

# **Likely ecological impacts of global warming and climate change on the Wet Tropics World Heritage Area**

Report prepared for an objections hearing in the  
Queensland Land and Resources Tribunal

Tribunal reference numbers: AML 207/2006 and ENO 208/2006  
Tenure identifier: 4761-ASA 2

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## INTRODUCTION

1. The Queensland Conservation Council Inc (QCC) has requested me to provide an expert report of the likely ecological impacts of global warming and climate change on the Wet Tropics World Heritage Area, Australia. My letter of instructions is attached as Appendix 1.
2. This report has been prepared in response to that request for use in an objections hearing concerning an open-cut coal mine in the Queensland Land and Resources Tribunal. The mine is an extension of the Newlands Coal Mine, 129 km west of Mackay, known as the “Newlands Wollombi No. 2 Project”. I am instructed that the mining, transport and use of the coal from the mine will produce greenhouse gas emissions contributing to global warming and climate change estimated to be 84.0 million tonnes of carbon dioxide equivalent. The contribution of these emissions to global warming and climate change is a matter for other witnesses. My evidence concerns the likely impacts of global warming and climate change on the Wet Tropics World heritage Area and the rainforest biodiversity contained within the area of which the emissions from the mine the subject of this objection are a contributing factor.
3. I note that I have read and understood from the Tribunal’s practice direction No. 11 of 2000 and that I have overriding duty to assist the Tribunal on matters relevant to my area of expertise.

## EXPERTISE

4. Appendix 2 to this report is a copy of my curriculum vitae. I am currently the director of the Centre for Tropical Biodiversity & Climate Change Research, a multidisciplinary research centre aimed at understanding the patterns and processes underlying tropical biodiversity and the impacts that global climate change will have on the natural environment. The centre is an initiative supported by the James Cook University Research Advancement Program (one of five competitively-funded research programs across the university), Queensland Government Innovation Funds, Marine & Tropical Science Research Facility, Earthwatch Institute, National Geographic and the National Science Foundation (USA).
5. I have an established international reputation in the research fields of climate change impacts on biodiversity and ecology. This recognition is demonstrated by invited and fully-funded participation in 9 international meetings on the subject over the last two years, and by invited participation in the Intergovernmental Panel on Climate Change (IPCC) 4<sup>th</sup> assessment report as an expert reviewer and as an invited member of the scientific advisory panels at the regional (Wet Tropics Management Authority and Great Barrier Reef Marine Park Authority), State (Queensland government), national (environment Minister advisory panel on climate change) and international levels (International Union for the Conservation of Nature (IUCN), United Nations Environment Program, DIVERSITAS). My papers in *Nature*, *Global Change Biology*, and *Proceedings of the Royal Society of London* were significant contributors to the fact that *Science* ranked climate change impacts on biodiversity as one of the top ten fields of research having the most impact during 2004. My publications have been cited widely and include 31 refereed journal articles, 20 of which are in high-quality international journals. Our

collaborative paper on predicting global extinctions (Thomas *et al.* 2004 *Nature*), that included a very significant contribution from my data on the Queensland Wet Tropics, is currently ranked by *ISI Essential Science Indicators* as the world's number 1 “hottest” paper in the field of ecology and the environment. The climate change impacts research has an established international reputation and has resulted in significant outcomes in policy development and further research around the globe.

6. Since 2003 I have had 16 publications on climate change impacts on biodiversity, plus a further three in review and five at manuscript stage and have received over \$1.6 million in competitive grants. My research has had significant outcomes and has been incorporated into the Wet Tropics Conservation Strategy, Queensland climate change policy, National Biodiversity & Climate Change Action Plan, State of the World's Birds Report, IUCN Climate Change reports and has instigated many more research projects.
7. My research was the first to identify global climate change as a severe threatening process in the tropics and the first to predict that we may be facing many species extinctions in mountain systems around the world. Tim Flannery in his new book “The Weather Makers: the history and future impact of climate change” describes my research as the “most detailed study of its kind in the world thus far”. My research project has always been deliberately multidisciplinary and collaborative and has led to an increasingly diverse array of research outputs with national and international collaborations. I have collected and compiled data on fauna in the Wet Tropics for over 15 years and the resulting database is of incalculable value in this project.

## **LIKELY IMPACTS OF CLIMATE CHANGE ON THE WET TROPICS WORLD HERITAGE AREA**

8. In 2003 I co-authored an article on the likely impacts of climate change on the Wet Tropics World Heritage Area: Williams S.E., Bolitho, E.E. & Fox, S. (2003). Climate change in Australian tropical rainforests: an impending environmental catastrophe. *Proceedings of the Royal Society of London. B.* 270:1887-1892. The following paragraphs generally reflect the scientific evidence and findings contained in that article. Similar results were published by Krockenberger (2004) and updated in Shoo *et al.* (2006), Shoo *et al.* (2005a, b), and Williams & Hilbert (2006).

### **Climate change**

9. Globally, average temperatures have already risen *ca.* 0.6 °C and they are continuing to increase (Houghton *et al.* 2001). Over the remainder of this century we will experience an increase in average temperatures of between 1.4 °C and 5.8 °C combined with large increases in atmospheric carbon dioxide (CO<sub>2</sub>) concentrations and significant changes in rainfall patterns (Houghton *et al.* 2001). Although the effects on rainfall patterns are more uncertain, it is predicted that rainfall variability and dry-season severity will increase (Walsh & Ryan 2000). That is, rainfall will be more variable from month to month, with longer dry spells and possibly with an increased frequency of disturbance events such as flooding rains and cyclones (Easterling *et al.* 2000; Walsh & Ryan 2000; Milly *et al.* 2002; Palmer

& Raianen 2002). Additionally, a rise in the average basal altitude of the orographic cloud layer is expected (Pounds *et al.* 1999; Still *et al.* 1999). A reduction in cloud-moisture capture from this cloud layer will exacerbate the effects of longer and more variable dry seasons (Still *et al.* 1999). Climate change has already produced significant and measurable impacts on almost all ecosystems, taxa and ecological processes, including changes in species distributions, phenology of biological behaviours, assemblage compositions, ecological interactions and community dynamics (Hughes 2000; Walther *et al.* 2002; Parmesan & Yohe 2003; Root *et al.* 2003).

## The Wet Tropics World Heritage Area

10. Rainforests in the Wet Tropics bioregion were listed as a World Heritage Area in 1988 primarily because of the high biodiversity values of a unique regional biota. Although the area of rainforest within the region is small on a global scale (*ca.* 10 000 km<sup>2</sup>), there are 65 species of rainforest vertebrate that are regionally endemic. On a regional scale, patterns of biodiversity have been largely shaped by Pleistocene contractions in rainforest area and subsequent expansion episodes (Winter 1988; Williams & Pearson 1997). The contraction of rainforests to cool moist upland refugia probably imposed an extinction filter resulting in most of the remaining regionally endemic species being cool-adapted upland species (Williams & Pearson 1997; Schneider *et al.* 1998). These factors have predisposed the fauna to being particularly vulnerable to global climate change for two reasons: (i) the biogeographic history has resulted in an endemic fauna that is adapted to a cool, wet and relatively aseasonal environment; and (ii) the impacts of increasing temperatures should be most noticeable across altitudinal gradients and, in this region, the altitudinal gradient and associated complex topography dominate the biogeography of the region (Nix & Switzer 1991; Williams *et al.* 1996). In fact, the altitudinal gradient is the most significant gradient determining species composition and patterns of biodiversity in the region (Williams *et al.* 1996; Williams 1997; Williams & Pearson 1997; Williams & Hero 2001). The total spatial extent of upland forest types in the Wet Tropics bioregion is also predicted to shrink significantly under expected climate-change scenarios (Hilbert *et al.* 2001).

