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**'What are we going to lose?  
Climate Change and Biodiversity'**

**Edited Transcript of Address given by Prof. Lesley  
Hughes on 18<sup>th</sup> November 2012.**

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Professor Lesley Hughes is an ecologist in the Department of Biological Sciences at Macquarie University and an expert on the impacts of climate change on species and ecosystems. She is a federal Climate Commissioner, the co-convenor of the Terrestrial Biodiversity Adaptation Research Network, Chair of the Tasmanian Climate Action Council and a member of Climate Scientists Australia and the Wentworth Group of Concerned Scientists.

Professor Hughes was also a member of the Expert Advisory Group on Climate Change and Biodiversity for the Australian Greenhouse Office and the Department of Climate Change, and a lead author for the UN's IPCC Fourth and Fifth Assessment Reports. Her research has been published extensively in peer-reviewed journals.

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### Introduction

Professor Lesley Hughes and the other commissioners on the Climate Commission have been going around Australia trying to help people understand the urgency of this issue, and I was fortunate enough to go a public meeting at Parramatta. It was a marvellous awareness raising meeting, but also a bit torrid for the presenters, because we also had a large group of climate change deniers and sceptics who were very vocal and very loud, and quite insulting in many cases. However, the majority I think were there to hear, listen, and learn. Thank you very much for coming Lesley. We are looking forward to learning from your expertise. Introduction given by Margaret Hinchey.

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## Edited Transcript of Address by Prof. Lesley Hughes

**Professor Hughes:** I should have a warning before I begin that the very nature of this topic is quite a depressing one, but I do try to end with a bit of hope and some good news at the end.

I'm going to talk about climate change and biodiversity, which has been my personal research interest and passion for about the last 20 years, and specifically talk about what we might lose. I want to begin by reminding you about what is really special about the Australian continent. There are a lot of things that make Australia special that also have a big influence on how our biodiversity is already responding to climate change and how it will respond in the future.

Firstly, Australia is the driest continent on the planet other than Antarctica. We have an extremely variable climate and in some ways, this is a good thing, because plants and animals in many parts of the continent have evolved in an environment that is highly variable climatically. So they do have a fair bit of inbuilt resilience because they had to, to have gotten this far. In a sense, a variable climate predisposes many of our species to being quite adaptable, so that is a quite positive message.

Another important factor in how species will respond in the future is our topography. Australia is the flattest continent on earth - only about 1% of the continent is above 600 metres and why is this important? As climate zones shift, species are going to have to shift also. A species in a very flat part of the world will have to go a long way. Indeed, for every degree of temperature increase, you have to go about 100-150 kilometres towards the south to stay in roughly the same temperature. If Australia were a very mountainous country, everything would be much easier, because a species could just go up 100 metres to get that same difference in climate.

Australia is also a very infertile continent. Most of our soils are very depleted in essential plant nutrients like nitrogen and phosphorus. This is important because carbon dioxide in the atmosphere acts like a fertilizer on plants. Plants grow larger and faster at high CO<sub>2</sub>, except if other factors limit growth. When

soil nutrients like nitrogen and phosphorus are very low, which is the case for many soils across Australia, the fertilizer effect will be limited.

Australia is a very flammable continent. All but about 5% of the continent burns relatively regularly. Many parts of northern Australia burn every year, sometimes twice a year. One of the things we're expecting is that as the climate gets warmer and in some places drier, conditions for ignition of bushfires occur more readily. So increases in severe bushfires are one of the things that we would expect to happen in the future.

Australia has also been isolated from the rest of the world for a very long time. About 54 million years ago, Australia broke away from the Gondwana supercontinent, and that means that our biodiversity has had over 50 million years on the continent to become different - lots of species have evolved since that time. They are known as endemic species and are not found anywhere else. One characteristic of endemic species is that they tend to have only very small distributions and experience a relatively narrow range of climatic conditions. This makes them vulnerable to rapid climate change in the future.

Many of our species are very rare and are already threatened by many other threats – which also mean they're more vulnerable to the threat of climate change. We've done terrible things to our environment. About 70% of our vegetation has either been cleared or degraded in some way by human activity. Biodiversity is considered the most vulnerable sector to climate change, for two main reasons.

Firstly, the rate of future climate change is about 10 and 50 times faster than the rate most species have had to adapt to in the past. The climate has changed substantially throughout the earth's history. We've gone in and out of ice ages, but it's happened very, very slowly - over thousands or sometimes millions of years. But we're now making those changes over the space of decades. And secondly, as I indicated earlier, climate change is happening in the context of all sorts of other stresses on our environment - clearing, habitat loss, invasive species, over allocation of water to irrigation etc. Climate change will exacerbate these stresses.

Despite the fact that we've had a little bit less than a degree of warming (on average) over the last 100 years, many species are already being affected. Many species are going through their life cycle faster and they're doing things that they would normally do in spring much earlier.

