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The Chair

Standing Committee on Natural Resource Management (Climate Change)

Parliament House

Macquarie Street

Sydney 2000

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Dear Chair

Managing climate change impacts on biodiversity inquiry

Thank you for the opportunity to make a submission on this topic to the Standing Committee on Natural Resource Management (Climate Change). The comments below reflect the expertise and opinions of members of the School of Biological Sciences at the University of Sydney. They have been collated in response to the two dot points set out in your letter to Professor Robyn Overall, Head of the School of Biological Sciences, on 11 March 2009.

We note that Anthropogenic Climate Change was listed as a key threatening process on schedule 3 of the *Threatened Species Conservation Act 1995* (TSC Act) in 2000, and that this original listing prescribed a number of specific actions and strategies that could be adopted to manage some of the impacts of climate change on biodiversity. We note also that a range of actions has been listed subsequently as part of the statutory threat abatement process triggered by the TSC Act, at http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/pas_ktp_profile.aspx?id=20025 These initiatives provide good overall direction for managing the effects of climate change on biodiversity, but we believe that they need much more detail if they are to be effective.

Comments on:

• *the adequacy of management strategies to address the impacts of climate change on biodiversity in New South Wales ecosystems*

1) The first step in assessing the adequacy of management strategies is to understand the likely effects of climate change in New South Wales. For our State, climate is mediated by marine and oceanographic processes. The CSIRO's modelling shows that New South Wales is likely to be the hardest hit of all the States by climate change. At present, the understanding of the consequences of climate change appear limited. While there has been some modelling of likely changes in mean climatic variables such as annual temperatures and rainfall, and the

effects of these changes on biota, there has been limited modelling of extreme events such as runs of very hot or cold days, prolonged droughts or flood events. Fauna, flora, ecological processes and systems may be able to adapt or shift in response to incremental changes in climate, but are unlikely to cope well with extreme events that will increase in frequency and magnitude. We have perhaps witnessed the effects of such events in the Victorian bushfires and the Queensland floods in early 2009. Management will need to recognise the importance of increased variance in future weather events, not just shifts in means.

2) Land-based management strategies for addressing climate change appear to be quite *ad hoc*. On the one hand, programs such the Great Eastern Ranges Initiative explicitly recognise that biota need continuous and contiguous habitat to be able to shift to remain within their preferred bioclimatic envelopes. Strategies to revegetate cleared areas to create habitat continuity and restore ecological processes are well taken. On the other hand, programs in some parts of New South Wales seem to be designed to consign biodiversity to the bin before climate change has any chance to do so. For example, the ill-considered government plan to sell off (= clear) travelling stock routes in central and western New South Wales would, at a stroke, deplete some of the last remaining examples of native vegetation communities in the larger part (>70%) of the state, and also destroy the last effective corridor connections over more than half a million square kilometres. The shift from sheep to goat grazing in large parts of the west, in response to the degradation wrought by over-grazing, is another example of poor management for the future. The denuded landscapes that will result will be highly susceptible to erosion by wind and flooding rains, greatly reducing biodiversity and the chances for a sustainable production industry. With respect to marine systems, there are no management strategies to mitigate the consequences of climate change, save the creation of Marine Parks. The failure of New South Wales to establish a connected network of Marine Parks means that the ability to Marine Parks to function as corridors to allow distribution changes for affected fauna and flora is limited. In both marine and terrestrial systems, management needs to be directed at creating (A) corridors to permit species distributional shifts rather than extinctions and (B) refugia, usually in the form of reserves/parks, for species incapable of moving any further. To put this into context, much attention has been drawn to the potential fate of the Great Barrier Reef under climate change. Coral reefs, however, have the potential to move south; it has been modelled that the southern limit of the Great Barrier Reef may, in the future, be off Coffs Harbour. But for our shallow water temperate marine fauna and flora, particularly macroalgae, the future is bleak; movement to higher latitudes means that there is nowhere for them to go. We suggest that an all-of-government approach must be taken to improve the coordination of strategies that are in place already across New South Wales.