## Methods

11. Williams *et al.* (2003) modelled the likely impacts of climate change on the Wet Tropics World Heritage Area. Distributional data on all terrestrial vertebrates were collected during intensive field surveys across the region and by collating all available sources from the literature and institutional databases. Realistic distribution models require good coverage of the range of environments present within the distribution of each species. Therefore, the regional coverage of both geographical and environmental space was analysed and additional standardized surveys were carried out to fill gaps in both geographical and environmental space as much as possible. Total survey effort across the bioregion consisted of 652 bird surveys, 546 reptile surveys, 249 spotlighting transects, *ca.* 50 000 trap nights for small mammals, 111 stream frog surveys, 231 microhylid frog surveys and a further 6373 miscellaneous records collected during the fieldwork. Other major sources of data included the *Birds Australia* database and the Queensland Parks and Wildlife Service 'WildNet' fauna database. This produced a database containing 92 967 spatially referenced records of 622 terrestrial vertebrate species. Each record was

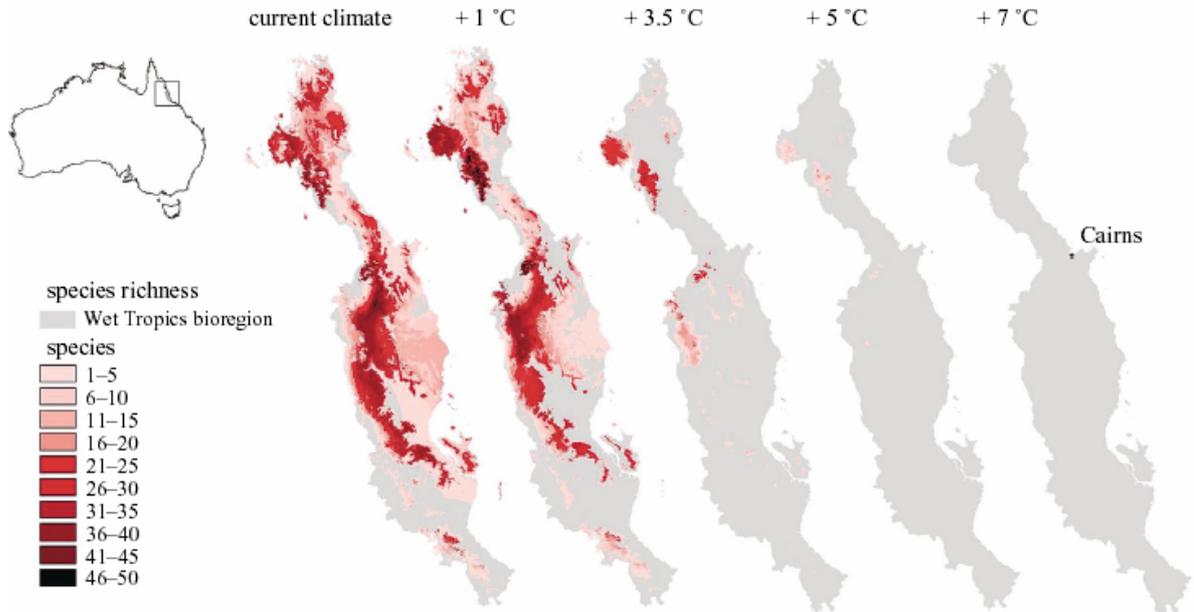
checked for both positional and taxonomic reliability and only records of high reliability were retained in the analyses. The analyses used a subset of these data consisting of 7123 non-duplicate records of the 65 species of regionally endemic rainforest vertebrates.

12. The modelling program we used was Bioclim, a part of the Anuclim 5.1 package (Houlder *et al.* 2000). The digital elevation model used for the region had a pixel resolution of 80 m × 80 m. Bioclim generates up to 35 climatic parameters based on maximum temperature, minimum temperature, rainfall, radiation and evaporation; however, the unrestricted use of so many variables in a climatic envelope method results in over parameterization and loss of predictive power of the models. Therefore, we restricted the environmental variables to 10 parameters that had previously demonstrated significance in explaining biological patterns of diversity within the region. The parameters chosen were the mean annual temperature, intraannual variability of monthly mean temperature, maximum temperature of the warmest quarter, minimum temperature of the coldest quarter, mean annual precipitation, intra-annual variability of monthly mean precipitation, precipitation of the wettest quarter, precipitation of the driest quarter, mean annual radiation and intra-annual variability of monthly mean radiation. Core environmental distribution was defined as the areas where the climatic parameters fall between the 5th and 95th percentiles of the values of the parameters in the species profile.
13. Bioclimatic envelope methods such as Bioclim will generally overestimate distribution area. Current distribution models were evaluated by experts and by comparison with known patterns of subregional occurrence (Williams *et al.* 1996). Out of the 65 species modelled, the distribution areas of 17 species were significantly overestimated. These were corrected by removal of over-predicted areas where we were highly confident that the species does not occur, thereby providing accurate models for 51 species (78%). There were 11 species for which the models possibly underestimate distribution area owing to a low number of records; however, expert evaluation of these models suggested that they were reasonable given current knowledge.
14. We chose a range of temperature-increase scenarios to encompass the predicted range (1.4–5.8 °C; Houghton *et al.* 2001), including temperature increases of 1, 3.5, 5 and 7 °C. These increases were applied to each of the three temperature variables uniformly across the region. We used the bioclimatic models based on current species distribution to predict distributional changes with increasing temperature and subsequent changes to regional patterns of biodiversity. The area of core environment remaining under the different temperature scenarios formed the basis of the analyses. Species-richness maps were produced by overlaying species-distribution models within each climate-change scenario.

## Results

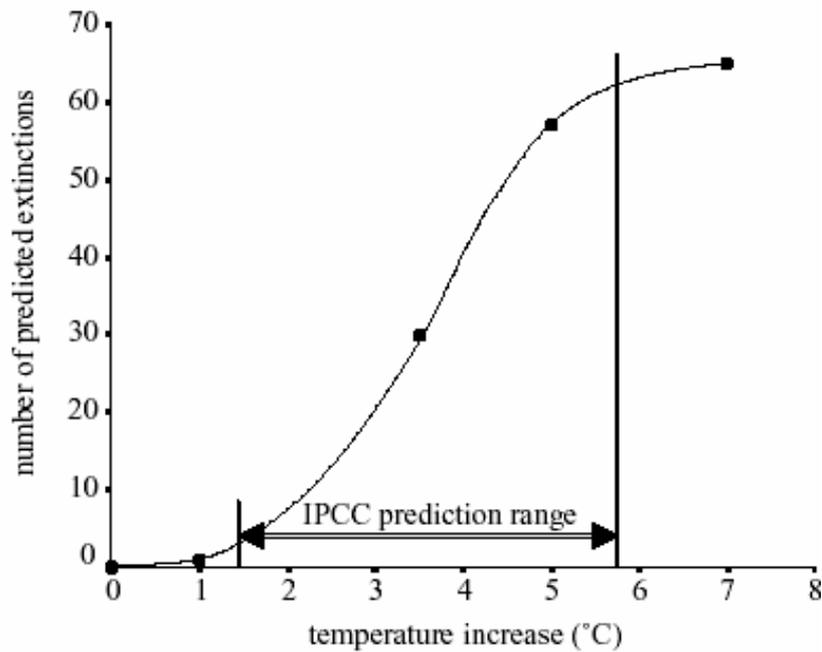
15. The changes in the pattern of geographical species richness are complex and dramatic on inspection (figure 1). They are significant even with a 1 °C increase in global temperature, a change that is considered inevitable within the next few decades. The major areas of high diversity in the uplands remain relatively unscathed and in some areas diversity may increase slightly; however, significant declines in local species richness occur across the lowlands and in mid-altitudinal

areas (figure 1). The loss of biodiversity with a 3.5 °C increase is obvious. There are no areas with high species richness remaining (greater than 30 species) and all endemics have disappeared from the low and mid-elevation regions. There are only four refugial areas remaining that support a reasonable level of species richness. Beyond this temperature the losses are essentially complete: small areas of refugia for a few species survive at +5 °C but the entire ranges of all 65 species are gone at +7 °C.



