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Effects of global warming on our native biodiversity

New Zealand's Climate Change Commitment

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My research interests in climate centre on understanding the response of the indigenous biota to climate changes over the past 40 million years and to ways in which modern plants adapt to climate along resource availability gradients.

Our understanding or the potential effects of climate change on New Zealand's terrestrial biodiversity were nicely 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).

On the climate side, we are looking at 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, and reduced rainfall in eastern and northern areas, and more regular extreme events.

- Terrestrial biodiversity declines in New Zealand are currently driven by mammalian predation (everywhere) and habitat loss (lowland-montane and coastal).
    - 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.
    - Habitat loss is currently via agricultural intensification (especially in threatened environments where little indigenous biodiversity remains or is protected), and there is concern that climate-change mitigation efforts around expanded plantation forestry hydro-electricity and 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.
- New Zealand is experiencing some of the effects of global 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.

- 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.

- 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.

- 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 (9), including wandering albatross, red-billed gulls and titi. In 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.

- Although there are few intrinsic constraints for indigenous biodiversity in the most realistic climate change scenarios 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.

- 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.

- Overall biodiversity is and will change to respond as the climate profile of New Zealand shifts. However, little of this is outside of the evolutionary climate envelope for most species. Climate change will exacerbate existing threats associated with predator pressure and habitat loss, and increase the potential for new invasive species. We need to maximise opportunities to maintain native dominance in systems and this could involve assisted migration and protection against ecosystem transformation, although these approaches would only be a sustainable option for very small areas.

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