accounts', resulting in a failure to represent the true value of biodiversity to society.[69] The Committee learned that this has flow on effects of reducing the urgency to reverse the loss of biodiversity, and of underinvestment in biodiversity conservation.[70] The Committee learned further of the importance of understanding the difficulties economic systems have in dealing with

65 Climate and Health Alliance, *Submission 49*, p. 2; Ms Armstrong, Climate and Health Alliance, *Transcript of evidence*, 4 May 2012, p. 47.

66 Dr Burke, Australian Psychological Society, *Transcript of evidence*, 4 May 2012, p. 49.

67 Ms Armstrong, Climate and Health Alliance, *Transcript of evidence*, 4 May 2012, p. 48.

68 Ms Armstrong, Climate and Health Alliance, *Transcript of evidence*, 4 May 2012, p. 54.

69 W. Steffen, A.A. Burbidge, L. Hughes, R. Kitching, D. Lindenmayer, W. Musgrave, M. Stafford Smith, P.A. Werner, *Australia's biodiversity and climate change*, CSIRO publishing, Collingwood, Victoria, 2009, pp. 20-21.

70 W. Steffen, A.A. Burbidge, L. Hughes, R. Kitching, D. Lindenmayer, W. Musgrave, M. Stafford Smith, P.A. Werner, *Australia's biodiversity and climate change*, CSIRO publishing, Collingwood, Victoria, 2009, p. 21.

biodiversity and the need to overcome these difficulties in order to improve the effectiveness of biodiversity conservation.[71]

2.47 In its submission, DSEWPAC stated that full valuation of biodiversity relies on understanding the goods and services that ecosystems provide, and acknowledged that there is further scope to measure the full value of ecosystem services.[72] DSEWPAC highlighted the market-based instruments that are providing opportunities to value ecosystem services, including environmental offsets, water pricing, and conservation tenders.[73]

2.48 The Australian Government has acknowledged biodiversity banking as a market-based mechanism to deliver environmental offsets. Biodiversity banking is a system that places financial value on biodiversity assets and a mechanism to trade biodiversity credits to offset the impacts of land use changes that degrade the conservation value of an area.[74]

2.49 The following are two examples of economic indicators in environmental areas currently in use, and show how they can be used in comparison to other areas of the economy:

- The Institute for Marine and Antarctic Studies (IMAS) stated that we are extracting a large economic benefit from our oceans, through marine tourism, oil and gas, shipping, fishing and aquaculture industries.[75] The Australian Institute of Marine Science (AIMS) 2012 Index of Marine Industry set the total measurable value of economic activity based in the Australian marine environment in 2009-10 at $42.3 billion,[76] a four per cent decrease from 2008-09.[77]
- The Index of Marine Industry figure of $42.3 billion was compared to the gross value of all agricultural production in Australia in 2009-10 ($39.6 billion), and the sales and service total income from automotive and automotive parts manufacturing in the same period ($19.4 billion).[78]

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71 W. Steffen, A.A. Burbidge, L. Hughes, R. Kitching, D. Lindenmayer, W. Musgrave, M. Stafford Smith, P.A. Werner, *Australia's biodiversity and climate change*, CSIRO publishing, Collingwood, Victoria, 2009, p. 21.

72 DSEWPAC, *Submission 66*, p. 9.

73 DSEWPAC, *Submission 66*, p. 9.

74 DSEWPAC, *Environmental Protection and Biodiversity Conservation Act 1999: Environmental Offsets Policy*, DSEWPAC, Canberra, October 2012, p. 26.

75 AIMS, *Supplementary Submission 77.2*, p. [1].

76 AIMS, *The AIMS Index of Marine Industry*, AIMS, Canberra, 2012, p. 6.

77 AIMS, *The AIMS Index of Marine Industry*, AIMS, Canberra, 2012, pp. 6-7: The decrease in value was mainly due to reductions in marine resource related industries.

78 AIMS, *The AIMS Index of Marine Industry*, AIMS, Canberra, 2012, p. 6.

2.50 Economic indicators of this kind, if applied to considerations of biodiversity and economic productivity, could provide a better understanding of the state of biodiversity in relation to the rest of the economy.

