



Impacts of Extreme Weather on Natural Systems

Submission to the Senate Standing Committee on Environment and Communications'
Inquiry into Recent trends in and preparedness for extreme weather events

January 2013

1. Introduction and Summary

WWF-Australia welcomes the opportunity to make this submission to the Senate Standing Committee on Environment and Communications' inquiry into recent trends in and preparedness for extreme weather events.

WWF-Australia is part of the WWF International Network, the world's largest and most experienced independent conservation organisation, with 80,000 supporters in Australia, five million supporters worldwide and a global network active in more than 100 countries. WWF's mission is to stop the degradation of the planet's natural resources and to build a future in which humans live in harmony with nature. WWF has been an advocate for national and international action to avoid dangerous climate change for more than two decades.

In this submission we focus primarily on the impact of extreme weather on Australia's natural environment and the adequacy of the Government's response to this threat (items (b) ii (f) and (g) from the Inquiry's Terms of Reference). By way of background we also address several of the other elements of Terms of Reference, including a short overview of recent trends and future projections for the occurrence of extreme events (items (a) and (b) i).

1.1 Summary of key points

There is broad scientific consensus that climate change is happening¹ and is a result of excess carbon emissions primarily a result of burning of fossil fuels and deforestation. There is also a significant body of international and Australian research suggesting a trend towards a more extreme climate in the recent past, which is projected to continue and worsen in the coming decades (noting regional variations and varying levels of certainty with respect to some types of extreme weather).

It is also widely accepted that of developed countries, Australia, has the most to lose from ongoing climate change², particularly our unique wildlife and places. Already, endangered species and ecosystems in Australia - like marine turtles, Carnaby's black cockatoos; and the Great Barrier Reef - are suffering the impacts of climate change, especially from extreme weather events.

While changes to the average climatic conditions will have profound implications for ecosystems and species, extreme events have larger impacts on many species because extreme events test the limits of species' physiological capacities. The more often extreme events occur, the more likely it will start to affect species at the population level.

¹ Not only is there extensive evidence but the overwhelming majority of scientists agree with the evidence. A Survey of over 3,000 Earth scientist found that 97.5% of those who specialise and publish in climate science agreed that human activity is causing global warming (http://tiger.uic.edu/~pdoran/012009_Doran_final.pdf). Similar results were also found in another independent study in 2010 <http://www.pnas.org/content/early/2010/06/04/1003187107.abstract>). This sentiment is supported by the Academies of Science from 19 countries, and 27 pre-eminent scientific research centers in the US, Australia and Europe (<http://www.skepticalscience.com/global-warming-scientific-consensus-intermediate.htm>).

² Garnaut (2011) Carbon Pricing and Reducing Australia's Emissions. Climate Change Review Update 2011:Update paper 6, pg.6. <http://www.garnautreview.org.au/update-2011/update-papers/up6-carbon-pricing-and-reducing-australias-emissions.pdf>

Scientists predict that a 1.5°C global temperature rise may see 25% of the Earth's animals and plants disappear; a 3°C rise may see 30% disappear.³ This would be a significant loss to the world and Australia. There is no way to put a dollar figure on this type of loss.

As biodiversity supports ecosystem functions and services that people depend upon, such as water and air purification, safeguarding biodiversity into the future is also vital for our health, resilience, the economy and wellbeing.

Adaptation to climate change will be critical to provide protection and resilience for ecosystems and species. Existing conservation strategies will remain relevant, but additional management actions are essential to ameliorate climate change impacts that cannot be offset by conventional approaches to conservation.

While federal, state and local governments have various adaptation programs in place, unfortunately the extent of these programs remains inadequate, or are under threat of reduced funding, wind-back or repeal.

Too much investment has gone toward temporary fixes rather than securing protected areas and enduring conservation arrangements. The submission outlines a number of recommendations to address gaps, focusing particularly on two of the world's internationally recognised biodiversity hotspots – the Great Barrier Reef and the Southwest Australia Ecoregion.

Our submission notes that while adaptation is imperative to build resilience and give Australia's wildlife and unique natural places a fighting chance against dangerous levels of climate change and increasing extreme weather events, there are limits to adaption. It therefore remains imperative that Australia and the world does all it can to mitigate against dangerous levels of global warming and climate change.

1.2 Summary of Recommendations

In this submission we make the following recommendations:

1.2.1 Climate Change Adaptation

- WWF recommends governments implementing additional conservation measures to provide protection and resilience of Australia's unique species and places including boosting the annual biodiversity investment levels from \$500 m to \$700 m in the next term of government under a new Biodiversity Rescue Program that combines Caring for Our Country and the Biodiversity Fund.
- WWF recommends an increase the overall terrestrial protected areas investment to \$170 million a year to ensure Australia meets its 2020 protected area commitments under the Convention on Biological Diversity (CBD).
- WWF recommends that the Southwest Australia Ecoregion be elevated to have a greater strategic focus (and portion of funding), commensurate with its global biodiversity importance. Starting with \$66 million a year to protect and restore the Southwest Australia biodiversity hotspot including funding for intensive threat abatement for nationally important species such as Carnaby's black cockatoo; the creation of new protected areas; and more detailed biodiversity planning that complements regional-scale planning.

³ IPCC (2007) Fourth assessment report. Working Group II: Impacts, Adaptation and Vulnerability http://www.ipcc.ch/publications_and_data/ar4/wg2/en/ch19s19-3-4.html

- WWF recommends the Commonwealth Marine Reserve System remains in place, and is enhanced over time based on the best scientific advice. To ensure the system is effective, WWF also asserts that provisions be made for fisheries adjustment, marine reserve establishment costs and ongoing management.
- WWF recommends reforms to strengthen the resilience of the Great Barrier Reef, including:
 - \$500 million be invested in Reef Rescue until to 2020;
 - Further pesticide reform including banning Diuron and put the burden of proof on chemical companies to demonstrate that chemicals are safe;
 - Prohibit the industrialisation of undeveloped and sensitive coastal areas;
 - No new ports, and the existing four major ports to operate to world's best practice; and
 - Mandating world's best practice standards for Reef shipping, including compulsory pilotage and caps on transits and anchorages.

