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Inquiry into Australia's biodiversity in a changing climate

By

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Introduction

The Monash Sustainability Institute is a multi-disciplinary, cross-faculty institute that delivers solutions to key climate change and sustainability challenges through research, education and action. As part of its Climate, Biodiversity and Health Program (funded through VicHealth and DSE, the Victorian Department of Sustainability and the Environment) it is working in partnership with DSE and the University of Melbourne to synthesise and disseminate information on the links between biodiversity and human health in an Australian context and the implications of biodiversity loss.

Biodiversity, climate change, health

This purpose of this submission is to highlight the threat of climate change to biodiversity in Australia and the value of biodiversity to human health and well-being. The specific terms of reference this submission seeks to address are

(1) how climate change impacts on biodiversity may flow on to affect human communities and the economy

and

(2) mechanisms to enhance community engagement.

Why is Australian biodiversity so important?

Biodiversity refers to the number, variety and variability of living organisms, encompassing genetic, species, and ecosystem diversity. Ecosystems comprise communities of plants, animals and microorganisms in an area and their interactions with one another and the physical environment.

Australia has about ten percent of the world's biodiversity, with a unique evolutionary history. More than 80 per cent of the country's flowering plants, mammals, reptiles and frogs are unique to Australia, along with most of its freshwater fish and almost half of its birds.[1]

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.

Biodiversity is an insurance policy for ecosystems, providing stability and resilience with the ability to adapt in the face of changing environmental conditions.

Climate change along with other environmental changes secondary to human activity (pollution, alien species, overexploitation, habitat destruction, urbanisation) is accelerating the rate and magnitude of biodiversity decline.

Biodiversity is the foundation for human health

Humans depend directly and indirectly on living systems for health and well-being. [2,3]
Biodiversity underpins ecosystem services to humans including:

- Provision of food, water, timber, fibre, fuel
- Photosynthesis
- Composition of atmosphere
- Food production : soil formation and fertility, waste decomposition, nutrient cycling, seed dispersal, pest control, pollination
- Medicinal and genetic resources
- Climate regulation
- Carbon sequestration
- Erosion prevention
- Natural hazard protection
- Water purification & cycling
- Pest invasion resistance
- Disease regulation
- Quality of life: cultural, spiritual, recreation, relaxation, improved psychological well-being

The Millennium Ecosystem Assessment report on Ecosystems and Human Well-being classifies ecosystems services as provisioning, regulating, supporting, cultural as depicted in the figure below.[2]

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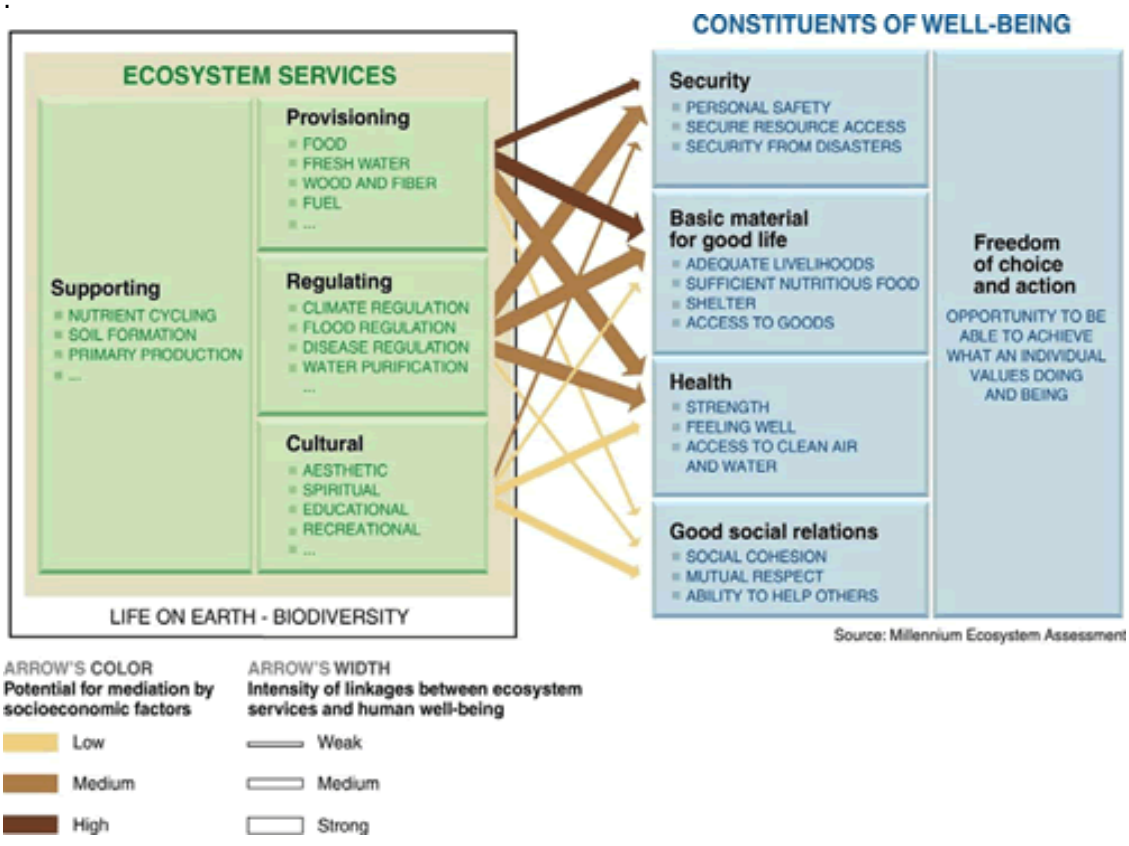