National environmental accounts

2.51 As demonstrated above, the loss of Australia's biodiversity could have detrimental effects on our economy. It is a long held view of this Committee, and predecessor committees of previous parliaments, that environmental accounts should be established. In the 2009 *Managing our coastal zone in a changing climate report,* a predecessor committee recommended to the Australian Government that a system of national coastal zone environmental accounts be established, through the Council of Australian Governments.[79] The Australian Government agreed with this recommendation in principle, referring to the development of its National Plan for Environmental Information.[80]

2.52 The Committee welcomed evidence from many individuals and organisations about the need for and importance of setting up a nationally consistent set of environmental accounts. Various models and their current status and viability are discussed below.

2.53 The Planet Ark Environmental Foundation (Planet Ark) stated that a precautionary approach to safeguarding biodiversity loss should be adopted, while the social and economic value of biodiversity is being identified by global initiatives such as The Economics of Ecosystems and Biodiversity.[81] Dr Sean O'Malley, Research and Technical Manager with Planet Ark, stated that people need to see the monetary value of ecosystems in order to see that ecosystems and biodiversity are critical and need to be preserved.[82] Dr O'Malley highlighted the role of the Australian Government as overseeing and coordinating the process of funding environmental management and putting economic values on ecosystems.[83]

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79 House of Representatives Standing Committee on Climate Change, Water, Environment and the Arts, *Managing our coastal zone in a changing climate: The time to act is now*, October 2009, pp. 167-72.

80 Australian Government, *Australian Government response, House of Representatives Standing Committee on Climate Change, Water, Environment and the Arts, House of Representatives Committee Report: Managing our coastal zone in a changing climate: The time to act is now*, November 2010, p. 19.

81 Planet Ark Environmental Foundation, *Submission 21*, p. 2.

82 Dr Sean O'Malley, Research and Technical Manager, Planet Ark Environmental Foundation, *Transcript of evidence*, 4 May 2012, p. 6.

83 Dr O'Malley, Planet Ark Environmental Foundation, *Transcript of evidence*, 4 May 2012, p. 6.

2.54 Mr Graham Tupper, the National Liaison Manager with the ACF recommended that Land and Water Australia—a rural research and development corporation that operated between 1990 and 2009, focussing on research into sustainable land use—or an equivalent body, be restored under the planned national environmental system.[84] He further suggested that the national environmental accounting system must have integrity and credibility, be accessible and understandable in the community, use satisfactory measures to monitor the environment, and be tested by external bodies such as this Committee.[85]

NRM governance

2.55 The Committee heard that natural resource management (NRM) groups nationally are working on establishing national environmental accounts.[86] The Western Catchment Management Authority, as an example, stated the necessity to implement a mechanism that recognises an economic value of environmental services.[87]

2.56 The Committee heard that a natural asset accounting framework, such as had been developed by the Australian Natural Resources Atlas (no longer being updated) 'needs to be developed as part of a national strategy on NRM'.[88] Australia's Regional NRM Chairs released a paper in July 2010 on Australia's NRM governance system. This document discussed the challenge of assessing environmental condition across Australia:

> … the lack of a nationally consistent framework means it is not possible to know with any certainty whether condition is improving or not across the nation – or whether interventions are having an impact – or even where the greatest need for investment really is. This issue has been on the work program of the NRM Ministerial Council [now discontinued] for many years without completion. The National Land and Water Audit has been discontinued. Meanwhile the Wentworth Group has proposed an approach based on accumulating simple regional catchment health assessments up to the national level … but it has not found formal acceptance in government at this stage. The review of the EPBC Act (Hawke 2009) also addressed this issue in its recommendation:
>
> > *… invest in building blocks of a better regulatory system such as national environmental accounts, skills development, policy guidance,*