1.2.2 Climate Change Mitigation

- WWF recommends the carbon price remain in place as an economy wide signal to transform to low carbon economy.
- WWF recommends setting a 2020 emissions reduction target to at least 25% of 1990 levels.
- WWF recommends increasing and extending the RET to 50% by 2030.
- WWF recommends banding or weighing the increased portion of the RET between 2020 and 2030.
- WWF recommends the Government prepare a White Paper on electrification of Australia's transport system to begin laying the foundations for this transition.
- WWF recommends the Government prepare a White Paper on reducing emissions in the agriculture sector.

2. Extreme Weather: Trends and Projections

Australia is a country that is exposed to extreme weather events as a result of natural variability of Australia's climate, particularly influenced by large-scale phenomena like El Niño-Southern Oscillation. However, there is a significant body of international and Australian research suggesting a trend towards a more extreme climate in the recent past⁴, which is projected to continue and worsen in the coming decades⁵. No doubt the Committee will receive many submissions outlining the latest science on this topic. To provide context we provide only a short summary of the situation in Australia below.

⁴ BoM (2013) Submission to The Senate Standing Committee on Environment and Communications' Inquiry into recent trends in and preparedness for extreme weather events. Submission 65 http://www.aph.gov.au/Parliamentary_Business/Committees/Senate_Committees?url=ec_ctte/extreme_weather/submissions.htm, p. 7.

⁵IPCC, 2012: Summary for Policymakers. In: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G. K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK, and New York, NY, USA, pp. 1-19.

2.1 Temperature extremes

The annual average daily maximum temperature for Australia has increased by 0.75°C since 1910, reflecting the increased frequency of warm weather and reduced frequency of cold weather.⁶ According to the Bureau of Meteorology (BoM) and CSIRO, the “frequency of extreme (record) hot days has been more than double the frequency of extreme cold days during the past ten years.”⁷

The start of 2013 has seen an exceptionally hot spell throughout much of Australia, with new local and national records set. In a Special Climate Statement issued on 9 January, the BoM made the following observation:

Australia set a new record for the highest national area-average temperature, recording 40.33 °C and surpassing the previous record set on 21 December 1972 (40.17 °C). To date (data up to the 8 January 2013) the national area-average for each of the first 8 days of 2013 have been in the top 20 hottest days on record, with 8 January the third hottest on record and the first time 7 consecutive days over 39 °C has ever been recorded for Australia.⁸

According to the Climate Commission “[m]any more record hot days will occur if global warming progresses unabated during the 21st century.”⁹ This is consistent with the findings of the Intergovernmental Panel on Climate Change (IPCC) which has stated that:

It is virtually certain that increases in the frequency and magnitude of warm daily temperature extremes and decreases in cold extremes will occur through the 21st century at the global scale. It is very likely that the length, frequency, and/or intensity of warm spells or heat waves will increase over most land areas.¹⁰

Species, like birds and bats for example, are highly susceptible to heat stress, with previous extreme heat events having led to mass deaths of some species.¹¹

2.2 Rainfall extremes and drought

According to the Bureau of Meteorology one of the most consistent results from climate modelling since the first IPCC scientific assessment report in 1990 has been the predicted ‘intensification’ of the hydrological cycle in association with global warming.¹² They and other expert scientists argue that this means more heavy rainfall and more frequent and severe droughts.^{13 14}

⁶ CSIRO and BoM (2012) *State of the Climate 2012*, <http://www.csiro.au/Outcomes/Climate/Understanding/State-of-the-Climate-2012.aspx>

⁷ Ibid

⁸ BoM (2013) *Special Climate Statement 43: Extreme January heat*, <http://www.bom.gov.au/climate/current/statements/scs43b.pdf>

⁹ Climate Commission(2013) *Off the Charts: Extreme Australian summer heat*, http://climatecommission.gov.au/wp-content/uploads/CC_Jan_2013_Heatwave8.pdf

¹⁰ IPCC (2012) *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*, A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change.

¹¹ See for example impacts on Carnaby Black cockatoos <http://www.sciencewa.net.au/topics/environment-a-conservation/item/1298-carnaby%E2%80%99s-black-cockatoo-population-suffering-blow-after-blow.html> and flying foxes <http://www.abc.net.au/science/articles/2007/11/29/2105307.htm>

¹² BoM (2013) Submission to The Senate Standing Committee on Environment and Communications’ Inquiry into recent trends in and preparedness for extreme weather events. Submission 65 http://www.aph.gov.au/Parliamentary_Business/Committees/Senate_Committees?url=ec_ctte/extreme_weather/submissions.htm, p. 14.

¹³ Ibid

¹⁴ Nichols, N. (2008) *Australian Climate and Weather Extremes: Past, Present and Future*, A report of the Department of Climate Change, <http://www.climatechange.gov.au/~media/publications/science/weather-extremes.pdf>.

Monash University and ex-Bureau of Meteorology Professor scientist, Neville Nichols, argues that droughts are likely to become more severe due to rising temperatures and warmer conditions leading to increased drying associated with higher levels of evaporation.¹⁵

We note however that there will be regional variation.

For example Nichols points out the observations vary significantly between different parts of Australia and between seasons.¹⁶ This is expected to be the case in the future with a “general increase in rainfall intensity... but with considerable spatial variation.”¹⁷

According to the Bureau of Meteorology, “droughts are expected to become more frequent in southern Australia.”¹⁸ For example the Climate Change Commission has reported that over the last 40 years much of eastern, southern and southwestern Australia has become drier¹⁹.

