AN APPROACH TO ASSESSING AND MANAGING CLIMATE CHANGE IMPACTS ON TERRESTRIAL BIODIVERSITY

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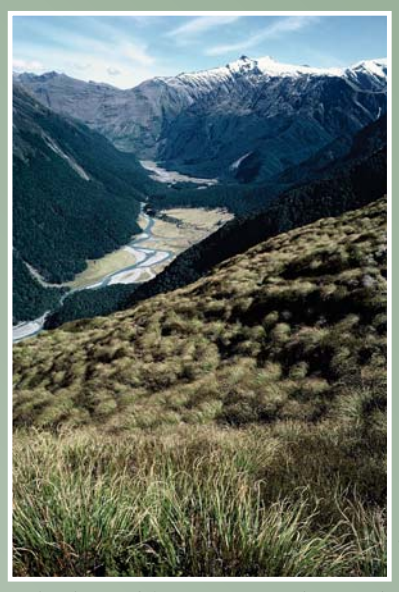
How will climate change impact on native biodiversity?

The current geographical range of New Zealand's native terrestrial species and ecosystems reflects the underlying environmental factors—including climate—and human-related impacts (such as pests, weeds and loss of habitat). These existing impacts have put many species and ecosystems under pressure. Climate change is expected to add to these, particularly where existing impacts are greatest, and where species already occupy small ranges, or are highly specialised, although uncertainty surrounds how individual species and ecosystems will respond.

McGlone (2001) identified five main types of climate change impacts on New Zealand's native biodiversity. These are:

1. Range changes southwards in latitude and upwards in altitude.
2. Changes in timing and frequency of annual and seasonal events.
3. Changes in species abundance and diversity.
4. Increased frequency of incursion events by damaging weeds, animal pests and diseases.
5. Loss or irreversible damage to native species and ecosystems from increased frequency of extreme events, such as drought, fire and storms.



C. Rudge

Reduced range of alpine ecosystems and associated loss of endemic plants and invertebrates due to rise in native tree line and increased weed pressure from wilding pines and other woody weeds.

T. Perrett

Changes in freshwater fish (e.g. *Galaxias* spp., Canterbury mudfish (*Neochanna burrowsius*)) and invertebrate distribution and abundance due to drying and warming of streams, rivers and wetland ecosystems.

How can we assess and manage the adverse impacts of climate change?

Climate change will exacerbate many of the management issues that the Department of Conservation (DOC) and other biodiversity managers already face. In order to help to manage the impacts of climate change, DOC has initiated research to identify the likely impacts, and their magnitude. Our research will address the following questions:

1. What are the likely impacts of climate change on terrestrial native biodiversity?

To answer this, we are developing a representative list of impacts and classifying each impact by ecosystem type, climate change drivers, mechanistic influence, impact for management and, finally, outcome for native biodiversity.

2. How large will these impacts be for each component of biodiversity affected?

We have developed the following function to assess the relative size of each impact on specific native species and ecosystems. This scoring approach allows impact assessment to be explicit, auditable and repeatable, and will allow us to identify the most serious impacts, and those that require urgent management and/or research:

$$\text{Impact} = \text{Likelihood} \quad (\Delta\text{Area} + \Delta\text{Biodiversity})$$

Likelihood:
An estimated probability value (0.0–1.0) based on the IPCC (2007) probability classifications.

Area:
Proportion (0–100%) of the total area (km) of the species or ecosystem affected by the impact.

Biodiversity:
Proportion (0–100%) of the taxa or ecosystem of interest affected. Calculated by assessing the difference between before (Time 1) and after (Time 2) the climate change impact.

J. L. Kendriek

Declines in breeding success of some sub-antarctic species. This is being experienced already, e.g. rockhopper penguins (*Eudyptes chrysocome*) have declined by 90% on Campbell Island/Motu Ihupuku.

Interpreting the equation scores:

- The larger an impact's score, the larger its affect on native biodiversity.
- The scores allow the impacts to be ranked relative to each other, irrespective of spatial scale and the number of species affected.
  - An impact that affects an entire ecosystem or removes an entire species/population of interest will get a high score, especially if the probability of the impact occurring is high.
  - An impact that affects just part of an ecosystem or a proportion of a species or population of interest will get a lower score, although this score will increase if the probability of the impact occurring is high.

3. How can climate change impacts be managed?

The climate change impacts identified in the first part of the study will be categorised into three groups according to our ability to manage them:

Manageable, using currently utilised tools and techniques
- This group includes impacts such as increased frequency of predator irruptions, weed spread and habitat fragmentation.

Manageable, but require new techniques and research
- This group includes impacts where management of whole populations will be needed to mitigate changes in range, altered timing of breeding etc. Examples of management actions include translocation, artificial habitat modification and supplementary feeding.

Unmanageable
- This group includes impacts such as changes in native forest composition, shifting tree line and increased mast (mass seed production) frequency for which we have no practicable means of management.

G. H. Sherley

Loss of species endemic to New Zealand at a family level, such as tuatara (*Sphenodon* spp.) and native frog species (*Leiopelma* spp.) which have adapted to specific climatic conditions and are therefore extremely sensitive to changes in climate.

L. Forester

Reduced range of coastal wetlands and associated plant species (e.g. mangroves (*Avicennia marina australasica*) and salt marsh species) as a result of sea level rise.

K. Smith

Changes in forest composition and regeneration trajectories. If the effect is at seedling level, the changes will be gradual, but if adult trees are affected, the response will likely be major and immediate, resulting in loss of forest dominants, and canopy collapse.

Future project directions

- Integrate the climate change impacts and magnitude results into DOC planning and management systems.
- Commence case studies on the climate change impacts predicted to be of high magnitude.
- Develop indicators/measures to verify that climate change is impacting on native species and ecosystems.

P. Morrison

Population decline in red-billed gull (*Larus novaehollandiae scopulinus*) has been linked to the effect of climate change on food availability.

References

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