BEFORE THE OTAGO REGIONAL COUNCIL
AT DUNEDIN

Under the	Resource Management Act 1991
In the Matter of	Proposed Otago Regional Council's Draft Regional Policy Statement

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STATEMENT OF EVIDENCE OF WILLIAM GEORGE LEE
IN SUPPORT OF SUBMISSIONS BY THE WISE RESPONSE SOCIETY INC.

BACKGROUND

1. My full name is William George Lee

2. I am a Principal Scientist with Landcare Research, the Crown Research Institute responsible for terrestrial biodiversity and land resources, based in Dunedin. I also employed part-time as Professor of Ecology, School of Biological Sciences, University of Auckland. I have B.Sc and PhD degrees, specialising in plant-soil interactions in native ecosystems, from the University of Otago where I currently hold the position of Honorary Professor.

3. I have published over 175 peer-reviewed formal articles in refereed international and national science journals and written over 100 client-related reports for local and central government, major companies and community groups. I have been involved in initiatives developing national biodiversity assessment indicators, the application of biodiversity offset frameworks and the implementation of effective biodiversity policy.

4. My research interests are in the ecology of native communities over short (historical) and long (evolutionary) time periods, the adaptation of plants to shifting disturbance regimes and the presence of invasive species associated with global change.

5. I have read the Code of Conduct for Expert Witnesses, and agree to comply with it.

6. I confirm that the issues addressed in this brief of evidence are within my area of expertise.

ECOLOGICAL SECURITY IN A CHANGING ENVIRONMENT

SUMMARY POINTS

7. Rates of biodiversity habitat loss in Otago place at risk valued ecosystem services, particularly water quantity and quality, and having a representative protection system. A precautionary approach to vegetation clearance and land-use intensification will assist to sustain these values.

8. Enhancing indigenous biodiversity will improve ecosystem resilience and sustain primary production and tourism as critical components of the Otago economy.

CONTEXT

9. I am familiar with the indigenous biodiversity and the environments of Otago, the dynamic character of ecosystems, the different approaches for evaluating biodiversity change and the range of threats driving biodiversity loss.

10. My comments are based on my research and understanding of the relevant scientific literature for Otago, nationally and internationally.

MECHANISMS OF BIODIVERSITY CHANGE IN OTAGO

11. Our understanding or the potential effects of global climate change on New Zealand's terrestrial biodiversity were summarised in 2011 in a report for the Department of Conservation by Matt McGlone and Susan Walker of Landcare Research (http://www.doc.govt.nz/Documents/science-and-technical/sfc312entire.pdf).

12. Rising mean and particularly winter temperatures, rising sea levels (at least 1-2 m over the next century), increasing precipitation along the main axial ranges, reduced rainfall in eastern and northern areas, and more regular extreme events, all threaten sustaining indigenous and production ecosystems regionally.

13. Terrestrial biodiversity declines in New Zealand are currently driven by mammalian predation (everywhere) and habitat loss (lowland-montane and coastal) and this pattern occurs in Otago.

14. Over recent decades, warmer temperatures, particularly winters, are expanding predator ranges (increasing altitudinal rat line) and increasing densities, impacting both meso-predators and top predators. This will make predator elimination and control strategies more challenging while increasing loss rates of vulnerable native birds, lizards and invertebrates. Mega-mast flowering in beech and tussock biomes may further exacerbate predator numbers and impacts, although there is debate about the likelihood of this occurring.

15. Climate change (particularly increasing temperatures) may constrain the ability to manage rabbits and other invasive mammalian pests by directly disrupting optimal strategies for control. A recent publication (Latham et al. 2015) based on climate changes recorded at Cromwell shows how a trend towards warmer winters over the past >60 years has significantly reduced the effective window for controlling rabbits in New Zealand. Currently, optimal control is achieved outside of their main breeding season (spring to early summer) when they are least territorial and food is limiting. Warmer winters may change both the duration of the breeding season and the pattern of food availability, thereby reducing the effectiveness of current control strategies. Climate change may thus exacerbate the unwanted impacts of invasive pest species by reducing our ability to manage them effectively.