**Figure 1. Geographical pattern of species richness of regionally endemic rainforest vertebrates at each temperature scenario.** Species richness is produced by overlaying all species-distribution models at each temperature scenario.

16. We predict that even a 1 °C increase will cause significant declines in range size in almost every species of regionally endemic vertebrate in the Wet Tropics bioregion. Out of the 65 species modelled, the area of core environment significantly declines in 63 species to an across-species mean of 63% of current area. One species may go extinct with a complete loss of core environment (*Cophixalus* sp. nov., found only at Thornton Peak). With an increase of 3.5 °C, all 65 species are predicted to undergo dramatic declines in distribution, with 30 of these species completely losing their core environment. The mean remaining area of core environment for the surviving 35 species is only 11.4% of their current distribution. A more severe increase of 5 °C will completely remove the core environments of 57 species and the remaining eight species will be left with an average of only 3% of their current core area. None of the 65 regionally endemic species is predicted to have any core environment remaining at the more extreme possibility of a 7 °C increase in temperature. If we assume that the complete loss of its core environment will result in the extinction of a species, we can predict the number of likely extinctions as a function of the increase in temperature (figure 2). The relationship between increase in temperature and predicted extinctions was best fitted by an S-curve ( $r^2 = 0.997$ ,  $p = 0.001$ ). The arrow on figure 2, indicating the range of predicted increases in temperature, highlights the difference in impacts between the minimum and maximum predictions, ca. 6% and 96% extinction of endemics, respectively.



**Figure 2. Relationship between increasing temperature and the number of predicted extinctions of regionally endemic rainforest vertebrates resulting from the predicted complete loss of their core environments.** Arrow shows the range of the possible increase in temperature during this century, as predicted by the Intergovernmental Panel on Climate Change (IPCC) (Houghton *et al.* 2001). S-curve fit:  $\text{adj. } r^2 = 0.997, p = 0.001$ .

## DISCUSSION

17. Globally, mountain systems are hotspots of biodiversity and endemism owing to the compression of climatic zones over the elevational gradient (Körner 2002). It is precisely this dependence on orographic gradients that makes these systems vulnerable to climate change. Many studies have predicted that climate-change impacts will largely consist of shifts in latitudinal and altitudinal species distributions with concomitant complex changes in assemblage structure (Parmesan 1996; Hill *et al.* 2002; Peterson *et al.* 2002; Parmesan & Yohe 2003; Root *et al.* 2003). In the Australian Wet Tropics, and in most montane systems, the dispersal distances involved in moving up with a moving climate are relatively small; however, we are facing the complete disappearance of specific environmental types combined with a low possibility of natural dispersal to other suitable habitats. An analogous study of the impacts of climate change on Mexican fauna predicted relatively few extinctions or drastic range reductions (Peterson *et al.* 2002). By contrast, our results suggest that we may be facing an unprecedented loss of biodiversity in any montane biota, an environmental catastrophe of global significance. We found that, despite formal and enforced protection of the rainforests of the Australian Wet Tropics World Heritage Area, most of the endemic vertebrates are severely threatened by predicted climate changes over the remainder of this century. The results presented here suggest that, even with an

extremely conservative increase of only 1 °C, one species will completely lose its core environment and almost all other species will face significant decreases in distribution. The predicted decreases in range size with climatic change rely on the assumption that distribution and environment are inextricably linked, an assumption that is generally accepted in ecology (Lawton 1995). There will surely be significant variation between species with respect to the validity of this assumption. However, we expect that there will be both species that suffer less than predicted owing to greater than expected environmental tolerances and species that decline faster than expected owing to the disruption of other ecological interactions. Additionally, predictions based on a climatic envelope method such as Bioclim will generally be conservative; therefore the predictions presented here may in fact be a best-case scenario.

18. The power of the overall pattern lies in the broad taxonomic and ecological generality of the results and in the strength of the altitudinal gradient in this ecosystem. The geographical contraction of species' ranges has implications beyond the loss of species richness. Based on known patterns of vertebrate phylogeography and population-level genetic diversity in the region (Moritz 2002), the geographical pattern of population extinctions (figure 1) represents a significant loss of genetic diversity and an associated reduction in evolutionary potential within the region.
19. Although the complete loss of its core environment may not unequivocally cause a species to go extinct, it will certainly make the species extremely vulnerable. At worst, the predicted extinction curve will be an underestimate of the extinction rate owing to the compounding effects of other impacts and disrupted processes. However, at best it describes the increase in the number of species that will become severely threatened as they lose their core environments. The low number of points on the curve in figure 2 means that the predictive power of the relationship is reduced; however, the shape of the curve is precisely what would be expected theoretically. Assuming that the relative extinction proneness of species is normally distributed with respect to a given threatening process (in this case increasing temperature) then we would expect the extinction curve to be an S-curve. Initially, the extinction rate would increase slowly, affecting only a few sensitive species; this would be followed by a period of rapidly increasing extinction rates through the modal region of the curve before the rate slows down when only a few hardy species remain. This is exactly the pattern demonstrated here (figure 2). An important point to note is the prediction that impacts will not increase linearly: they may be quite slow initially but the rate will increase rapidly. This is a significant point with respect to conservation management: it would be completely inappropriate to define thresholds for management action on the basis of monitoring the increase in temperature. It is probable that once the lower inflection point is reached on the S-curve there will be massive and rapid increases in the impacts with relatively small increases in temperature. It is imperative to keep the temperature increase below this inflection point of *ca.* 2–2.5 °C to minimize impacts.
20. Several other independent lines of evidence support the predictions presented here. Hilbert *et al.* (2001) used neural-net models to predict the magnitude of vegetation changes in the region with strikingly similar results to those presented here for vertebrate distributions. A generalized linear model predicted a very similar pattern of decline for the golden bowerbird (*Prionodura newtoniana*), although at a slightly

faster rate than the equivalent Bioclim model presented here (Hilbert *et al.* 2003). There is also experimental and anecdotal evidence to support the predictions. It has previously been suggested that the limited altitudinal ranges of many species of mammalian folivores are determined by thermal tolerances (Winter 1997; Kanowski *et al.* 2001). Laboratory studies confirm that one species, the green ringtail possum (*Pseudochirops archeri*), is intolerant to high temperatures, with body temperature increasing linearly with time when the ambient temperature is above 30 °C, leading to the possibility of lethal effects after only 4–5 h (A. Krockenberger, personal communication). There have also been anecdotal reports of unusual mortality in arboreal folivores within the region following recent periods of record maximum temperatures. As most models of climate change predict not only rising mean temperatures, but also more frequent periods of extreme temperatures, it is likely that the marsupial folivores will be particularly sensitive to predicted climate changes.