We're also seeing some evolutionary changes in species like fruit flies that evolve very quickly. In some places, they are actually keeping up evolutionarily with the climatic changes. Behavioural changes in species are also evident - sleepy lizards, for example, are mating earlier in the year than they did 30 years ago. Some of our species are also getting smaller. Species tend to be smaller where it's hotter, which is why you have polar bears in the Polar Regions. And so one of the things we might expect in the future is that species will actually get smaller, and in fact, there's some evidence that this is occurring in some species of birds.

We talk a lot about heatwaves in relation to human health, but we don't think about heatwaves very much in relation to natural ecosystems - but we are starting to appreciate how increasing heatwaves may be affecting species and natural ecosystems. Carnaby's cockatoo is a threatened species from Western Australia. A couple of years ago the area around Geraldton got to over 48 degrees, just for a day. There were also very hot winds, and very low relative humidity on that day, and literally hundreds of these birds just dropped dead. A similar situation has occurred with flying foxes in NSW. In 2004, temperatures reached 46 degrees just for one day. About 13% of flying foxes being monitored at a number of sites died that day.

Many changes are also happening in our oceans. Some species are moving south, from the tropics to more temperate areas, and from the temperate areas down into the southern oceans. For example, a NSW sea urchin called *Centrostephanus rodgersii* has now migrated in the East Australian Current down to Tasmania where it has been decimating the kelp forests, and having a great impact on species such as lobsters that live in these communities. This is an example of where a native species has been able to move somewhere new in response to climate change and is having all sorts of ecological and economic impacts.

I was very fortunate last week to be on Heron Island in the Great Barrier Reef for three days talking to a group of interested people about the impacts of climate change on coral reefs. Corals exist within a degree or two of catastrophe in the summer - if they get too hot, they throw out their symbiotic algae, then bleach. If the high temperatures persist, the corals can die. The oceans are actually absorbing a lot of the extra CO<sub>2</sub> that we're putting into the atmosphere. This is changing the chemistry of the oceans, making the water more acidic. Organisms like corals build their skeletons out of very alkaline material, out of calcium carbonate, and as the water surrounding the corals becomes more acidic, the ability of these organisms to build their skeletons becomes more difficult.

New diseases, some of which are probably becoming more prevalent as the oceans warm up, are also affecting corals. These diseases can have quite devastating impacts on coral.

### **The future.**

The Earth has already had experienced about 0.9 degrees warming over the past century. If the rate of emissions of CO<sub>2</sub> and other greenhouse gases continues to accelerate, climate models indicate that the world may warm by four degrees or more by the end of the century. The United Nation Framework Convention on Climate Change has a famous sentence in its second paragraph in Article 2 that says we need to keep global temperature to below two degrees above pre-industrial levels to avoid the dangerous impacts of climate change.

So what might we expect for Australia in the future? By 2030, CSIRO climate projections indicate warming of between approximately 0.5 and 1.5 degrees by 2030, and by 2070 somewhere between 2.0 and 5.0 degrees under a scenario where we continue to produce most of our energy by fossil fuels.

It's a lot more difficult to project rainfall into the future. Up in the north for example, rainfall projections are fairly uncertain with some of the models predicting more rainfall, and others predicting less. In the southern parts of Australia, the models have a much higher level of agreement and generally indicate the continuation of the long-term drying trend and therefore more droughts. This could have serious impacts on agricultural productivity in areas such as the Murray Darling basin. However, even in those areas where the

overall trend is for drying, we also expect that the frequency of heavy rainfall events will increase, leading to flooding.

As it gets hotter and drier, we expect more extreme hot days when the dangers of intense fires are greater. Projections of tropical cyclones in the future are rather uncertain, but the models generally indicate cyclones will probably not become more frequent, but those that do occur may be more intense.

*So how will species be affected?* I can sum this up by saying we expect more of the types of trends we have already observed, but that these trends will accelerate. For example, we expect the more mobile species to shift their distributions in a southerly direction or to higher elevations, where they are able to do so. Trends toward earlier life cycle events will also increase. These types of changes will affect the way in which species interact - some present day relationships between species are going to break down while new ones will develop. The nature of present day ecological communities will change accordingly.

We may well lose populations, and perhaps species, under the influence of extreme heat waves. Overall, climate change is expected to diminish our biodiversity.

Our ecosystems are likely to undergo significant transformation. For example, the current alpine zone may be completely snow free by the end of this century, leading to major changes in the plants and animals that will occur in these regions. We are already seeing changes in some freshwater wetlands, especially those in the Northern Territory around the Alligator and Mary Rivers where saltwater is intruding into freshwater swamps. Kakadu National Park could be eventually be threatened by this process, as sea levels continue to rise.

We also expect continued bleaching in the Great Barrier Reef. Before about the late '70s there was no large bleaching events known on the reef, and since then there has been several. The most severe were in 1998 and 2002 where up to 60% of the reefs were affected in some way.

Our ecosystems and species could also suffer negative impacts as humans adapt to climate change. For example, after the horrendous Victorian bushfires in 2009 new rules in Victoria about hazard reduction have come into force, allowing more clearing of bush around townships to reduce the threat of wildfire. Another example is the potential building of new dams to increase water security for agriculture and urban areas – once again, it is biodiversity that will probably lose out. Building of seawalls to protect property from rising sea levels and storm surges also has impacts on biodiversity of beaches and rocky shores.