84 Mr Graham Tupper, National Liaison Manager, ACF, *Transcript of evidence*, 4 May 2012, p. 27.

85 Mr Tupper, ACF, *Transcript of evidence*, 4 May 2012, p. 28.

86 Ms Kate Andrews, Chair, Territory Natural Resource Management, *Transcript of evidence*, 4 July 2012, p. 10.

87 Western Catchment Management Authority, *Submission 42*, p. 3.

88 Liz Burton, *Submission 85*, p. 21.

and acquisition of critical spatial information. This is a crucial issue for good NRM governance.[89]

Accounting for Nature

2.57 In response to questions on notice asking what elements should be included in a national environmental account, BirdLife Australia supported the Wentworth Group of Concerned Scientists' Accounting for Nature model for building the national environmental accounts for Australia.[90] This model identifies five asset classes for inclusion in national environmental accounts:

- land: native vegetation, fauna and soils
- water: rivers, wetlands and estuaries
- atmosphere: greenhouse gas emissions
- marine and coastal resources: fish stocks, reefs, beaches and estuaries
- towns and cities: air quality, waste, water use and consumption.[91]

2.58 Ten of the 56 regional NRM organisations are participating in a trial of the Accounting for Nature model (stage three of the trial is expected to conclude in 2014), in which the organisations are testing whether it is possible to construct asset condition accounts using a common unit of measurement (based on the established science of reference condition benchmarking), and whether it is feasible to do so.[92] Another of the important elements of this model is the requirement for scientific accreditation of the account and information supporting it, which will encourage markets and decision makers to accept ecosystem accounting as an accurate measure of asset condition.[93]

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89 K. Andrews, K. Broderick, S. Ryan, Y. Sneddon, *Australia's NRM Governance System: Foundations and principles for meeting future challenges*, Australian Regional NRM Chairs, Canberra, July 2010, p. 42.

90 BirdLife Australia, *Supplementary Submission 40.1*, p. [1].

91 BirdLife Australia, *Supplementary Submission 40.1*, p. [1]; Wentworth Group of Concerned Scientists, *Accounting for nature: a model for building the national environmental accounts of Australia*, 2008, Sydney, pp. 4-5.

92 P. Cosier, Wentworth Group of Concerned Scientists, *Environmental asset condition account trials in Australia*, a paper prepared for the United Nations Statistics Division International Seminar entitled 'Towards linking ecosystems and ecosystem services to economic and human activity', New York, 27-29 November 2012, pp. 3-4.

93 P. Cosier, Wentworth Group of Concerned Scientists, *Environmental asset condition account trials in Australia*, a paper prepared for the United Nations Statistics Division International Seminar entitled 'Towards linking ecosystems and ecosystem services to economic and human activity', New York, 27-29 November 2012, p. 4.

United Nations System of Environment-Economic Accounting

2.59 The Australian Bureau of Statistics (ABS) discussed the United Nations' System of Environmental-Economic Accounting, an initiative to standardise ecosystem reporting which incorporates environmental and economic information in a common framework. The benefits of the system were described as allowing for 'consistent analysis of the contribution of the environment to the economy, the impact of the economy on the environment, and the efficiency of the use of environmental resources within the economy'.[94] The System of Environmental-Economic Accounting will include a framework for experimental ecosystem accounting, in the development of which ABS was taking part. The ABS stated that 'it is recognised that spatially referenced environment and economic data are essential for ecosystem accounting', and that socio-ecological landscape units were emerging as the preferred unit of reference.[95]

ABS Land Accounts

2.60 The ABS discussed its Land Accounts and how they have the capacity to, among other things, 'provide a system into which monetary valuations of land assets and environment related flows can be incorporated with physical data, to assess the monetary implications of environmental actions'.[96] The benefits of Land Accounts were described as: providing a powerful decision making tool for planning by industry, government and the community; to inform debate; and as a critical tool in ecosystem management.[97] One example given by ABS that demonstrated these benefits related to Australia's population growth:

> With Australia's population projected to be between 31 and 43 million people by 2056 … and further impacts from climate change forecasted, land use changes such as the loss of agricultural land to urban growth or the clearance of native forests for agriculture will become a key policy and planning issue for some locations. Land accounts would provide information for policy makers to make informed decisions about the economic and environmental impact of the location of new suburbs, towns and cities.[98]