21. In the distribution models discussed here, only the effects of increasing temperature have been considered. The impacts of climate change on the region will conceivably be much more severe owing to a range of compounding factors. Increased CO<sub>2</sub> levels will reduce the nutritional value, increase the toughness and increase the concentration of some defence compounds of foliage (Lawler *et al.* 1997; Kanowski 2001). This will have significant detrimental effects on folivore abundance (particularly affecting endemic ringtail possums, tree kangaroos and many insects). Furthermore, the predicted changes in geographical distribution will move species from nutrient-rich basaltic soils to increasingly poorer granitic soils at higher elevations. Rainforests on these poorer soils support lower densities of arboreal folivores (Kanowski *et al.* 2001). A lifting cloud bank (Still *et al.* 1999), directly resulting in a reduction in critical inputs of mist and water at high altitude, has been linked with synchronous declines of amphibians and altitudinal shifts in the distributions of birds in the cloud forests of Monteverde, Costa Rica (Pounds *et al.* 1999). These impacts are particularly relevant to the frogs of the family Microhylidae (a diverse group of restricted regional endemics), where species richness is limited by low rainfall in the dry season (Williams & Hero 2001). A raised orographic cloud base will potentially affect many taxa requiring high and consistent moisture levels (e.g. microhylid frogs, litter skinks, soil invertebrate faunas, microbes), thereby indirectly affecting most litter-feeding insectivores (many species of birds, skinks, microhylid frogs, dasyurid mammals, bandicoots, etc.) and litter processes (nutrient cycling, decomposition, etc.). Increasingly unpredictable rainfall may also have significant negative impacts (Knapp *et al.* 2002; McLaughlin *et al.* 2002). The intra-annual variability in rainfall was the most significant variable explaining regional patterns of bird abundance in the Wet Tropics bioregion, particularly for insectivores and frugivores (Williams 2003). Basically, population size is negatively related to rainfall seasonality, a factor that is predicted to increase under climate-change scenarios. Short periods of dry weather have been shown to limit insect biomass (Frith & Frith 1985) and probably fruit biomass, providing a plausible mechanism explaining these patterns, namely, that short bottlenecks in available resources limit local abundances (Williams 2003). Habitat fragmentation has previously been shown to increase the extinction proneness of many species within the Wet Tropics bioregion (Laurance 1991, 1994). Fragmentation has two implications in the context of the analyses presented here: (i) current habitat fragmentation will impede climate-induced shifts in faunal distributions; and (ii) as species' ranges contract further up the mountains,

distributions will become more fragmented, thereby exacerbating the impacts of reduced range size. All of these factors are likely to compound the impacts of increased temperature and may act to increase the slope and decrease the position of the lower inflection point predicted in figure 2.

22. Ultimately, the impacts of global climate change will depend on two factors: first, the final realized degree of change and, second, the resilience of the ecosystem in question. The first factor needs to be addressed globally and at a governmental level by reducing global greenhouse gas emissions. The second issue, of resilience, can be addressed locally and immediately. Resilience refers to the ability of a system to withstand and/or recover from perturbation and is a key management concept in dealing with an unpredictable future (Walker *et al.* 2002). To maximize ecosystem resilience, it is imperative that we maintain ecological processes and minimize any action that may damage the inherent resilience of the ecosystem, such as habitat fragmentation, feral animals, weeds and diseases.

## **GLOBAL EXTINCTION RISK FROM CLIMATE CHANGE**

23. We have also demonstrated that when we use empirical field data on the abundance of birds across different altitudes, that population sizes may decline even faster than we predicted in the paper discussed above (Shoo *et al.* 2005). These analyses using extensive field data suggest that the distribution models discussed above, may in fact be quite conservative.
24. Following the publication of Williams *et al.* (2003), I have participated in ongoing research into the global extinction risk from climate change, including Krockenberger (2004), Shoo *et al.* (2006), Shoo *et al.* (2005a, b), and Williams & Hilbert (2006).
25. One major publication from this research was Thomas *et al.* (2004) in which I contributed to an international assessment of the extinction risk from climate change. Using projections of 1,103 animal and plant species' distributions for future climate scenarios, we assessed extinction risks for sample regions that cover some 20% of the Earth's terrestrial surface. Climate projections for 2050 were divided into three categories: minimum expected change resulting in a mean increase in global temperature of 0.8–1.7 °C and in CO<sub>2</sub> of 500 parts per million by volume (ppmv); mid-range scenarios with temperature increases of 1.8–2.0 °C and CO<sub>2</sub> increases of 500–550 ppmv; and maximum expected scenarios with temperature increases of >2.0 °C and CO<sub>2</sub> increases >550 ppmv (Houghton *et al.* 2001). Projections for the year 2100 were allocated to 2050 scenarios according to their end temperatures and CO<sub>2</sub> levels.
26. We concluded that on the basis of mid-range Intergovernmental Panel for Climate Change (Houghton *et al.* 2001) climate-warming scenarios for 2050, that 15–37% of terrestrial species in our sample of regions and taxa will be “committed to extinction”.
27. As regional differences are expected, we compared the relative risks during 2000–2050 associated with land use and climate change (using area approaches) for the three region–taxon combinations that correspond most closely to single habitat or

- biome types. Based on Williams *et al.* (2003), the montane Queensland forests (principally contained in the Wet Tropics World Heritage Area) were assessed and extinction risk was found to be dominated by climate change (7–13% and 43–58% predicted extinction for minimum and maximum climate scenarios, respectively; 0% predicted on the basis of further habitat destruction, given its legal protection).
28. Many unknowns remain in projecting extinctions, and the values provided in Thomas *et al.* (2004) should not be taken as precise predictions. Note also we estimated proportions of species committed to future extinction as a consequence of climate change over the next 50 years, not the number of species that will become extinct during this period. Information is not currently available on time lags between climate change and species-level extinctions, but decades might elapse between area reduction (from habitat loss) and extinction.
  29. Despite these uncertainties, Thomas *et al.* (2004) believe that the consistent overall conclusions across analyses establish that anthropogenic climate warming at least ranks alongside other recognized threats to global biodiversity. Contrary to previous projections, it is likely to be the greatest threat in many if not most regions. Furthermore, many of the most severe impacts of climate-change are likely to stem from interactions between threats, factors not taken into account in our calculations, rather than from climate acting in isolation. The ability of species to reach new climatically suitable areas will be hampered by habitat loss and fragmentation, and their ability to persist in appropriate climates is likely to be affected by new invasive species.
  30. Minimum expected (that is, inevitable) climate-change scenarios for 2050 produce fewer projected “committed extinctions” (18%; average of three area methods and two dispersal scenarios) than mid-range projections (24%), and about half of those predicted under maximum expected climate change (35%). These scenarios would diverge even more by 2100. In other words, minimizing greenhouse gas emissions and sequestering carbon to realize minimum, rather than mid-range or maximum, expected climate warming could save a substantial percentage of terrestrial species from extinction. Returning to near pre-industrial global temperatures as quickly as possible could prevent much of the projected, but slower-acting, climate-related extinction from being realized.

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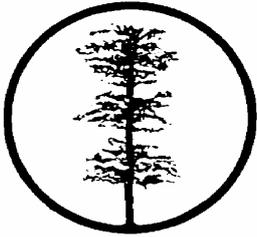
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## DECLARATION

I have made all the inquiries which I believe are desirable and appropriate and no matters of significance which I regard as relevant have, to my knowledge, been withheld from the Tribunal.

## APPENDIX 1 – LETTER OF INSTRUCTIONS



### ENVIRONMENTAL DEFENDERS OFFICE (QLD) INC.

Level 9, 193 North Quay  
(corner Herschel St)  
Brisbane QLD 4000

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ABN 14 911 812 589

13 January 2007

Dr Stephen Williams  
Director  
Centre for Tropical Biodiversity & Climate Change Research  
School of Tropical Biology, James Cook University  
Townsville Qld 4811

By e-mail only to: [stephen.williams@jcu.edu.au](mailto:stephen.williams@jcu.edu.au)

Dear Dr Williams

#### **Queensland Conservation Council Inc ats Xstrata Coal Queensland Pty Ltd & Ors Objection to Mining Lease Application for Newlands Coal Mine Expansion**

We act for the Queensland Conservation Council Inc (“QCC”) in relation to an application lodged by Xstrata Coal Queensland Pty Ltd for a coal mine expansion at Newlands Coal Mine. QCC will argue, in the Land & Resources Tribunal, that the coal mine expansion should not be approved without imposing conditions to avoid, reduce or offset the greenhouse gas emissions from the mining, transport and use of the coal.