Agriculture is also going to have to adapt. We're going to be growing crops in different places, and be selecting for different breeds of livestock. But all of that potentially has negative impacts on biodiversity as well. Shifting our agricultural production to new areas, especially to areas that have not previously been farmed, could also potentially have negative impacts on biodiversity.

*So what can we do?* One thing I think we need to do is to increase the size of Australia's protected area system. Currently about 12% of the Australian continent is under protection. The marine national parks are increasing which is a very good thing, but I think we need a lot more terrestrial parks as well. We need to focus on conserving the maximum amount of environmental heterogeneity both within and outside the parks system. The greater variety of landscapes we can protect, the more species we can conserve.

When the climate has changed in the past, species have often survived in small pockets of land called refugia. Identifying likely places that will act as future refugia will be really important for future conservation.

I think we also need to turn back the clock on habitat clearing, restore a lot of what's been lost. We also need to do a much, better job of controlling invasive species and reducing other threats so as to promote healthy ecosystems that will be more resilient to the impacts of rapid climate change.

We might also need to move a lot of species to other places, especially those species that we think will simply go extinct where they are now, though this is quite a controversial view.



Finally, we need to expect the unexpected because we don't know enough about any single species to be able to predict with a high degree of confidence what will happen to them, let alone whole communities.

*Here's a couple of good news items on the policy front.* When the Clean Energy package was announced, along with the carbon price there was a whole raft of complementary measures that will have environmental benefits. The Carbon Farming Initiative is one of those, allowing landholders to earn money by sequestering carbon, either in soils or in vegetation on their properties. If done properly, with biodiverse plantings, this measure will have significant benefits for biodiversity.

Another measure within the package is the Biodiversity Fund which is providing nearly \$1 billion to support the restoration of landscapes, management of invasive species and building carbon stores.

In conclusion, climate change is here. It's already having impacts, and those impacts are going to accelerate. All sectors, both human and natural, are going to be affected, but biodiversity most of all. This is the critical decade to reduce emissions – the sooner we turn things around, the more effectively we can get on top of the problem.

### KEY QUESTIONS

*Audience Question: What sort of catastrophe are we going to experience ...*

Well I think we've just had one, which is Hurricane Sandy, but we've also had many record-breaking extreme events here in Australia. In the last year or so, we've had the worst ever drought, severe storms and then Hurricane Sandy, following on from Hurricane Katrina. These are the types of events we expect more of in the future. Major catastrophes like these do affect people's perceptions of climate change.

*Audience Question: Well there hasn't been a cyclone that's affected Sydney since 1943.*

Yes and it still is going to be a very rare occurrence, at least in the next few decades because you only get tropical cyclones when the surface temperature

of the water gets above 26-27 degrees and you don't get that in Sydney very often.

*Audience Question: Does the carbon tax make any difference?*

Putting a price on carbon is one very important thing to do, as will be the emissions trading scheme when it comes in. This is simply an extension of the polluter pays principle, which is the reason we don't have raw sewage in our streets, as they did in medieval times.

If you're interested in this in relation to the rest of the world, the Climate Commission has put out a report on the international action on climate change, which summarises what every major greenhouse gas emitting country is doing to control emissions.

*Audience Question: I thought we were leading?*

No certainly not –I think we were the 33<sup>rd</sup> country to bring in some sort of scheme to control emissions by pricing carbon in some way. Australia is a small emitter in absolute terms, but we're actually still 15<sup>th</sup> largest, and there's 170 countries behind us that pollute less than we do. We're also the biggest per capita emitter, about 28 tons per year. I think there's no question that we have to do our bit.

*Audience Question: Do they take into account the effect that we're having by exporting these extra large quantities of coal?*

No it doesn't, the figures I quotes are just for emissions produced within Australia, not by our exports.

The good news is that last year for the first time there was more global investment in renewable energy than there was in traditional energy - \$270 billion in renewable; that was the first time it overtook coal and gas. The cost of solar panels manufactured in China has been reduced by over 70% in the last four years.

I recently heard a quote from Tony Cooper, the CEO of a company called Energetics. He said 'climate change is the biggest business opportunity of the 21<sup>st</sup> century'. It highlights the fact that climate change presents us with many opportunities to live differently, and better.

*Audience Question: One level that hasn't been mentioned is world population. The world's population has probably doubled and surely is having a major effect on lack of biodiversity ...?.*

The latest UN estimates indicate that the world population could reach about nine billion before levelling off. But it's not just the size of the population that's important, it's how everyone lives, and especially their level of resource consumption.

*Q: What's the website for the Climate Commission*

It is [www.climatecommission.gov.au](http://www.climatecommission.gov.au).

**CCJP wishes to thank Prof. Lesley Hughes for an extremely informative and thought provoking presentation and discussion.**

**Please see our website [www.ccjpoz.org](http://www.ccjpoz.org) for other Sunday Seminar summaries and reports.**