94 Australian Bureau of Statistics (ABS), *Submission 53*, p. [4].

95 ABS, *Submission 53*, p. [4].

96 ABS, *Submission 53*, p. [5].

97 ABS, *Submission 53*, p. [5].

98 ABS, *Submission 53*, p. [5].

Committee conclusions on environmental accounting and information

2.61 The Committee understands that putting a value on ecosystems and biodiversity is a global challenge, and acknowledges the need to properly ascertain the economic value of biodiversity in Australia. This is required in order to be able to accurately measure the impacts of climate change on biodiversity, the effects of policies and management practices on biodiversity, and in order to be able to adapt to prevent future losses and minimise the effects of the losses of biodiversity on the community. The Committee notes Australia's support for the Communiqué on Natural Capital Accounting, arising out of the United Nations Conference on Sustainable Development (Rio+20) in June 2012, aimed at strengthening the implementation of natural capital accounting. The Committee notes the November 2012 report entitled *Independent Review of Australian Government Environmental Information Activity*, which is discussed in greater detail in chapter five, in the context of a national biodiversity database.

2.62 In recognition of the critical role of accurate environmental accounting on a national level, the Committee proposes that this issue be included on the agenda of the Council of Australian Governments (COAG), to ensure that appropriate frameworks be developed with the assistance of lead Commonwealth agencies, as well as input from states and territories.

Recommendation 1

2.63 **The Committee recommends that in the course of developing and implementing an effective and sustainable system of national environmental accounts, the Australian Government include on the agenda of the Council of Australian Governments a requirement for five-yearly reports, using the existing framework of the national State of the Environment Report, and equivalent reports of each state and territory. Such reports should include assessments of the state of all significant national parks and reserves, including:**

- **qualitative and quantitative analysis of native biota including any loss of distribution, and**
- **qualitative and quantitative analysis of invasive species of flora, fauna and pathogens, including any increase of distribution.**

Community engagement through education programs and citizen science initiatives

2.64 Together with establishing a framework for managing national environmental accounts, the Committee heard that education, engagement and communication programs are important in helping the community to understand and play an active role in finding solutions to biodiversity loss.[99] Evidence received throughout the inquiry focussed on the need for biodiversity education programs, including citizen science initiatives, to highlight the relevance of biodiversity to human communities.

2.65 The importance of community engagement to highlight the relevance of biodiversity was described by Dr Gretta Pecl, a Senior Research Fellow at the Institute of Marine and Antarctic Studies in Tasmania:

> Public acceptance and understanding of the impacts of climate change on biodiversity is quite low, yet that is probably a necessary prerequisite … for the development of adaptation options. For example, in our fishing industry, development of adaptation options to changing climate depends on acknowledging that climate change is real, acknowledging that there are changes in the marine environment, and then linking that to their own activities, and, further, that there is something constructive they may be able to do to help with that. Those links are not there for large sectors of our marine community.[100]

2.66 Citizen science initiatives are also important in ensuring that communities understand climate change impacts. The Range Extension and Database Mapping (REDMAP) project launched in 2009 in part evolved from:

> … research in a project [Dr Pecl] was involved in [which] demonstrated that up to 80 per cent of commercial fishers did not think climate change existed nor that it was an issue for their industry … That research has recently been published in the *Journal of Marine Policy*. Surveys conducted by the Tasmanian Seafood Industry Council suggest similar numbers for lack of acceptance of climate change.[101]

2.67 During the course of site inspections, the Committee observed various biodiversity education programs and citizen science initiatives, including:

- Community engagement in Sydney Olympic Park

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99 Dr Sinclair, ACF, *Transcript of evidence*, 4 May 2012, p. 23.

100 Dr Gretta Pecl, Senior Research Fellow, Institute for Marine and Antarctic Studies (IMAS), *Transcript of evidence*, 31 January 2012, p. 19.

101 Dr Pecl, IMAS, *Transcript of evidence*, 31 January 2012, p. 19.

- Melbourne Museum's interactive exhibits
- Museum Victoria's Reef Watch Victoria
- BirdLife Australia's Birdata and Atlas of Australian Birds
- The REDMAP project
- CSIRO supported acid sulphate soil monitoring program in the Coorong, Lower Lakes and Murray Mouth region in South Australia
- Reef HQ Aquarium in Townsville's formal school education program and the Reef Guardian program.