These services are irreplaceable and their economic value immense. In 1997 Constanza et al attempted to estimate the value of the world's ecosystem services,

and estimated that the value would be on average US$33 trillion a year (about 1.8 times the global GNP).[4]

How is climate change affecting biodiversity?

Climate change is resulting in increasing mean temperatures and changes in the frequency and severity of extreme events, changes in patterns of precipitation, increasing ocean warming and acidification. There is already evidence that may of Australia's plants, animals and micro-organisms are being affected by climate change. Examples include changes of geographic ranges, reduced reproduction and changes in life cycles in some species. Many species are threatened with extinction to the point where they can no longer play an effective role in the functioning of ecosystems. There is a loss of resilience of populations, changes in distribution of species, and fragmentation of ecosystems leading to a reduced ability to provide ecosystem services.[5]

Exceeding our planetary boundaries

Rockstrom and colleagues have proposed a framework to define a "safe operating space for humanity" within the Earth's natural systems. This is based on planetary boundaries, beyond which there are serious and potentially disastrous consequence for humans. The nine boundaries are climate change, rate of biodiversity loss, interference with nitrogen and phosphorus cycles, stratospheric ozone depletion, ocean acidification, global freshwater use, change in land use, chemical pollution and atmospheric aerosol loading. Their analysis suggests that three of these boundaries have already been crossed – nitrogen cycle, climate change and rate of biodiversity loss.[6]

Human health implications of climate change impacts on biodiversity

The human health implications of climate change impacts on biodiversity are not completely known but are likely to be extensive and the impacts profound. This can be illustrated by a number of examples in the areas of disaster risk, mental health, food and water security, increased disease risk and loss of important biomedical resources.

Disaster risk

The loss of ecosystem services can increase vulnerability to the impacts of disasters. Increased frequency and severity of natural disasters such as floods, fires, storms, and drought predicted under climate change scenarios are likely to further damage fragile ecosystems and reduce protection and livelihoods for human communities. We need look no further than the Black Saturday fires in Victoria to see an example of that devastation wrought on human communities and the natural environment by extreme weather. Preserving ecosystems such as wetlands and mangroves can help mitigate against predicted impacts such as storms and tidal surges, and intact forests reduce erosion and risk of flooding and landslides.[7]

Mental health

There is a large body of literature on health benefits of contact with natural environments. These physical and psychological benefits include facilitation of exercise for cardiovascular health, improvement in concentration, benefits for children's cognitive development and reduction in anxiety and depression. [8,9,10]

The popularity of gardening, bird watching, visiting zoos and aquariums, snorkeling, diving, bushwalking, nature retreats, swimming with dolphins, whale watching, and so on, testifies to the value of natural species to human wellbeing. In fact the increasing isolation of children from the natural world has been coined "nature-deficit disorder" and sparked community movements to reconnect people with nature at an early age.[11]

Food and water security

The Co-operation on Health and Biodiversity Initiative (COHAB) notes "climate change presents particular threats to food production systems and to animal and plant health, through impacts on weather patterns, soil quality, pollinators, the availability of clean water, and the distribution of pest species and infectious diseases".[7]

Native vegetation is threatened by the increasing fire and drought risks associated with climate change. Natural vegetation regulates the hydrological cycle and is very important for fresh water quality and quantity. As water flows over the land, trees hold the soil, retain nutrients, prevent erosion and allow water to seep more slowly into the earth and the release back into the atmosphere is controlled through transpiration. Forests can affect local microclimate and can sometimes increase local water supply even in the absence of rain by "cloud-stripping".

Water filtration and purification is especially important for the prevention of waterborne disease in humans. Estimates of the financial worth of such services of the Catskills mountain forest catchment for New York City, for example, have been valued at around US $8 billion. [12]The 157,000 hectares of forest that protect Melbourne's water supply have been called " a priceless legacy", ensuring some of the best drinking water in the world. In the absence of such systems, extensive and expensive artificial treatment facilities would be required.[13]

Loss of biodiversity around waterways leads to loading of waterways with pathogens and nutrients. This may lead to contaminated drinking water, or blooms of harmful blue-green algae which produce a range of toxins, making water unfit for human or stock use.