#### **Background**

Xstrata Coal Queensland Pty Ltd (“Xstrata”) and its joint venturers<sup>1</sup> have applied for a mining lease under the *Mineral Resources Act* 1989 (Qld) (“MRA”) and an environmental authority (mining lease) under the *Environmental Protection Act* 1994 (Qld) (“EP Act”) for an open cut coal mine (ML 4761). The applications are for an additional surface area for extension of the Newlands Coal Mine, Wollombi No 2 Surface Area, at Suttor Creek approximately 129 km west of Mackay, known as the Newlands Wollombi No. 2 Project (“the Newlands Coal Mine Expansion”).

The mine will produce up to 2.5 million tonnes per annum (“Mtpa”) of run of mine (“ROM”) black coal for a nominal annual average of 1.9 Mtpa product coal over a 15 year mine life, or 28.5 Mt of coal in total.

The coal from the mine will be transported to domestic and/or export markets for electricity production (thermal or steaming coal) and/or steel production (metallurgical or coking coal).

<sup>1</sup> Itochu Coal Resources Australia Pty Ltd, ICRA NCA Pty Ltd, and Sumisho Coal Australia Pty Ltd.

*Environmental Defenders Office (Qld) Inc.*

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The total greenhouse gas emissions from the mining, transport and use of the coal from the mine are estimated to be 84.0 million tonnes of carbon dioxide equivalent (“MtCO<sub>2</sub>-e”). Of this total amount, 1.37 MtCO<sub>2</sub>-e (1.63%) comes directly from the mining operation itself. The bulk (98%) comes from the use of the coal overseas.

### **Expert evidence**

The key evidentiary issues QCC will address in expert evidence are:

1. What is global warming and climate change, how serious a problem is it, and how does the mining, transport and use of coal contribute to these processes?
2. The likely greenhouse gas emissions from the mining, transport and use of the 28.5Mt of coal from the mine.
3. The contribution that the likely greenhouse gas emissions from the mining, transport and use of the coal from the mine will make to climate change and potential impacts of this.
4. The reasonable and practicable means to avoid, reduce or offset the likely greenhouse gas emissions from the mining, transport and use of the coal from the mine, including the costs of these measures being imposed.
5. The likely impacts of climate change on the Queensland economy.

We would very much value your assistance as an expert for QCC to address issue **1**, in particular the likely ecological impacts of global warming and climate change on the Wet Tropics World Heritage Area.

### **Documents**

We refer you to the following documents:

1. The Land and Resources Tribunal Guidelines for expert witnesses (Practice Direction No 11 of 2000) – available at <http://www.lrt.qld.gov.au/LRT/proceedings/pd11.htm> .
2. The objection dated 7 November 2006 lodged by QCC – available at <http://www.envlaw.com.au/newlands1.pdf>.
3. Directions made by the Land and Resources Tribunal on 27 November 2006 – available at <http://www.envlaw.com.au/newlands2.pdf>.
4. *Factual and Legal context of the QCC objection in the Queensland Land & Resources Tribunal to the Newlands Coal Mine Expansion* prepared by Chris McGrath, barrister – supplied by email.

### **Timeframe**

There is a very tight timetable for the proceedings as follows:

1. Experts’ affidavits are to be filed by **15 January 2007**;
2. Experts within similar field of expertise are to confer by **18 January 2007** with a view to resolving or narrowing any matters upon which they disagree;

***Environmental Defenders Office (Qld) Inc.***

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3. Experts within similar field of expertise are to file and joint report by **22 January 2007** setting out the matters upon which they agree and any matters upon which they disagree, and the reasons for any disagreement;
4. The matter is set down for hearing in the Land and Resources Tribunal over three days commencing **31 January 2007**.

It may well be that the other parties will not rely on evidence from experts within your area of expertise and there will be no need for a joint meeting or joint report. At this stage, we do not know whether you will be required for cross-examination.

**Your duty to the Tribunal**

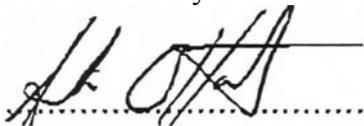
We emphasise that, in accordance with the Tribunal's guidelines for expert witnesses:

- You have overriding duty to assist the Tribunal on matters relevant to your area of expertise;
- You are not an advocate for QCC; and
- Your paramount duty is to the Tribunal and not to QCC.

We also emphasise that neither QCC nor its lawyers seek to influence your views in any way and we ask for your independent opinion to assist the Tribunal. Consequently, please note that any statements of fact or opinion in this letter of instructions, the above documents, or anything given or said to you by QCC or its lawyers relevant to the issues in your report do not constrain you in any way and are not intended to influence your views. We ask you to form your own opinion about the relevant facts and circumstances for the purposes of your report.

If you have any queries, please do not hesitate to contact me on (07) 3289 7991.

Yours sincerely

A handwritten signature in black ink, appearing to be 'A. O'Hart', written over a horizontal line that extends to the right. Below the line is a dotted line.

Anita O'Hart  
Solicitor

Environmental Defenders Office (Qld) Inc

## APPENDIX 2

### CURRICULUM VITAE

#### Dr Stephen (Steve) E. Williams

**Address:** Centre for Tropical Biodiversity & Climate Change Research  
 School of Tropical Biology  
 James Cook University, Townsville, QLD, 4811, Australia  
**Ph:** (07) 47815580 (intl: -61-7-47815580)  
**Fax:** (07) 47251570  
**E-mail:** stephen.williams@jcu.edu.au

**Date & place of birth:** 4 July 1962, Charters Towers, Queensland, Australia

#### CAREER SUMMARY:

- Current:** **Director, Centre for Tropical Biodiversity & Climate Change Research.**  
**Queensland Smart State Senior Research Fellow (Acad. Level D)**  
**Project Leader (Marine & Tropical Science Research Facility, Proj. 2.5ii4) Impacts of - climate change on biodiversity.**
- 2005** **Principal Research Fellow / Project Leader – Rainforest-CRC**
- 2002-2004** **Senior Research Fellow – Rainforest-CRC**
- 2001-2003:** **Associate Editor *Austral Ecology***
- 2000-2002:** **Senior Research Fellow (Academic level B)(ARC post-doctoral fellowship with JCU supplement) with Prof. C. Moritz (University of California - Berkeley), Prof. S. Hubbell (Princeton University), Prof. J. Endler (Santa Barbara University), and Dr. C. Johnson (James Cook University) examining determinants of biodiversity and spatial scale.**
- 1999-2002:** **Project Coordinator** of Rainforest CRC project examining the determinants of rarity.
- 1999:** **Research Fellow (Academic Level B)** with Rainforest CRC biodiversity project.
- 1997 – 1999:** **Post-Doctoral Fellow** with Rainforest CRC (academic level A).
- 1998:** **Awarded PhD** from James Cook University “Vertebrate Biodiversity & Assemblage Structure in the Australian Wet Tropics”.
- 1994 - 1997:** **Research Officer:** Reviewing patterns of vertebrate biodiversity in Australia's wet tropics for the Rainforest CRC.
- 1992 - 1998:** PhD studies (APA Priority scholarship) on the patterns of vertebrate diversity in the Wet Tropics (1995-1998 part-time).

**1990:** Honours degree in Zoology, JCU. The interactive relationship between vegetation and the structure of the small mammal community of the tropical rainforest ecotone.

**1990-current: Ecological Consultant / Expert Reviewer (vertebrate fauna).**  
 Numerous environmental impact assessment consultancies involving a wide range of habitats, fauna, geographic areas and types of impacts, including: rainforest, freshwater, open forest, brigalow, woodland, mountain tops, grasslands, and arid woodland/spinifex habitats.