2.68 These and other programs and initiatives were described in the Committee's two interim reports, so will not be examined in detail in this report. Some general observations about the utility of such programs can provide some insights into establishing and maintaining effective links to ensure the relevance of biodiversity to human communities is better understood.

Biodiversity education programs

2.69 The Conservation Council of South Australia highlighted the need to support and strengthen environmental education in order to connect people to the importance and value of biodiversity, as well as promote participation in local biodiversity conservation initiatives.[102] It further suggested that the Australian Government use the United Nations Decade on Biodiversity to 'launch a community-wide program to upgrade ecological literacy, and improve skills in biodiversity management'.[103]

2.70 Mr Tupper of the ACF suggested that biodiversity education programs needed to look outside of successful environmental programs to places like sporting club outreach programs and broader public health initiatives, like the efforts made to deal with smoking.[104] Further, that direct feedback to the community is required, for example by way of a sign on the side of the road saying what the daily consumption of water was the day before.[105] Mr Tupper described the need for more programs allowing 'schools to connect with parks and reserves and experience the things that are important … food, veggie gardens, local suppliers, where milk comes from …'.[106] Dr Sinclair urged the Committee to recommend that 'schools and universities be supported to create teacher-friendly, classroom-ready

102 Conservation Council of South Australia, *Submission 58*, p. [6].
103 Conservation Council of South Australia, *Submission 58*, p. [6].
104 Mr Tupper, ACF, *Transcript of evidence*, 4 May 2012, p. 29.
105 Mr Tupper, ACF, *Transcript of evidence*, 4 May 2012, p. 29.
106 Mr Tupper, ACF, *Transcript of evidence*, 4 May 2012, p. 29.

resources to help Australians understand the shared interest we all have in replenishing our natural life support systems'.[107]

2.71 Mr Kevin Evans, Chief Executive Officer of the National Parks Association of New South Wales, discussed how the Association communicates biodiversity protection issues to the public and helps people understand those issues, through its website, various publications and the biodiversity survey work it undertakes. The biodiversity survey allows the public to meaningfully contribute by doing simple scientific assessment under supervision, by entering a sighting or absence of a particular bird in the national park, for example, with the information being put into the Atlas of Living Australia.[108] Mr Evans further highlighted the need for nationally consistent, simple communications to the public on climate change and invasive species issues, and suggested that the design of such educational material could be discussed within COAG.[109]

2.72 The Committee heard numerous ideas for biodiversity education in schools, including that park agencies should be encouraged to develop programs at low cost for school children, to teach them about the cultural and natural values of the environment.[110]

2.73 The Committee heard about the tourism and recreation activities undertaken by a large number of visitors to the Australian Alps, and how they present an 'opportunity to educate the general public about the outstanding natural heritage values of the Australian Alps, and their vulnerability to climate change and other human impacts'.[111]

2.74 Another example of community engagement in education programs is the school excursions undertaken at the conservation sites, the Education Centre in Bicentennial Park and the wetlands at Sydney Olympic Park, as discussed in greater detail in the Committee's first interim report.[112]

Citizen science initiatives

2.75 The Committee considered numerous citizen science initiatives throughout the inquiry, and notes the value of these initiatives in directly engaging members of the community on biodiversity and climate change issues. Citizen science uses local observations and expertise in larger scale

107 Dr Sinclair, ACF, *Transcript of evidence*, 4 May 2012, p. 23.

108 Mr Kevin Evans, Chief Executive Officer, National Parks Association of New South Wales (NPA NSW), *Transcript of evidence*, 28 March 2012, p. 29.

109 Mr Evans, NPA NSW, *Transcript of evidence*, 28 March 2012, p. 29.

110 IUCN WCPA, *Submission 30*, p. 15.

111 Research Centre for Applied Alpine Ecology, *Submission 72*, p. 4.

112 CCEA Committee, *Case studies on biodiversity conservation: volume 1*, May 2012, pp. 51-52.

analyses,[113] and in the case of examples provided below, it is used to gather nationwide environmental data.