16. Habitat loss is currently most rapid via agricultural intensification (especially in Threatened Environments where little indigenous biodiversity remains or is protected), and there is concern that mitigation efforts around expanded agriculture and plantation forestry, particularly water

abstraction, will further reduce native habitats. In addition, the coastal squeeze where rising sea-levels hit against hard infra-structure is also displacing native habitats.

17. Further losses of indigenous biodiversity in Otago will increase nutrient concentrations, suspended sediment and impact water colour and quality, especially in catchments naturally supporting tussock cover (Galbraith and Burns 2007). Intensification of agriculture in North Otago, for example, and adopting current best practice, is unlikely to limit nitrogen and phosphorus losses into rivers (McDowell et al. 2011), indicating that alternative options are currently required to sustain water quality.

18. New Zealand is experiencing some of the effects of global climate changes. For example, a global analysis of phenological changes in vegetation based on remotely sensed absorption of photosynthetically active radiation (Normalised Difference Vegetation Index) revealed strong shifts in the vigour of southern hemisphere forests, including those in New Zealand (Buitenwerf et al. 2015). Across ecosystems they indicate increasing productivity, an extended growing season and greater seasonality.

19. Globally, forests are a major carbon sink, sequestering 26% of fossil fuel emissions. In New Zealand, with increased temperature, annual wood production could increase by 6-23% depending on rainfall, mostly confined to cool mountain environments. Maximum productivity and therefore carbon sequestration gains will require spatial shifts in structure and composition. Overall, the adjustment speed to temperature and rainfall shifts will depend on disturbance frequency.

20. International evidence suggests that post-industrial atmospheric carbon-dioxide increases are improving conifer forest productivity amongst older trees where rainfall is not limiting. In contrast, widespread growth-declines are occurring in drought-prone areas (Camarero et al. 2015) with continental climates, similar to Central and parts of Eastern Otago.

21. We currently do not understand how global-change processes impact the spread of wilding conifers in Otago but there is strong evidence for depleted water availability in catchments where *Pinus* species are displacing indigenous tall tussock grassland in eastern Otago.

22. Freshwater systems are vulnerable to water warming where unbuffered by forest. Temperatures above 22 C may be lethal for stoneflys and eel migration. These habitats will also face more invasive fish and plant species from subtropical climates and will experience lower habitat quality in eastern catchments reflecting declining water flows from reduced precipitation and water abstraction for agriculture.

23. Marine ecosystems changes are already occurring but the system is complex, depending on currents, Southern Oscillation Cycles etc. Most

noticeable are recent declines in seabirds, including wandering albatross, red-billed gulls and titi. For some of these fishing is possibly a factor, but not all. A common influence seems to be the lower availability of krill or other food sources associated with locally warmer nutrient-poor surface water created by changing ocean currents.

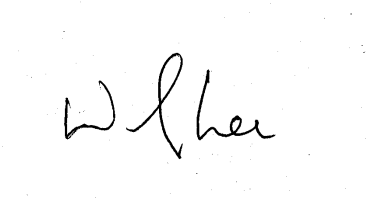
24. Although there are few intrinsic constraints for indigenous biodiversity in the most realistic climate change scenarios over the 21st Century for New Zealand, range readjustment to accommodate climate shifts are nowadays complicated by habitat fragmentation restricting migration and lack of suitable warm climate-adapted taxa to occur in northern areas.

25. Conversely, many current and potential invasive species, both plant and animals, and including pathogens and diseases, will have increased opportunities in a warmer-climate New Zealand.

CONCLUSIONS THAT CAN BE DRAWN FOR OTAGO

26. There is much uncertainty about the impacts of environmental change on indigenous biodiversity and the ecosystem values they provide. Overall biodiversity will adapt to respond as the environmental profile of Otago shifts but critical thresholds may be crossed for some species and ecosystems when multiple stressors occur.

27. However, over this century many of these environmental changes will exacerbate existing threats associated with predator pressure and habitat loss, and increase the potential for new invasive species. These trends and importance of biodiversity/ecosystem function require changes to current resource management practices if important ecosystem services and natural values are not to be lost. Given the inherent uncertainties and non-linear responses associated with biological systems, precaution will be required.



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William George Lee

Date: 23rd November 2015

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