Understanding this regional variability will be critical for species adaptation.

2.3 Cyclones

There is significant uncertainty about whether the intensity and/or frequency of cyclones in Australia have changed in recent decades.

As CSIRO’s Deborah Abbs noted in her 2012 paper, climate change projections indicate that globally there will be less tropical cyclones in overall number, but that a greater number of particularly intense cyclones will occur.²⁰ More intense cyclones could result in higher levels of damage to ecosystems like the Great Barrier Reef, as well as infrastructure, agriculture etc.

However more research is required to reduce the levels of uncertainty around these projections.²¹

2.4 Bushfires

Recent decades have seen an upward trend in the bushfire risk rating across much of Australia.²² The trend towards drier and warmer conditions as a result of climate change is projected to increase the risk of bushfires. According to one study, there could be as much as 65 per cent increase in the number of ‘extreme’ fire days by 2020, compared in 1990.²³

According to Zoos Victoria, the 2009 Victorian bushfire put species that are already endangered under even more pressure to survive. They argue that “Victoria’s faunal emblems – the Helmeted

¹⁵ Nichols (2008) *op cit*.

¹⁶ *Ibid*.

¹⁷ *Ibid*, p.19

¹⁸ CSIRO and BoM (2012) *State of the Climate 2012*, <http://www.csiro.au/Outcomes/Climate/Understanding/State-of-the-Climate-2012.aspx>

¹⁹ Climate Commission (2013) *Off the Chart: Extreme Australian Summer Heat*. http://climatecommission.gov.au/wp-content/uploads/CC_Jan_2013_Heatwave21.pdf

²⁰ Abbs, D. 2012. The impact of climate change on the climatology of tropical cyclones in the Australian region. CSIRO Climate Adaptation Flagship Working paper No. 11. 24pp

²¹ See: Nichols (2008) *op cit*; and Climate Commission (2012), *The Critical Decade*, <http://climatecommission.gov.au/report/the-critical-decade/>.

²² Lucas, C. et al (2007) *Bushfire Weather in Southeast Australia: Recent Trends and Projected Climate Change Impacts*, http://www.climateinstitute.org.au/verve/_resources/fullreportbushfire.pdf

²³ *Ibid*.

Honeyeater and Leadbeaters Possums – were both affected by the fires and potentially we could have lost these species forever”.²⁴

2.5 Sea surface temperatures

There has been a general trend to warmer sea surface temperatures around Australia.²⁵ This trend is projected to increase over the coming decades²⁶. Warmer sea surface temperatures can contribute to more intense rain and flooding, especially in combination with La Nina events.

According to the BoM, the 2010-11 La Niña event, which resulted in repeated severe flooding in Queensland and Victoria, was associated with record high sea-surface temperatures in the Australian region. The BoM argues that “[w]hile it remains difficult to attribute all causes of record-breaking rainfall during 2010 and 2011, it is almost certain that global warming contributed to record sea-surface temperatures during that period”.²⁷

The 2010/11 floods had significant impacts on coral mortality and turtle health in and around the Great Barrier Reef.

3. Impacts on Natural Systems

The wide range of threats to Australia’s natural environment can make it difficult to determine the extent of the impact of climate change. Nevertheless, as Stefan et al makes clear, “an increasing number of the changes in Australian biodiversity document in recent times are consistent with having a climate change signal, mainly due to changes in temperature and rainfall.”²⁸ Indeed, the general consensus is that climate change will exacerbate pre-existing threats to Australia’s natural environment.

Scientists predict that a 1.5°C global temperature rise may see 25% of the Earth’s animals and plants disappear; a 3°C rise may see 30% disappear.²⁹

Recent research shows a little under half of our threatened species are also vulnerable to extinction due to climate change.³⁰

According to the National Climate Change Adaptation Research Facility (NCCARF), the Intergovernmental Panel on Climate Change identified terrestrial ecosystems as among the most vulnerable sectors in Australia and New Zealand.³¹

²⁴ <http://wild.zoo.org.au/bushfires/> accessed 25/01/2013

²⁵ CSIRO and BoM (2012) op cit.

²⁶ IPCC (2007) Fourth Assessment Report: Working Group 1: The Physical Science Basis. Projections of Future Climate Change. http://www.ipcc.ch/publications_and_data/ar4/wg1/en/spmsspmp-projections-of.html

²⁷ BoM (2013) Submission to The Senate Standing Committee on Environment and Communications’ Inquiry into recent trends in and preparedness for extreme weather events. Submission 65

http://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Committees?url=ec_ctte/extreme_weather/submissions.htm, p. 18-19.

²⁸ Stefan et al (2009) *Australia’s Biodiversity and Climate Change*, p.103,

<http://www.climatechange.gov.au/~media/publications/biodiversity/biodiversity-vulnerability-assessment.pdf>

²⁹ IPCC (2007) Fourth assessment report. Working Group II: Impacts, Adaptation and Vulnerability

http://www.ipcc.ch/publications_and_data/ar4/wg2/en/ch19s19-3-4.html

³⁰ J.Lee (2013), pers. comm., 24 January 2013. (Honours Thesis investigating the vulnerability of Australia’s threatened species to climate change)

³¹ http://www.nccarf.edu.au/sites/default/files/attached_files/Impacts%20on%20Terrestrial%20Biodiversity.pdf

While changes to the average climatic conditions will have profound implications for ecosystems, the prospect of increased frequency and severity of extreme events is particularly concerning. Indeed, as Stefan et al note, “[c]hanges in the frequency, intensity and seasonality of extreme events may have larger impacts on many species than the directional shifts in temperature and changes in rainfall patterns.”³² This is because extreme events test the limits of species’ physiological capacities. One off extreme events may affect species at the individual level. The more often extreme events occur, the more likely they will start to affect species at the population level. For particularly vulnerable species with a limited range, continued exposure to extreme events could push them further towards extinction.