#### **PUBLICATIONS:**

#### **IN PREPARATION (only included if manuscript is well under way):**

**Williams S.E.** & Shoo L. Potential for increasing productivity to alleviate climate change impacts on biodiversity *Nature / Science*

**Williams S.E.**, Williams Y., Shoo L.P., Johnson C. Quantifying the dimensions of rarity: triple jeopardy and ecological compensation. *Nature / Science*

**Williams S.E.** & Yeates, D. Vertebrate / invertebrate patterns of endemism & scale  
*Ecology Letters*

**Williams S.E.** Ecological atlas of the rainforest vertebrates of the Australian Wet Tropics. Preliminary publication discussions have been with CSIRO publishers.

Austin J., **Williams S.E.** & Moritz C. Phylogeography & ecology of rainforest birds  
*Evolution*

Shoo L. & **Williams S.E.** Species richness and energy flow of rainforest birds. *Ecology Letters*

Williams Y.M., Alford R.A., **Williams S.E.** & Shoo L. Patterns of species abundance, distribution and biology in Microhylid frogs of the Wet Tropics, Australia: a review. *Australian Journal of Zoology*

#### **IN REVIEW:**

**Williams S.E.**, Middleton J. Climatic seasonality, resource bottlenecks and bird abundance: with implications for climate change impacts *Ecology Letters*

**Williams S.E.**, Shoo L., Henriod R. & Pearson R.G. Macroecology of rainforest birds in the Australian Wet Tropics bioregion: elevation, diversity, abundance, productivity and the impacts of climate change. *Ecology – currently in invited revision*

Graham *et al.* (including **Williams**). The influence of spatial errors in species occurrence data in distribution models. *J of Applied Ecology*

Wilson R., **Williams S.E.**, Yeates D. Potential climate change impacts on schizophoran flies in the rainforests of the Australian Wet Tropics. *Ecological Entomology*

#### **IN PRESS:**

Marsh H., Dennis A., Hines H., Kutt A., McDonald K., Weber E., **Williams S.E.** & Winter J. Optimising the allocation of management resources to species of wildlife. **Conservation Biology**.

Guisan, A. et al. (including **Williams**). Sensitivity of predictive species distribution models to change in grain size: insights from a multi-models experiment across five continents. **Diversity and Distributions**. (Impact factor = 3.35)

#### **PUBLISHED:**

**Williams S.E.** & Hilbert D. 2006. Climate change threats to the biodiversity of tropical rainforests in Australia. Pp. 33-52 *In Emerging Threats to Tropical Forests*. W.F. Laurance & C. Peres (eds.). Chicago University Press.

**Williams S.E.** 2006. Vertebrates of the Wet Tropics rainforests of Australia: species distributions and biodiversity. (282 pages) Cooperative Research Centre for Tropical Rainforest Ecology and Management, Cairns, Australia.  
[http://www.rainforest-crc.jcu.edu.au/publications/vertebrate\\_distributions.htm](http://www.rainforest-crc.jcu.edu.au/publications/vertebrate_distributions.htm)

**Williams, S.E.**, G. Langham and L. Shoo. 2006. Macroecology in the mountains of the Australian wet tropics: the impacts of global climate change on rainforest biodiversity, p203 *In Global change in mountain regions*, M.F. Price (ed.), Sapiens Publishing, UK, ISBN 0-9552282-2-0

Williams Y.M, **Williams S.E.**, Waycott M., Alford R. & Johnson C.J. 2006. Niche breadth and geographic range: ecological compensation for geographic rarity in rainforest frogs. **Biology Letters** 2: 532-535

Shoo, L., **Williams S.E.** & J-M Hero. 2006. Predicting and detecting impacts of climate change on montane rainforest birds in the Australian wet tropics, p.205. *In Global change in mountain regions*, M.F. Price (ed.), Sapiens Publishing, UK, ISBN 0-9552282-2-0

Elith J., Graham, C., Anderson R.P, Dudi'k M, Ferrier S., Antoine Guisan A., Hijmans R.J., Huettmann F., Leathwick J., Lehmann A., Li J., Lohmann L.G., Loiselle B.A., Manion G., Moritz C., Nakamura M., Nakazawa Y., Overton J.M., Peterson A.T., Phillips S.J., Richardson K., Scachetti-Pereira R., Schapire R., Soberon J., **Williams S.E.**, Wisz M.S. & Zimmermann N.E.. 2006. Novel methods improve prediction of species' distributions from occurrence data. **Ecography** 29(2): 129-151 (news & reviews writeup in *Nature*, most downloaded paper in Ecography history) **(Impact factor - 2.70)**

Shoo L.P., **Williams S.E.** & Hero J-M. 2006. Detecting climate change induced range shifts: where and how should we be looking? **Austral Ecology** 31:22-29 **(Impact factor = 1.77)**

Graham C., Moritz, C & **Williams S.E.** 2006. Habitat history improves prediction of biodiversity in a rainforest fauna. **Proceedings of the National Academy of Science** 103:632-636 **(Impact factor = 10.5)**

Hero J-M, **Williams S.E.** & Magnusson W. 2005. Ecological traits of declining amphibians in upland areas of eastern Australia. **Journal of Zoology, London** 267: 221-232 **(Impact factor = 1.22)** (1.22)

- Shoo L.P., **Williams S.E.** & Hero J-M. 2005. Potential decoupling of trends in distribution area and population size of species' with climate change. *Global Change Biology* **11**: 1469-1476 (**Impact factor = 4.08**)
- Shoo L.P., **Williams S.E.** & Hero J-M. 2005. Climate warming and the rainforest birds of the Australian Wet Tropics: using abundance data as a sensitive predictor of the change in total population size. *Biological Conservation* **125**: 335-343 (**Impact factor = 2.58**)
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- Kutt, A.S., Kemp, J.E., McDonald, K.R., Williams, Y., **Williams, S.E.**, Hines, H.B., Hero, J-M. and Torr, G. 2005. Vertebrate fauna survey of White Mountains National Park in the Desert Uplands Bioregion, central-north Queensland. *Australian Zoologist* **33**: 17-38
- Williams, P., Kemp, J., Parsons, P., Devlin, T., Collins, E., and **Williams, S.E.** 2005. Post-fire plant regeneration in montane heath of the Wet Tropics, north-eastern Queensland. *Proceedings of the Royal Society of Queensland* **112**: 63-70
- Winter, J.W., Dillewaard, H.A., **Williams, S.E.** and Bolitho, E.E., 2004. Possums and gliders of North Queensland: distribution and conservation status. Pp 26-50, in *The Biology of Australian Possums and Gliding Possums* ed. by R.L. Goldingay and S.M. Jackson. Surrey Beatty & Sons, Chipping Norton.
- C.D. Thomas, **S.E. Williams**, A. Cameron, R.E. Green, M. Bakkenes, L.J. Beaumont, Y.C. Collingham, B.F. N. Erasmus, M. Ferriera de Siqueira, A. Grainger, L. Hannah, L. Hughes, B. Huntley, A.S. van Jaarsveld, G.F. Midgley, L. Miles, M.A. Ortega-Huerta, A.T. Peterson, O.L. Phillips. 2004. Extinction risk from climate change is high. *Nature* 2004 430: doi:10.1038/nature02719 (**Impact factor = 29.27**)
- Cameron, A., C.D. Thomas, R.E. Green, M. Bakkenes, L.J. Beaumont, Y.C. Collingham, B.F. N. Erasmus, M. Ferriera de Siqueira, A. Grainger, L. Hannah, L. Hughes, B. Huntley, A.S. van Jaarsveld, G.F. Midgley, L. Miles, M.A. Ortega-Huerta, A.T. Peterson, O.L. Phillips, **S.E. Williams**. 2004. Will climate change catch us off guard? *Conservation in Practice* **5** (2): 28-29 (**Impact factor = 3.67**)
- Krockenberger A.K., Kitching, R., Turton, S.M.(eds) plus 12 other authors (including **Williams**). 2004. Environmental Crisis: Climate Change and Terrestrial Biodiversity in Queensland. Cooperative Research Centre for Tropical Rainforest Ecology and Management. Rainforest CRC, Cairns, QLD, Australia.
- C.D. Thomas, A. Cameron, R.E. Green, M. Bakkenes, L.J. Beaumont, Y.C. Collingham, B.F. N. Erasmus, M. Ferriera de Siqueira, L. Hannah, L. Hughes, B. Huntley, A.S. van Jaarsveld, G.F. Midgley, L. Miles, M.A. Ortega-Huerta, A.T. Peterson, **S.E. Williams**. 2004. Extinction risk from climate change. *Nature* **427**: 145-148. Cover story for 8<sup>th</sup> Jan. 2004 issue with news & views article in same issue by Pounds & Puschendorf. (**Impact factor = 29.27**; **Citations – 233 @ 10/8/06; currently the #1 “hottest paper” in environmental sciences by ISI Science Indicators**)