3) Monitoring of key biota, ecological processes and systems is needed to track changes in biodiversity and provide timely feedback so that adaptive management can be implemented. Apart from programs such as the Fox Threat Abatement Plan, which is excellent, it seems that monitoring at present is insufficient to detect changes in most biota in most parts of the state. There is a great temptation on behalf of government to utilise so-called 'volunteer' schemes for biodiversity monitoring. Such moves must be considered with caution. Properly, understanding distributions of biota is an ecological assessment; no member of government suggests we employ the community as neurosurgeons, so if Government require high quality robust ecological science then the Government must fund this as such. Currently, most effort seems to be directed at vertebrates, consideration should be given to which components of the biota to monitor (individual species, habitats, systems), including such neglected components as invertebrates and algae.

• *any options for improving these strategies in order to ensure that these ecosystems are resilient to the likely impacts of climate change*

It should be noted that direct investment by the State Government into environmental / ecological research is trivial, bordering on the non-existent when compared to that of Victoria or Queensland.

1) Predictive modelling of species distributions under climate change can be improved by adding physiological constraints to species' currently-known known ecological requirements. Successful application of this approach has been pioneered by Dr Michael Kearney (University of Melbourne), and can be expected to have particular value for predicting invasions of weeds and pests.

2) Target groups and sites need to be identified for long-term monitoring, and set up as a matter of priority. Such sites should include examples in marine, freshwater and terrestrial habitats.

3) There are two aspects to ecological responses to climate change. The first are distribution shifts by biota in response to changing conditions or ecological processes. This requires that we have accurate data on where species are currently found and the ecological tolerances of potential key structuring species in assemblages/communities; inadequate data in this respect will completely undermine any attempts to model the effects of climate change. The second aspect is changes in ecological processes. For example, most ecological processes are underpinned by nutrient cycling; such cycling comes about from the activity of detritivores and decomposers, this key group is excluded from many monitoring programmes. In order to properly anticipate changes to ecosystem function as a result of climate change, we must understand how ecological processes are affected; simply mapping changes in distribution is not sufficient. An additional example of changes on ecological processes as a result of climate change is the potential for an increase in pest insects. Outbreaks and swarms of economically-important locust species are driven by local rainfall and vegetation distribution patterns. Both of these local ecological factors are determined by larger-scale and longer-term climactic processes likely to be affected by climate change. Locust outbreaks have important consequences, both negative and positive, for biodiversity. Locusts can provide food for other organisms, provide ecosystem-level nutrient cycling services, and potentially compete with other herbivores for limited plant resources. Changes in the frequency or severity of locust outbreaks will also have direct consequences for agriculture in terms of the need to control locust numbers to minimise crop or forage loss. As such, effective locust management is central to mitigating their potential impacts on biodiversity and human endeavours in the face of climate change. Australia is at the forefront in developing and implementing preventative locust management strategies that seek to suppress local locust outbreaks before they become widespread plagues. The Australian Plague Locust Commission, acting in New South Wales, Victoria, South Australia and Queensland, conducts population monitoring and forecasting programs aimed at identifying incipient locust outbreak areas. The continuation of these programs, along with an improved understanding of how climactic conditions influence locust population dynamics and movement patterns, will be critical tools in responding to climate driven changes in locust outbreak and swarming patterns in NSW and throughout Australia.

An undue emphasis on distribution shifts will not provide evidence on climate change associated impacts on ecosystem processes. Society benefits greatly from ecosystem services, and

so these should be the target of research. These could be carbon dioxide exchange, nutrient cycling, water balance, soil retention and fisheries.

In both of these aspects (distribution shifts and ecological processes), current emphasis is towards terrestrial systems. This ignores the considerable lack of knowledge on our near-shore and oceanographic environments.

Thank you for the opportunity to make this submission.

On behalf of the School of Biological Sciences.

Yours sincerely

Associate Professor Ross Coleman

Professor Chris Dickman