NCCARF has produced a range of fact sheets on climate impacts and natural systems, which includes impacts of extreme weather, and we would urge the committee to review these as part of their deliberations:

Impacts of Climate Change: Terrestrial Biodiversity -

http://www.nccarf.edu.au/sites/default/files/attached_files/Impacts%20on%20Terrestrial%20Biodiversity.pdf

Impacts of Climate Change: Marine Biodiversity and resources -

http://www.nccarf.edu.au/sites/default/files/attached_files/Impacts%20on%20Marine%20Biodiversity%20and%20Resources.pdf

Impacts of Climate Change: Water resources and Freshwater Biodiversity -

http://www.nccarf.edu.au/sites/default/files/attached_files/Impacts%20on%20Freshwater%20Biodiversity.pdf

In 2008, WWF also produced a report profiling the impact of climate change (including extreme weather events) on 11 Australian species, we again urge the committee to review and consider this report.



http://awsassets.wwf.org.au/downloads/sp029_australian_species_and_climate_change_25mar08.pdf

In the sections below we provide several case studies to illustrate the effects of extreme events on Australia natural environment, with a focus on two regions where WWF-Australia is particularly active: the Great Barrier Reef (GBR) and the Southwest Australia Ecoregion (SWAE).

3.1 Great Barrier Reef

The Great Barrier Reef area is one of the most biologically diverse regions in the world. Climate change is now recognised as the greatest long-term threat to the Great Barrier Reef (GBR), with implications for nearly every part of the ecosystem.³³ According to the Australian Institute of Marine Science, Reef hard coral is in rapid decline almost entirely due



³² *Ibid*, p.91.

³³ *Ibid*.

to greenhouse gas emissions driving worse storms and warmer seas, and farm fertiliser pollution driving increased COTS outbreaks³⁴. The economic contribution of the GBR in 2007 was estimated to be \$5.4 billion and supporting more than 50,000 jobs³⁵, the figures are likely to be much higher today. Extreme weather events have a particularly severe impact on the reef. Some examples from the recent past include:

- High sea surface temperatures: Periods of high sea surface temperatures have in the past caused extensive coral bleaching in the GBR. In 1998 an estimated 50 per cent of reefs in the GBR Marine Park sustained bleaching. In 2002 an estimated 60 per cent of reefs were affected. In both instances, an estimated 5 per cent of reefs were severely damaged.³⁶
- Storm damage and Cyclones: An estimated 34 per cent of coral mortality in the GBR between 1995 and 2009 can be attributed storm activity.³⁷ In 2011 Cyclone Yasi provided an extreme example, causing damage to estimated 15 per cent of the GBR, and severe damage to approximately 6 per cent of the reef.
- Heavy rainfall and flooding: Heavy rainfall events can significantly increase the sediment and nutrient loads in the GBR, contributing to increased coral mortality. For example, the 2010-11 Queensland floods were estimated to have resulted in coral mortality rates of between 80-100 per cent in some inshore areas close to the mouth of the Fitzroy River.³⁸

The impacts extreme events in the GBR region can also be seen at the species level, with marine turtles providing an important case in point. Six out of the seven species of marine turtle living in Australia's waters are either critically endangered or endangered. The main threats to marine turtles include unsustainable coastal development that impacts on turtle habitat, and increases in global temperatures through climate change, which disrupt the turtles' temperature-dependent sex determination and could lead to population instability.³⁹

Some species of marine turtles are almost entirely reliant on seagrasses for their nutrition; it is likely that the impacts of the extreme weather events of 2011 will have ongoing detrimental effects on these species. Recent evidence from on-ground studies by WWF staff suggests that the numbers of turtle deaths are increasing.⁴⁰ We are now seeing the lingering effects of the floods and cyclones of 2011 in which thousands of hectares of sea grass were wiped out and covered in toxic sediment. As a result there have been record numbers of turtle mortalities in both 2011 and 2012 totalling over 2500.⁴¹

The Great Barrier Reef Marine Park Authority have produced a report on the impact of extreme weather events on the GBR, and we urge the committee to review and consider the report in its

³⁴ De'ath, G., Fabricius, K.E., Sweatman, H. and Puotinen, M. (2012) The 27 year decline of coral cover on the Great Barrier Reef and its causes. Proceedings of the National Academy of Sciences of the United States of America. <http://www.pnas.org/content/early/2012/09/25/1208909109>.

³⁵ Access Economics Pty Ltd (2008), Economic contribution of the GBMP, 2006-07: prepared for the Great Barrier Reef Marine Park Authority. Access Economics Pty Ltd, Canberra, Australia. http://www.gbrmpa.gov.au/___data/assets/pdf_file/0009/5598/gbrmpa_RP98_Economic_Contribution_Of_The_GB_RMP_2009.pdf

³⁶ GBRMPA, <http://www.gbrmpa.gov.au/outlook-for-the-reef/climate-change/what-does-this-mean-for-species/corals/what-is-coral-bleaching> (accessed January 2013).

³⁷ Osborne et al (2011) in GBRMPA (2001), *Impacts of Cyclone Yasi on the Great Barrier Reef*, http://www.gbrmpa.gov.au/___data/assets/pdf_file/0008/8783/GBRMPA_ImpactsTC_Yasi_onGBRSept2011.pdf.

³⁸ GBRMPA (2012), *Extreme Weather and the Great Barrier Reef* http://www.gbrmpa.gov.au/___data/assets/pdf_file/0016/14308/GBRMPA-ExtremeWeatherAndtheGBR-2010-11.pdf

³⁹ http://www.wwf.org.au/our_work/saving_the_natural_world/wildlife_and_habitats/australian_priority_species/marine_turtles/marine_turtles_and_threats_they_face/

⁴⁰ Media Release, Tuesday 15th January 2013 *The Silence of the Turtles: Six months on: Mass Deaths Remain a Mystery*

⁴¹ *Ibid.*

deliberations (see: http://www.gbrmpa.gov.au/data/assets/pdf_file/0016/14308/GBRMPA-ExtremeWeatherAndtheGBR-2010-11.pdf).