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- Williams S.E.** 2003. Impacts of global climate change on the rainforest vertebrates of the Australian Wet Tropics. pp. 50-52. In: Climate change impacts on Biodiversity in Australia. Howden, M., Hughes, L., Dunlop, M., Zethoven, I., Hilbert, D. & Chilcott, C. (eds.). Commonwealth of Australia, Canberra.
- Hilbert D. & **Williams S.E.** 2003. Global warming in the Wet Tropics. *Issues in Tropical Forest Landscapes*. Cooperative Research Centre for Tropical Rainforest Ecology, James Cook University, Cairns, Australia.
- Williams S.E.**, Marsh H. & Winter, J. 2002. Spatial scale, species diversity and habitat structure: small mammals in Australian tropical rainforest. *Ecology* **83 (5)**: 1317-1329 **(Impact factor = 4.51)**
- Williams S.E.** & Hero J-M. 2001. Multiple determinants of Australian tropical frog biodiversity *Biological Conservation* **98**: 1-10 **(Impact factor = 2.58)**
- Williams S.E. 2001. Invited book review: "Australian rainforests: islands of green in a sea of fire", D.M.J.S. Bowman. *Quarterly Review of Biology* **76**: 376 **(Impact factor = 7.33)**
- C. Moritz, K.S. Richardson, S. Ferrier, G.B. Monteith, J. Stanistic, **S.E. Williams** & T. Whiffin. 2001 Biogeographical concordance and efficiency of taxon indicators for establishing conservation priority in a tropical rainforest biota. *Proceedings of the Royal Society Lond. B.* **268**: 1875-1881 **(Impact factor = 3.54)**
- Williams S.E.**, Vernes K. & Coughlan J. 1999. The vertebrate fauna of Cannabullen Plateau: a mid-altitude rainforest in the Australian Wet Tropics. *Memoirs of the Queensland Museum* **43**: 849-858
- Williams S.E.** & Hero J-M. 1998. Rainforest frogs of the Australian Wet tropics: guild classification and the ecological similarity of declining species. *Proceedings of the Royal Society Lond. B.* **265**: 597-602 **(Impact factor = 3.54)**
- Williams S.E.** & Marsh H. 1998. Changes in small mammal assemblage structure across a rainforest/open forest ecotone. *Journal of Tropical Ecology* **14**: 187-198 **(Impact factor = 1.01)**

- Williams S.E.** 1998. Spatial patterns of vertebrate biodiversity and assemblage structure in the rainforests of the Australian Wet Tropics. *Australian Journal of Ecology* **23**:185-186 (Phd thesis abstract).
- Williams S.E.** 1997. Patterns of mammalian species richness in the Australian tropical rainforests: are extinctions during historical contractions of the rainforest the primary determinant of current patterns in biodiversity ? *Wildlife Research* **24**: 513-530 (**Impact factor = 0.80**)
- Williams S.E.** & Pearson R.G. 1997. Historical rainforest contractions, localised extinctions and patterns of vertebrate endemism in the rainforests of Australia's Wet Tropics. *Proceedings of the Royal Society Lond. B.* **264**: 709-716 (**Impact factor = 3.54**)
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- Williams S.E.** 1995. Measuring and monitoring wildlife communities: the problem of bias. pp. 140-144 in Conservation through sustainable use of wildlife, ed. by G.C. Grigg, P.T. Hale and D. Lunney. Centre for Conservation Biology, The University of Queensland.
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- Williams S.E.**, Pearson R.G. & Burnett S. 1993. Survey of the vertebrate fauna of the Dotswood area, north Queensland. *Memoirs of Queensland Museum* **33**(1): 361-378
- Williams S.E.**, Pearson R.G. & Burnett S. 1993. Vertebrate fauna of three mountain tops in the Townsville region (north Queensland): Mount Cleveland, Mount Elliot and Mount Halifax. *Memoirs of Queensland Museum* **33**(1): 379-387
- Couper P.J., Cohen M., **Williams S.E.** & Couper K. 1993. Reptile records for the Heathlands area, Cape York Peninsula. Cape York Peninsula scientific expedition, wet season 1992 (Vol. 2). Royal Geographical Society of Queensland, Brisbane.
- Cohen M.P. & **Williams S.E.** 1993. Frogs of the Heathlands area, Cape York Peninsula. Cape York Peninsula scientific expedition, wet season 1992 (Vol. 2). Royal Geographical Society of Queensland, Brisbane.
- Cohen M.P. & **Williams S.E.** 1993. General ecology of the Cane toad, *Bufo marinus*, and examination of their direct effects on native frog choruses at Heathlands, Cape York Peninsula. Cape York Peninsula scientific expedition, wet season 1992 (Vol. 2). Royal Geographical Society of Queensland, Brisbane.

### **Presentations:**

I am a confident and practised public speaker. During the last five years I have presented talks at more than 30 scientific meetings including many climate change impacts meetings, the IUCN World Parks Congress, Ecological Society of Australia, Association of Tropical Biology, Australian Society of Herpetology, Australian Mammal Society, Society for Conservation Biology and Rainforest CRC. Many of these have been invited and fully funded presentations (see below). I have also

presented research at various workshops, departmental seminars, CRC program meetings and other scientific / community groups (QNPWS; CSIRO; Wildlife Preservation Society).

**Invited Participation / Presentations (➔ indicates funded participation by inviting organization):**

- ➔ Southern Hemisphere Ornithological Congress (Plenary presentation), Perth 2007.
- ➔ Presidential Forum: International Ornithological Congress, Hamburg, Aug. 2006.
- ➔ Smithsonian Tropical Research Institute, Panama, 11-19 Oct. 2005. Macroecology and climate change in Australian tropical rainforests
- ➔ Global Environmental Change & Biodiversity, Paris, May 2005. International workshop funded by UNEP, Diversitas & TERRAC.
- ➔ Intergovernmental Panel on Climate Change (IPCC) authors meeting, Canberra, April 2005.
- ➔ IPCC authors meeting, Cairns, March 2005.
- ➔ Adelaide University / SA Museum, Aug 2004: Impacts of global climate change on the macroecology of the Australian Wet Tropics
- ➔ CSIRO /ANIC, Canberra, June 2004: Impacts of global climate change on the macroecology of the Australian Wet Tropics
- ➔ IUCN, Gland Switzerland, Sept. 2004: meeting to write policy documents on nature conservation and climate change impacts.
- ➔ Wet Tropic Management Authority board meeting: "Climate change impacts in the Wet tropics World Heritage Area" June 2004
- ➔ Okazaki Biology Conference Japan, Jan. 2004: "The Biology of Extinction",
- ➔ IUCN World Parks Congress, Durban, South Africa, Sept. 2003: Address on the impacts of climate change on biodiversity.
- Global Change - Biodiversity and ecosystem drivers symposium, Southern Connections Conference, Cape Town, South Africa, 19-23 January 2004
- Emerging threats to tropical forests symposium, Assoc. of Tropical Biology, Aberdeen June 2003.
- ➔ Impacts of Climate Change on Biodiversity Workshop, Brisbane July 2003, Premiers Department.
- ➔ Global Climate Change and Biodiversity April 2003, Norwich, England (UNEP funded)
- ➔ Scientific advisory committee NHT 2 Wet Tropics planning
- ➔ Scientific advisory panel for Wet Tropics Management Authority regional planning
- ➔ Spatial modelling of species distributions (National Centre for Ecological Analysis and Synthesis (NCEAS), Santa Barbara – workshosp 2002-2004).
- ➔ Committee to address the national objectives on preserving biodiversity and to advise the commonwealth minister on climate change impacts. Workshop funded by the Biological Diversity Advisory Committee. (Canberra, Sept/Oct. 2002). Published report (see publications).
- "Rarity & biodiversity in the Australian Wet Tropics", U. of California, Santa Barbara, 2002.
- ➔ "Impacts of Global Warming on biodiversity", U. of California, Berkeley, USA, 2002.