Atlas of Living Australia

2.76 The Atlas of Living Australia is an online biological collection database—with records uploaded by citizen scientists, from museum and herbaria collections and other biological collections—that makes biodiversity knowledge accessible to the nation. Community events have been held with local residents and scientists to conduct surveys of local biodiversity, using tools to assist in capturing biodiversity data to input into the Atlas.[114]

2.77 Dr John La Salle, Director of the Atlas, stated that the Atlas was working with CSIRO education (its host agency), the Academy of Science and the Australian Science Teachers Association, to promote the availability of the database and the usefulness of the data, including working on creating mobile data capture tools to collect records on hand-held devices.[115] In terms of accuracy of the data, the Committee was informed that:

> Every one of those 32 million records has had over 40 data cleaning tools run over … Additionally, for any record, anybody can go in … and report an issue or flag an issue with the record … If you are doing an analysis, you can do your analysis just on the dataset that represents vouchered museum specimens, or Birds Australia data. So you can cut out all of these citizen science sightings and not use them at all if you do not trust them … What we are finding is that the people who want to contribute data to us are in general trying to do a pretty good job of keeping it nice and clean and tidy.[116]

2.78 The identification and control of invasive species in a governance context is discussed in chapter seven. Dr La Salle discussed the issue of invasive species' identification in the Atlas, as follows:

> … the atlas, as an aggregator of data, does not make decisions on what is invasive or what is not invasive. What we would do is create a list of agreed names for all organisms in Australia and then ask someone to provide us a list of those names that are invasive, and then we would flag them … In the first instance, we

113 Professor Ted Lefroy, Director, Centre for Environment, University of Tasmania and Director, Landscapes and Policy National Environmental Research Hub, *Transcript of evidence*, 31 January 2012, p. 8.

114 Atlas of Living Australia (the Atlas), *Submission 83*, p. 2.

115 Dr John La Salle, Director, The Atlas, *Transcript of evidence*, 21 June 2012, p. 2.

116 Dr La Salle, The Atlas, *Transcript of evidence*, 21 June 2012, p. 4.

> would not make any decisions on invasive species; we would ask someone else to supply us a list.[117]

Range Extension Database Mapping Project

2.79 The Committee heard that REDMAP—hosted by IMAS in Tasmania—promotes education and awareness of marine and climate change issues, successfully engaging a broad audience in marine monitoring, including directly engaging with fishers and divers, and engaging with school groups and local events to promote marine issue awareness.[118] The REDMAP project is a volunteer research program inviting community members to report observations of marine species from outside their known distributions; the resulting data will show the marine species that are shifting range as a result of warming waters.[119]

2.80 IMAS stated that REDMAP lets people 'discover for themselves how the seas are changing by collecting their own 'data'; and over time will show marine industries – on a map – which species are on the move'.[120] Dr Pecl of IMAS stated that citizen scientist data had been used to fill research gaps, by being added to scientific survey information to be used in journal articles.[121] Dr Pecl also commented on the importance of reporting back to the community on how the information gathered by citizen scientists is being utilised, with the methods used in this case being through a Facebook page and a quarterly newsletter.[122]

2.81 The Committee heard that participation in initiatives such as REDMAP is very important as it engages local communities to provide important information to the public whilst providing valuable scientific information for use by scientists.[123] The Committee heard that there are 3.5 million recreational fishers in Australia, thousands of commercial fishers and thousands of divers that can help with this monitoring, in the process engaging with biodiversity and marine climate change issues.[124] It was also suggested that the REDMAP framework could be duplicated in other geographical areas.[125]

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117 Dr La Salle, The Atlas, *Transcript of evidence*, 21 June 2012, p. 4.

118 IMAS, *Submission 77*, pp. [1], [2] and [3].

119 IMAS, *Submission 77*, p. [1].

120 IMAS, *Submission 77*, p. [3].

121 Dr Pecl, IMAS, *Transcript of evidence*, 31 January 2012, p. 22.

122 Dr Pecl, IMAS, *Transcript of evidence*, 31 January 2012, p. 22.

123 Dr Anthony Press, Chief Executive Officer, Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC), *Transcript of evidence*, 31 January 2012, p. 8.