3.2 Southwest Western Australia

The Southwest region of Western Australia is one of only 34 global biodiversity hotspots, is one of WWF's 35 Global Priority Places, and is both an Endemic Bird Area and Centre for Plant Diversity.⁴² It is home to endangered animals found nowhere else on Earth, including the numbat, chuditch (or western quoll), western swamp tortoise, Carnaby's black cockatoo and Gilbert's potoroo.



WWF-Australia has for a long time worked with landholders and decision makers to help protect and enhance the region's unique and highly vulnerable ecosystems. Much of this work is focused on reversing the region's alarming rates of habitat destruction. However, climate change looms as perhaps the region's most difficult long-term challenge.

A number of recent extreme weather events have provided a worrying insight into the potential impacts of climate change on some of the region's most important species. For example:

- Carnaby's black cockatoo: The endangered Carnaby's black cockatoo is one of just two species of white-tailed black cockatoo on Earth. The other is the Baudin's black cockatoo, and they are both found only in Southwest WA.⁴³ It is estimated that Carnaby's black cockatoo numbers in the Southwest have declined by at least 50 per cent over the last 45 years due to range of factors, including habitat loss.⁴⁴

In 2010 an extreme heatwave in the Southwest left 145 of this already endangered species dead.⁴⁵ Saunders et al (2011) concluded that any increase in adverse stochastic events will only lead to greater pressure on their numbers.⁴⁶

- Black-footed rock wallaby: The once widespread Black-footed rock wallaby is now only found in a few scattered locations, including Southwest WA.⁴⁷ Remaining populations are very isolated and they are now considered to be at risk of extinction.⁴⁸ Studies that are currently underway suggest that the situation for this species has been worsened by recent droughts, which have reduced their food supplies. Indeed the drought of 2010 is believed to have been the major underlying cause of the population crash that appeared to occur in that year.⁴⁹

⁴² http://www.wwf.org.au/our_work/saving_the_natural_world/australian_priority_places/southwest_australia/

⁴³ http://www.wwf.org.au/our_work/saving_the_natural_world/wildlife_and_habitats/australian_priority_species/black_cockatoos/carnabys_black_cockatoos/

⁴⁴ http://awsassets.wwf.org.au/downloads/sp033_fs_carnabys_cockatoo_26feb08.pdf

⁴⁵ McKechnie, A. et al (2012), "Feeling the heat: Australian landbirds and climate change", *Emu*, 2012, 112, i-vii, CSIRO Publishing, http://www.publish.csiro.au/?act=view_file&file_id=MUv112n2_ED.pdf.

⁴⁶ *The impact of two extreme weather events and other causes of death on Carnaby's Black Cockatoo: a promise of things to come for a threatened species?* Dennis Saunders et al. 2011 in *Pacific Conservation Biology*, Vol 17: 141-148

⁴⁷ http://awsassets.wwf.org.au/downloads/sp004_fs_black_footed_rock_wallaby_1oct03.pdf

⁴⁸ http://www.wwf.org.au/our_work/saving_the_natural_world/wildlife_and_habitats/australian_priority_species/rock_wallabies/black_flanked_rock_wallaby/

⁴⁹ This observation is based on personal communications between WWF-Australia's Katherine Howard and rock wallaby experts, Craig Pentland and Jack Kinnear.

4. Adequacy of Australia's Response

4.1 Adaptation

Species will need to cope with change where they currently live, or they will need to move to where they can thrive, or they may die out, as the climate and ecosystem around them changes. As biodiversity supports ecosystem functions and services that people depend upon, such as water and air purification, safeguarding biodiversity into the future is also vital for our health, resilience and wellbeing.

Shoo et al argue that "existing conservation strategies will remain relevant, but additional management actions are being considered to ameliorate climate change impacts that cannot be offset by conventional approaches to conservation that generally focus on existing locations".⁵⁰

Adaptation consists of actions undertaken to reduce the adverse consequences of climate change on natural and human systems, through building resilience and providing safeguards like protected areas.

Generally adaptation approaches include⁵¹:

- Protecting the conservation targets and key ecological attributes (especially ecological processes) that underpin the system;
- Reducing direct (non-climate) threats to the system;
- Increasing the representation of genotypes, species, and natural communities under protection, especially where they are projected to persist;
- Increasing the replicates of ecosystems, natural communities, and species under protection, especially where they are projected to persist;
- Restoration of ecosystems that have been degraded or lost, especially considering directions and degree of change - as restoration may only be reasonable in some areas;
- Identifying and protecting climate refugia areas where the climate will likely be more stable;
- Identifying, protecting and restoring ecological corridors that allow systems and species to self relocate;
- Relocation of organisms to more favourable areas as a last resort.

Federal, state and local governments have various adaptation programs in place to build resilience and provide habitat protection; unfortunately the extent of the programs remains inadequate, or they are under threat of reduced funding, wind-back or repeal.

Shoo et al in a recent publication have recommended a decision framework for the full complement of actions aimed at conserving species under climate change that Governments should consider.⁵²

Too much investment has gone toward temporary fixes rather than securing protected areas and enduring conservation arrangements. Investments have been scattered, short-changing the species and ecosystems that need the most help - the Matters of National Environmental Significance -

⁵⁰ Shoo, L.P., Hoffman, A.A., Garnett, S., Pressey, R. L., Williams, Y.M., Taylor, M., Falconi, L., Yates, C.J., Scott, J.K., Alagador, D., and Williams, S.E. et al (2013) Making Decisions to Conserve Species Under Climate Change. In press, DOI 10.1007/s10584-013-0699-2.