Biodiversity supports food security and dietary health. Food production relies on genetic diversity, crop pollination, pest control, soil formation, fertility, and nutrient recycling. Diets based on a diversity of food species promote good health. In the space of a week at least 20 to 30 biologically distinct types of food are needed for good human nutrition. While about half of childhood deaths in the developing world are due to under nutrition, in countries such as Australia, poor nutrition is linked to chronic disease with increases in hypertension, serum cholesterol, obesity and some cancers. [2,3,7],[14]

Many crops are dependent on specific natural pollinators for fertilisation yet bee populations in many countries have been decimated. In Australia, natural vegetation

is important for both commercial and native bees, providing essential nectar and pollen.

The impact of climate change on oceans – both acidification and warming- in association with other stressors is causing severe impacts on marine ecosystems and will have significant impacts on fisheries, a major source of protein and other nutrients for the human diet. An estimated 500 million people globally depend for their daily existence on coral reefs – marine species provide 17% of animal protein consumed by humans. Yet the predictions are that CO_2 concentrations of 450ppm will largely eliminate carbonate coral reefs.[3,15]

Increased disease risk

Biodiversity plays a role in the regulation of infectious disease, and ecosystem disturbance has significant implications for human disease emergence and re-emergence. Loss of species diversity can lead to a population expansion of competitive species and switching of pathogens from one host to another. The majority of emerging infectious diseases in humans are or were zoonotic ie transmitted between animals and humans. [2,3,7,16,17]

Biodiversity helps protect the balance among predators and prey and among vectors and parasites. For example, disappearance of vertebrate predators may alter the abundance of rodent reservoirs leading to an increase in human disease. Mosquitoes are very sensitive to ecosystem change, which can alter their survival, density, behaviour and distribution. In Australia warmer temperatures, changes to precipitation, tides and salinity can affect mosquito ecology, leading to potential changes in mosquito–borne diseases such as Ross River Virus and Dengue fever.[18]

Climate change-induced changes to geographical ranges and habitat destruction of bats brings them closer to human settlement. Flying foxes are natural reservoirs for a number of viruses that can affect humans, including Nipah and Hendra viruses. Recent outbreaks of Hendra virus infection (which can be fatal for humans) in horses and for the first time a dog has recently been observed in Queensland and Northern NSW. The recent Queensland floods have been postulated as a factor in this outbreak due to the need to migrate for food and that fact that stressed populations may be more likely to excrete the virus.[19]

Loss of important biomedical resources

Our biodiversity is an important source of unique medicinal compounds to treat current and future diseases as well as biomedical models for research.
More than half of commercially available drugs are based on bioactive compounds extracted or patterned from non-human species. Many plants have evolved chemical defences to protect themselves from being eaten. Social insects such as ants, bees, wasps and termites have evolved to control disease in dense populations and there is much we can learn from them. [3,7,16,17]

For example, research is currently being undertaken on the platypus, a monotreme which has developed unique mechanisms to combat disease. Platypus venom antimicrobials have been found to be potent against a number of human pathogens. The wallaby has immature young with no mature adaptive immune system. Antimicrobials from wallaby milk are being explored for uses against multi-drug resistant bacterial infection in humans.

Australia's reefs and marine environment are rich source of biomedical compounds, to be found in creatures such as the cone snail. There are about 700 species of *Conus*, each with 100 or more unique peptide molecules in its venom. The first drug from *Conus* venoms, was approved in 2004 for treating chronic, intractable pain, such as that suffered by people with cancer, AIDS, or certain neurological disorders. It is 1,000 times more powerful than morphine, but is not believed to be addictive. Yet only 0.2% of these peptides have yet been characterised.[3,20]

Biomedical research relies on plants, animal, microbes to understand human physiology and understand and treat human disease. For example a particular gene found in the placenta of one species of Australian lizard is also found in precancerous human cells, so this discovery may be important for cancer treatment in humans.Climate change risks us losing the genetic "books" in our "library" often before we have even read and benefited from them.

Health as a means to improving community engagement.

It appears that the health, social and economic values of ecosystem services are relatively poorly understood in the community. Increasing awareness about the value of biodiversity to health can be one way of increasing the everyday relevance of biodiversity.