**Policy Involvement:**

- Invited expert reviewer: IPCC 4<sup>th</sup> Assessment Report on the impacts of climate change
- Invited member of the GBRMPA climate change vulnerability advisory committee
- IUCN Nature Conservation and climate change
- Birdlife International – State of the Worlds Birds report 2004
- Invited comments on “Consultation paper: Developing a National Biodiversity & Climate Change Action Plan” by the National task group on Climate Change Impacts on Biodiversity
- “Daintree Group” report to the Premiers department on the impacts of climate change on Queensland's biodiversity
- State of the Wet Tropics report 2003
- Wet Tropics Conservation Strategy 2003/2004
- Vertebrate biodiversity of the Wet Tropics to the “Biological Diversity Chapter” of the Queensland State of the Environment Report to the Minister, Department of Environment, Brisbane
- “The 1996 Action Plan for Australian Marsupials and Monotremes”, (eds) S. Maxwell, A.A. Burbidge & K. Morris, Wildlife Australia, Dept. of Environment, Canberra, Australia.

### **Unpublished reports**

Numerous reports pertaining to consultancy and environmental impact assessments, reviews of reports, fauna surveys etc.

### **Popular articles**

Cohen M.P. & **Williams S.E.** 1993. Most Creatures Moist or Scaly. *Wildlife Australia*, 30(1):10-13.

### **SUPERVISION EXPERIENCE:**

- Five current post-docs: Dr Gary Langham (NSF Bioinformatics post-doc funding); Dr Jason Mackenzie based at Vert Museum Berkeley (NSF funded collaboration with Prof Craig Moritz); Dr Joanne Isaac (RAP grant – Extinction proneness); Dr Rebecca Fisher (GLM models of species abundance); Dr Brett Goodman (spatial and evolutionary patterns of species morphology)
- Two completed and six current PhD students.
- Four completed Honours students
- Five completed & one current Masters students

### **TEACHING EXPERIENCE (UNDERGRADUATE):**

- Guest lectures in several third year subjects: “Community Ecology” (1995-2002); “Australian Vertebrate Fauna”(1996-2003); “Wildlife Ecology & Conservation” (1995-1996); “Conservation Biology” (2002-2004); “Biometrics” (2002).
- Approximately one third of a second year course “Tropical Animal Biodiversity” including eight lectures, two tutorials and two practicals on defining and measuring biodiversity. (1999 & 2000)

- Lecture series on the evolution and biogeography of Australian mammals in “Australian Vertebrate Fauna” (1997; 2002).
- Several lectures on bird ecology for “Australian Vertebrate Fauna” (1998, 1999, 2000).
- Tutor on “Australian Vertebrate Fauna” field trips including involvement in all aspects of planning and execution of the trip (1995-2002). I coordinated the trip on three occasions (1997/1998/1999) including all aspects of staff, student exercises, timetables and logistics.
- Tutor on five separate years for second year zoology field camp (mammals, birds, reptiles).
- Tutor for third year “Wildlife Ecology & Conservation” (all terrestrial vertebrates) over five consecutive years (1991-1996): practical demonstrating, preparation and delivery of tutorials, and field trips.
- Tutoring second year ecology classes on the description and characterisation of faunal communities.
- Tutoring second year ecology classes on population regulation.
- Tutor in Biometrics (2 years).
- Demonstrating in 2nd year zoology laboratory classes.

#### **ECOLOGICAL CONSULTANT (1990 – 2004):**

Numerous environmental impact assessment consultancies involving a wide range of habitats, fauna, geographic areas and types of impacts, including: rainforest, freshwater, open forest, brigalow, woodland, mountain tops, grasslands, and arid woodland/spinifex habitats. Surveys and assessments have predominantly involved the terrestrial vertebrate fauna but have included freshwater invertebrates, fish and invertebrate surveys. Output has included numerous unpublished reports and contributed to five refereed publications in professional journals.

#### **FIELD WORK EXPERIENCE:**

I have extensive field experience in many aspects of field ecology gained from over 17 years of field work including: field surveys of terrestrial vertebrates and invertebrates in association with research on biodiversity, climate change, rarity, environmental impact assessments, teaching wildlife ecology and surveys of remote areas of the Wet Tropics. I have generally led these trips and been responsible for sampling methodology, staff, logistics and dissemination of results. All of my research has involved intensive field work throughout the Wet Tropics and some special expeditions including:

- 2000** Hinchinbrook Uplands scientific expedition: I proposed, designed, organised funding and logistics of an extensive survey of the islands uplands. Funding amounting to over \$20 000 was raised from a variety of sources to fund the three week long expedition of 14 people.
- 1993** Vertebrate fauna survey of Cannabullen National Park. The survey was proposed, designed and led by myself. The funding came from the Wet Tropics Management Agency and Australian Geographic. The survey of Cannabullen plateau (mid-elevation undisturbed rainforest) was conducted by a six person field team with the gear being lifted in by helicopter. Field time : 20 days

- 1991** Vertebrate fauna survey of the Townsville Field Training Area (Dotswood Station)(TFTA) as consultant vertebrate ecologist. Sampling included a wide variety of habitats from dry woodland to rainforest. I had complete responsibility for designing and implementing the sampling program, logistics and personnel. Field time : 80 days
- 1990 - 1991** Vertebrate fauna surveys of mountaintops (Mt Elliot, Mt Halifax, Mt Cleveland) as consultant vertebrate ecologist. My responsibilities and the techniques employed were similar to the TFTA survey, with the additional requirement of organising helicopter support to lift equipment into the sites. Field time : 60 days

### **PROFESSIONAL SOCIETIES**

Ecological Society of Australia; Ecological Society of America; Association of Tropical Biology; Society for Conservation Biology; Australian Mammal Society; Australian Herpetological Society; Birds Australia

### **OTHER PROFESSIONAL SKILLS:**

Fauna survey techniques; 'A' class bird banding licence; Computer skills (programming, wordprocessing, databases, spreadsheets, statistical packages and graphics.); Bio-statistics; Vegetation analysis; Scuba Diving open water; Heavy Rigid driving licence.

### **OTHER WORK EXPERIENCE:**

Computer programmer for Planet Home P/L, Townsville for 2 years.  
Assistant manager of Townsville branch of Dick Smith Electronics for 8 months.  
Owner/operator of ecotourism business for 2 years.

### **INTERESTS:**

Wildlife photography, bushwalking (previous president of Townsville Bushwalking club and leader on numerous club walks), skydiving, rock climbing, white water rafting, diving, travel (previously travelled in Europe, Nepal, USA, New Zealand, Africa, Central America and South-east Asia).

### **REFEREES:**

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