⁵¹ WWF (2011) Climate Adaptation: Mainstreaming in existing conservation plans. http://www.panda.org/standards/climate_adaptation

⁵² Shoo et al (2013) *op cit*.

threatened species and ecological communities, World, National and Commonwealth Heritage places, marine and migratory species, and Ramsar wetlands.

WWF believes there is an opportunity to ensure investments are focused on recovery of nationally important species and ecosystems and are applied at scale, with maximum synergy with other initiatives for example carbon farming.

Below is a summary of some of WWF's key priorities, concerns and recommendations with respect to climate adaptation for Australia's natural systems.

4.1.1 Terrestrial Ecosystems

Protected areas and wildlife corridors are critical to the protection of terrestrial species survival rates under climate change. Currently only 30% of terrestrial threatened species enjoy a minimum standard of protection in protected areas.⁵³

A much larger, ecologically representative and well-connected system of protected areas, as committed by Australia under the Convention on Biological Diversity (CBD) under Aichi Target 11⁵⁴, should be the first and most important response to prevent extinctions of our unique wildlife and secure resilience to climate change.⁵⁵

WWF is concerned that the Government recently indicated it will slash funding for the only program focused on this international commitment, the National Reserve System (NRS) program. This is despite having increased the program fivefold in 2008 and despite the program being one of the most cost-effective of the programs within Caring for Our Country and the only one that secures permanent conservation land management arrangements as opposed to temporary abatement of threats.⁵⁶

WWF recommends boosting the annual biodiversity investment levels from \$500 m to \$700 m in the next term of government under a new Biodiversity Rescue Program that combines Caring for Our Country and the Biodiversity Fund.

This includes an increase to the overall terrestrial protected areas investment to \$170 million a year to ensure Australia meets its 2020 CBD protected area commitments.

SWAE

As noted earlier, the Southwest region of Western Australia is one of only 34 global biodiversity hotspots and, is one of WWF's 35 Global Priority Places. Climate change and extreme weather events have already and will continue to put even greater pressure on this unique place and species. To build resilience in the region WWF believes it is imperative that the Southwest Australia Ecoregion be elevated to have a greater strategic focus (and portion of funding), commensurate with its global biodiversity importance.

WWF recommends:



⁵³ WWF *Building Nature's Safety Net* report 2011 <http://www.wwf.org.au/?2750/Building-Natures-Safety-Net-2011-The-State-of-Protected-Areas-for-Australias-Ecosystems-and-Wildlife>

⁵⁴ See: <http://www.cbd.int/sp/targets/rationale/target-11/>

⁵⁵ Dunlop, M and Brown, P (2008) *Implications of Climate Change for Australia's National Reserve System: A preliminary assessment*, <http://www.csiro.au/files/files/pgj1.pdf>

⁵⁶ Taylor, M. et al (2011), *Building Nature's Safety Net 2011: The state of protected areas for Australia's ecosystems and wildlife*, http://www.wwf.org.au/news_resources/?2750/Building-Natures-Safety-Net-2011-The-State-of-Protected-Areas-for-Australias-Ecosystems-and-Wildlife.

- \$25 million a year be allocated for intensive threat abatement for nationally important species like the numbat, chuditch (or western quoll), western swamp tortoise, Carnaby's black cockatoo and Gilbert's potoroo.
- \$40 million a year be dedicated to the creation of new protected areas. WWF has developed the Southwest Australia Ecoregion Strategic Biodiversity Framework, which identifies priority areas for conservation action⁵⁷. The funds should be used to develop critical landscape linkages to build the resilience of ecosystems and native wildlife to climate change, and the expansion of the national reserve system. These funds would be used to leverage about \$18 million of Carbon Farming investments in ecosystem recovery; and
- \$1 million a year be allocated to more detailed biodiversity planning that complements regional-scale planning.

4.1.2 Marine Ecosystems

Marine protected areas can build resilience in marine habitats like reefs, and greatly assist populations of marine species recover from extreme events.

The Commonwealth Marine Reserve System is nearly finalised, and it is vital that it remains in place, and is enhanced over time based on the best scientific advice. To ensure the system is effective, WWF also asserts that provisions be made for fisheries adjustment, marine reserve establishment costs and ongoing management.

WWF recommends:

- \$40 million a year over three years be allocated to the Director of National Parks for the cost of establishing the new Marine Reserve System;
- \$40 million a year base marine reserve management funding be provided to the Director of National Parks; and
- \$50 million a year over three years be allocated to fisheries assistance.

Great Barrier Reef

One of WWF's global priority areas is the Great Barrier Reef. Despite an increase in no-take marine sanctuaries in 2004 more than half the GBR's coral cover has been lost⁵⁸ and turtles and dugongs have been dying in large numbers due to seagrass depletion and entanglement in fishing gear. Farm pollution, crown-of-thorns starfish outbreaks, fishing, ocean warming, storm damage, are the key causes.

It is critical to build the resilience of the reef if it has a chance of surviving future climate change.

The Federal Government's \$200 million Reef Rescue reduced polluting farm practices on 5 million hectares of grazing land and 630,000 hectares of cropping land. This should be renewed and reinvigorated, with \$500 million provided out to 2020.

According to the Great Barrier Reef Marine Park Authority (GRMPA) there has been a large increase in the amount of fertilisers used in GBR catchments over the last century⁵⁹. These elevated levels

⁵⁷ Witham, D. (2012), *A Strategic Framework for Biodiversity Conservation Report A: For decision-makers and practitioners*, Southwest Australia Ecoregion Initiative, WWF-Australia.
http://www.wwf.org.au/news_resources/resource_library/?5120/A-strategic-framework-for-biodiversity-conservation

⁵⁸ De'ath et al (2012) *op cit*.