The Victorian Department of Sustainability and Environment's Draft Biodiversity Strategy notes "There is limited data available on the current level of awareness and understanding of biodiversity by Victorians and what the community wants as an outcome for biodiversity." It is noteworthy that a 2009 survey of Victorians reported that the most important environmental issue requiring government attention was lack of water (43%) but few respondents mentioned the protection of parks and forests (2%) or the loss of species (<1%) as of a high priority. This is despite the fact that Melbourne's water is in part dependent on biodiverse forested catchments. [21]

Engaging children with nature from an early age is another important way to increase the appreciation of biodiversity. Linking health and biodiversity in policy and research would help to promote greater interdisciplinary focus on the importance of biodiversity. Engaging the community in the understanding the health impacts of climate change can be an effective engagement strategy, presenting a positive vision of "win-win" benefits of mitigation strategies for both health and the environment, and protecting biodiversity can be part of this approach.

Recommendations:

1. Act urgently to mitigate against climate change
2. Reduce other stressors on biodiversity and act to protect and restore existing ecosystems
3. Improve understanding of how the community can be engaged in understanding impacts from climate change and biodiversity loss
4. Increase awareness amongst the public and policymakers about the importance of biodiversity to human health
5. Facilitate cross-disciplinary research in areas involving climate change, biodiversity loss and human health
6. Provide opportunities for early and active engagement of children with the natural world to develop a life-long appreciation of biodiversity.

References

[1] About Australia. Australian Government Department of Foreign Affairs and Trade. http://www.dfat.gov.au/facts/flora_and_fauna.html

[2] Ecosystems and human well-being: health synthesis. A report of the Millennium Ecosystem Assessment. World Health Organisation 2005. http://www.millenniumassessment.org/documents/document.357.aspx.pdf

[3] Chivian (ed). Biodiversity: its importance to human health. Interim executive summary. 2003. Center for Health and the Global Environment. Harvard Medical School. http://chge.med.harvard.edu/publications/documents/Biodiversity_v2_screen.pdf

[4] Constanza R et al. The value of the world's ecosystem services and natural capital. Nature 1997;387:253-260.

[5] Steffen W. et al. Australia's biodiversity and climate change: Summary of a report to the Natural Resource Management Ministerial Council, Summary for policy makers . Prepared for the Department of Climate Change, Australian Government by the Biodiversity and Climate Change Expert Advisory Group. 2009. Commonwealth of Australia.

[6]Rockstrom J et al. A safe operating space for humanity. Nature 2009;461:472-475.

[7] COHAB initiative.The importance of biodiversity to human health, Biodiversity and Global Health 1, UN CBD COP 10 Policy brief, October 2010. http://www.cohabnet.org/en_issues.htm; http://www.cohabnet.org/news/documents/COP10policybrief3r.pdf

[8] Maller C et al. 2008. Healthy Parks, Healthy People. The health benefits of contact with nature in a park context. A review of the literature. Second Edition March 2008. http://www.parkweb.vic.gov.au/resources/mhphp/pv1.pdf

[9] Beyondblue to Green.: benefits of contact with nature for mental health and well-being. Townsend M, Weerasuriya R. April 2010 .http://www.beyondblue.org.au/index.aspx?link_id=105.898&oid=1820

[10] Frumkin H. Beyond toxicity. Human health and the natural environment. Am J Prev Med. 2001;20:234-240.

[11] http://www.telegraph.co.uk/health/children_shealth/5587636/Does-your-child-have-Nature-Deficit-Disorder.html

[12]Green breakthroughs. Solving Environmental problems through innovative policy and law. United Nations Environment Program 2008 http://www.unep.org/dec/PDF/Green_Breakthroughs.pdf

[13] Melbourne Water http://education.melbournewater.com.au/content/water_supply/protected_catchments/protected_catchments.asp

[14] Wahlqvist ML, Specht RL. Food variety and biodiversity: Econutirition. Asia Pacific J Clin Nutr 1998;7:314-319.

[15]Hoegh-Guldberg O. Coral reef ecosystems and anthropogenic climate change. Reg Environ Change 2011;11(Suppl 1):S215-227.

[16] Cassis G. Biodiversity loss: a human health issue. MJA 1998;169: 568-569.

[17] Chivian E. Environment and health: 7. Species loss and ecosystem disruption- the implications for human health. CMAJ 2001;164:66-9.

[18] Jardine A, Speldewinde P, Carver S, Weinstein P. Dryland salinity and ecosystem distress syndrome: human health implications. Ecohealth 2007;4:10-17.

[19] http://www.abc.net.au/news/stories/2011/07/05/3261158.htm

[20] Livett BG, Gayler KR, Khalil Z. Drugs from the sea: Conopeptides as potential therapeutics. Current Medicinal Chemistry 2004;11:1715-1723.

[21] Department of Sustainability and the Environment Victoria. Victoria's Biodiveristy Strategy 2010-2015: consultation draft. http://www.dse.vic.gov.au/conservation-and-environment/biodiversity/victorias-biodiversity-strategy/biodiversity-strategy-renewal/draft-victorian-biodiversity-strategy-2010-2015/seven-elements