124 Dr Pecl, IMAS, *Transcript of evidence*, 31 January 2012, p. 19.

125 Dr Press, ACE CRC, *Transcript of evidence*, 31 January 2012, p. 8.

Reef Life Survey

2.82 The Reef Life Survey uses recreational divers trained to collect scientific data compatible with data collected by scientific teams using scientific methods.[126] The Committee heard that the Reef Life Survey is 'the most comprehensive ecological dataset for the marine system' with 1200 sites, and is a 'hugely valuable resource in terms of understanding how threats are distributed in the marine environment' and also in 'providing a baseline to assess changes through time'.[127]

Australian Seed Bank Partnership

2.83 The Australian Seed Bank Partnership suggested that it will work with the Botanic Gardens Education Network to 'design and launch a citizen science program to engage communities in the diverse work of the Partnership and encourage greater use of the growing seed biology information'.[128] In its submission, the Partnership stated that it was also working with the Atlas to create national standards for recording data on wild species collections, and to build an accessible online seed resource.[129]

2.84 The Committee is supportive of the many citizen science initiatives observed during the course of the inquiry, and views these initiatives as powerful tools that can be used to engage the community in climate change and biodiversity issues. The Committee acknowledges the need for accurate and useful information to be gathered in a structured and consistent way, so that it can be used in scientific research projects, and to provide data that can be supplemented in future to build Australia's environmental knowledge base.

Conclusions and recommendations

2.85 The Committee acknowledges the benefits the community derives from biodiversity education programs and citizen science initiatives, and the importance of local, regional and national programs and initiatives to highlight the relevance of biodiversity to human communities.

2.86 The Committee acknowledges the importance of engaging the community in biodiversity issues, and the opportunities afforded by citizen science to involve the community in collecting environmental data and in that way

126 Professor Graham Edgar, IMAS, *Transcript of evidence*, 31 January 2012, p. 21.

127 Professor Edgar, IMAS, *Transcript of evidence*, 31 January 2012, p. 22.

128 Australian Seed Bank Partnership, *Submission 19*, p. 6.

129 Australian Seed Bank Partnership, *Submission 19*, p. 6. See chapter six for further discussion on this issue.

contribute to biodiversity research and the collection of baseline environmental information. The Committee notes the unique opportunity to use these initiatives to educate the public on the importance of biodiversity to human communities, our way of life and the economy.

2.87 The Committee considers that national programs should be organised and promoted by the Australian Government, utilising existing programs and initiatives (discussed above) to develop a nationally consistent, clear education program, the material and framework of which could be discussed at the COAG forum.

2.88 The Committee concludes that the Atlas of Living Australia (Atlas) is one such important tool in community education on biodiversity issues, and encourages the Australian Government to provide funding to develop and broaden its community engagement functions, and also to develop its information technology data collection tools to improve the quality and quantity of data collected (see further discussion in chapter five).

2.89 Further, in regard to the Atlas and the development of a national database for environmental information (discussed further in chapter five), the Committee considers that a national list of invasive species would assist the Atlas in categorising invasive species on its database. Invasive species management is discussed further in chapter seven.

2.90 The Committee was impressed by the REDMAP project and suggests to the Australian Government that it look into the viability of extending this concept to be implemented for other ecosystems.

2.91 The Committee acknowledges the considerable potential of developing existing citizen science databases into a single consistent and adaptable national database for monitoring biodiversity and the environment.

2.92 The Committee considers that the Australian Government must view provision of this information in an accessible format as a priority, in order to assist the community to understand the effects that biodiversity loss has on the community and the economy, and to assist land managers and policymakers in measuring the effects of policy implementation on biodiversity, and to ensure that adaptive management is a priority.

Recommendation 2

2.93 **The Committee recommends that the Australian Government, through the Council of Australian Governments, develop a central national database, incorporating a consistent and adaptable model of uploading and storing information which is able to be scientifically accredited.**