⁵⁹ GRMPA (2012), *Extreme Weather and the Great Barrier Reef op cit*

entering the GBR ecosystem are reducing its resilience. Unmanageable pesticides such as Diuron (which is responsible for 80% of the pesticide impact on the Reef) should be banned, and the whole approach to chemical assessment needs to be reformed.

Improvements to coastal management are critical, including restrictions to port development and shipping.

WWF recommends

- \$500 million be invested in Reef Rescue over seven years to 2020, including:
 - \$60 million a year to support farmers drive deeper cuts in pollution from reduced stocking rates and lower fertiliser and pesticide use, noting that funding will be conditional on matching contributions from industry. Some \$22 m of this funding will be used to assist best practice accreditation; and
 - \$10 million a year to monitor, accredit and validate that farm pollution reduction targets are being met.
- Further pesticide reform including:
 - Banning Diuron
 - Implementing new laws to: (1) put the burden of proof on chemical companies to demonstrate that chemicals are safe, (2) ensure that old pesticides undergo modern risk assessments, and (3) ensure independent scientific advice is obtained and followed.
- Prohibit the industrialisation of undeveloped and sensitive coastal areas.
- No new ports, and the existing four major ports to operate to world's best practice.
- Mandating world's best practice standards for Reef shipping, including compulsory pilotage and caps on transits and anchorages.

4.2 Limits to Adaptation

According to NCCARF we have to acknowledge that there are limits to adaptation and plan accordingly:

Much of the research on adaptation avoids the question of what adaptation cannot achieve. It is therefore implied by omission that adaptation can avoid all climate impacts. Yet this is clearly not going to be the case for many systems, sectors and places at even modest rates of warming, let alone at the more rapid rates of warming that now seem almost inevitable.⁶⁰

NCCARF explain that the notion of 'limits to adaptation' is concerned with identifying the thresholds at which actions to adapt cease to reduce vulnerability. According to NCCARF these thresholds exist in four domains although there are often complex and dynamic overlaps between the types⁶¹:

- Ecological limits, when ecosystems and species are unable to adapt and experience a decline in function or diversity - for example under high rates of warming it seems little can be done to avoid repeated and severe coral bleaching, with subsequent impacts on species diversity and function;
- Economic limits, where the financial costs of adaptation exceed the costs of direct impacts averted - for example, the costs of protecting small settlements from sea-level rise may be higher than the costs of the impacts;

⁶⁰ <http://www.nccarf.edu.au/content/limits-adaptation>

⁶¹ http://www.nccarf.edu.au/sites/default/files/attached_files_publications/Limits%20-%20synthesisWEB.pdf

- Technological limits, where technology cannot avoid impacts – for example in warmer climates snow making may be unable to sustain snow cover for the purposes of skiing; and
- Social limits, where people judge that an adaptation has failed because it fails to protect things that they value - for example no amount of adaptation can avoid damages to cultures that will be incurred when coastal lands are submerged by sea-level rise.

NCCARF's publication outlines 6 cases studies that explore some the limitations to adaption, including the Great Barrier Reef, The Alpine region, Wetlands and the Corong and Lower lakes region. WWF urges the committee to review the publication in more detail, noting that WWF's views preservation of our natural systems as critical (see:

http://www.nccarf.edu.au/sites/default/files/attached_files_publications/Limits%20-%20synthesisWEB.pdf).

Given there are limits to adaptation, especially when it comes to extreme weather events, it therefore remains imperative that Australia and the globe does all it can to mitigate against dangerous levels of global warming and climate change.

4.3 Climate change mitigation

Australia has the policy foundations in place to make an effective contribution to global efforts to mitigate climate change, including the emissions trading scheme (ETS), the Renewable Energy Target (RET) and the Carbon Farming Initiative (CFI). However, WWF remains concerned that Australia will not realise the full potential of these policies to maximise our own domestic efforts and leverage greater levels of ambition from other countries.

WWF reiterates its long-held support for a price on pollution as the primary mechanism to reducing Australia's greenhouse gas pollution, supported by complementary measures. WWF believes an ETS is the most economically efficient and environmentally effective price mechanism. WWF notes that this view is in line with the conclusions of many economists and in particular by two seminal Australian reports to Government on climate change: the Prime Ministerial Task Force on Emissions Trading prepared under the Howard Government, also known as the *Shergold Report*⁶², and the *Garnaut Climate Change Review*⁶³.

While WWF believes the Clean Energy Package could be improved, especially with respect to over compensation to industry, WWF still believes it's an important first step and provides the following benefits:

- The provision of certainty around pollution reduction targets;
- Minimises national budgetary risk because it is revenue neutral;
- It provides an economic incentive to reduce pollution and switch to cleaner technologies, goods and services;
- It enables the market to determine where pollution reduction will occur, which can drive innovation and efficiency throughout the economy;
- Delivers least cost abatement in covered sectors;
- Sends a long-term price signal for large-scale investment;

⁶² Prime Ministerial Task Force on Emissions Trading (2007) Report of the Task Group on Emissions Trading http://pandora.nla.gov.au/pan/79623/20080117-2207/dpmc.gov.au/emissions/docs/emissions_trading_report.pdf

⁶³ The Garnaut Climate Change Review (2008) Final report <http://www.garnautreview.org.au/CA25734E0016A131/pages/draft-report>

- In the absence of a price signal, support for the deployment of emerging technologies through mechanisms such as grants, a Renewable Energy Target Scheme (RET) or a feed-in-tariff will be *more costly* and *required for a longer period of time* than with a carbon price; and
- Enables international linkage

Research commissioned by WWF-Australia by independent analysts – Climate Risk – found that removing the carbon-pricing scheme altogether would leave an AUD\$67 billion deficit in renewable energy investment requirements to transition to low carbon energy sector by 2050; this shortfall would need to be addressed using other policy measures.⁶⁴

WWF recommends that all sides of politics commit to keeping the carbon price package in place.

We are also concerned that some important gaps remain in Australia's response.

4.3.1 Emissions Targets

Both the Government and the Opposition support the view that it is in Australia's national interest to keep global warming below 2°C. There is also agreement that Australia would need to reduce emissions by 25% below 2000 levels by 2020 as a contribution to broader global efforts to achieve this goal of staying below 2°C. This view is supported by detailed global modelling undertaken as part of the Garnaut Review, which concluded that a 25% target for 2020 would represent Australia's fair contribution to a coordinated global response consistent with a 450 ppm CO₂-e stabilisation pathway.⁶⁵

For the record, WWF is of the view that even 2°C of warming is too much and will have profound impacts on Australia's environment, people and economy. We support the view of many countries – including our Pacific island neighbours – that the international community should be doing everything it can to stabilise global warming at no more than 1.5°C. There is no doubt that this will be extremely difficult to achieve, but to do otherwise is to accept severe and possibly irreversible impacts that are likely to occur with 2°C of warming.

WWF welcomes the Government's re-affirmation late in 2012 that Australia remains prepared to move to 25% target. However, given the urgency of the risk posed by climate change, rather than waiting for certain conditions to be met, Australia should be willing to move to a 25% target as its minimum contribution to global efforts.⁶⁶ This would represent true leadership in doing what is best for our national interest and remove any doubt about Australia's commitment to avoiding dangerous climate change.

⁶⁴ WWF and Climate Risk (2012) Our Clean Energy Future: 100% Renewable Energy Powering our Future. http://awsassets.wwf.org.au/downloads/cl043_our_clean_energy_future_100_renewables_powering_australias_future_24sep12.pdf

⁶⁵ Garnaut, R. (2008), *The Garnaut Climate Change Review*, <http://www.garnautreview.org.au/index.htm>

⁶⁶ At very least the Government should be willing to lift Australia's minimum target above 5%. Analysis by the Department of Climate Change and Energy Efficiency supports the view that, given the actions being taken other nations, Australia should be prepared to commit to at least a 10-15% emissions reduction target. Significantly, the Department's analysis also concluded that China's emissions target is consistent with the conditions for Australia's 25% emissions target.⁶⁶ Other independent analysts – including Professor Ross Garnaut – have also shown that Australia's unconditional 5% target falls short of the efforts being taken by other countries.⁶⁶

4.3.2 Support for renewable energy

The RET has begun the job of unlocking Australia's world-class renewable energy resources, creating significant new employment and investment opportunities in regional Australia along the way. However, this support will end in 2020, leaving a significant risk that renewable energy investment will stall. Indeed, a recent study by Climate Risk commissioned by WWF found that unless there is sustained support post-2020, deployment of renewable energy technologies could stall for between 4 and 32 years.⁶⁷ This would derail Australia's efforts to decarbonise our economy.



While the carbon price will be critical for long-term development of renewable energy, given uncertainty about future carbon prices, extending and increasing the RET will provide a *safety net* for Australia's renewables industry, ensuring there is no investment shortfall should the carbon price be low.

WWF recommends a 2030 RET target of 50%.

The Climate Risk analysis also finds that Australia's six main renewable energy sources need to grow concurrently to achieve a 100% renewable energy goal by 2050. If they do not, some renewable energy technologies may need to grow at unsustainably high rates at later dates to allow the goal to be met. Current policies such as the carbon price and the RET design favour the development of low-cost technologies first. Banding or weighting the RET will give less developed/more costly technologies a "leg up" to develop and bring down their cost curves, to spur their growth alongside cheaper renewable technologies.

WWF recommends banding or weighing and increased RET between 2020 and 2030.

4.3.3 Transport emissions

Transport accounts for approximately 15.3 per cent⁶⁸ of Australia's emissions profile and rising.

However there are very few policies currently aimed at reducing emissions in this sector, for example emissions from passenger cars was excluded from the carbon price, and the RET is for electricity generation (and some heat) only.

There have been some trends to reduce GHG emissions from vehicles, including greater fuel efficiency standards, inclusion of biofuels in the fuel mix, the production of hybrid cars that use a mix of petrol and electrification, and fully electrified vehicles.

The Climate Risk analysis suggests that to achieve 100% renewable energy by 2050, Australia will need to significantly transform our transport sector shifting from combustion engines and their reliance of liquid to an electric automotive transport system. At the same time, allocate of bio-hydrocarbons to aviation and shipping.

⁶⁷ WWF and Climate Risk (2012) Our Clean Energy Future: 100% Renewables Powering Australia's Future. http://awsassets.wwf.org.au/downloads/cl043_our_clean_energy_future_100_renewables_powering_australias_future_24sep12.pdf

⁶⁸ DCCEE (2011) Australian National Greenhouse Accounts: National Greenhouse Gas Inventory – December 2010, pg 10. <http://www.climatechange.gov.au/~media/publications/greenhouse-acctg/national-greenhouse-gas-inventory-accounting-december-quarter-2010.pdf>

Electrification of Australia's transport system will require a significant level of planning: infrastructure for charging facilities; incentives to switch to electric vehicles, including off-peak pricing; and a strong signal to vehicle manufacturers.

WWF recommends the Government prepare a White Paper on electrification of Australia's transport system to begin laying the foundations for this transition.

4.3.4. Agriculture and land sector emissions

WWF accepts the decision to exclude the land sector from the carbon price and recognises the important role that the Carbon Farming Initiative can play in promoting low-emission farming and increased carbon sequestration in landscape. We also commend the significant amount of funding the Government has put towards research and development in this area. However, what is missing is a comprehensive strategy to address land sector emissions over the coming decades.

WWF recommends the Government prepare a White Paper on reducing emissions in the agriculture sector.