The Latitudinal Gradient Project
– Celebrating 5 Years of Integrative Research

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Objectives

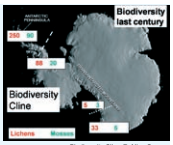
- Increase our understanding of the complex marine, terrestrial and freshwater ecosystems that exist along the Victoria Land coast of the Ross Sea region
- Determine the effects of environmental change on these ecosystems

Key Questions and Research Examples

General Hypothesis: Ice-driven dynamics control the structure and function of ecosystems (marine, terrestrial and freshwater) along the latitudinal gradient encompassed by the Victoria Land coast

Brown = Terrestrial Research
Blue = Marine/Aquatic Research
Green = Climate Research

1 How does ecosystem structure and function change with latitude, and why?



Biodiversity Cline © Allan Green

- Lichen species numbers are high in the maritime Antarctic but relatively constant and low on the continent. There is no apparent cline in species number in the Ross Sea area (Allan Green).
- Characteristics of marine benthic communities along the Victoria Land coast link to differences in ice conditions between locations (Vonda Cummings).


Cape Evans © Rod Budd, NIWA


Spike Cape © Rod Budd, NIWA

2 What is the role of persistent, large-scale ice structures in defining community composition?

- Springtails are limited in dispersal: 10 species are found along the Victoria Land gradient in 3 main areas with different species in each area. However, recent data indicate much greater levels of genetic diversity within species in northern Victoria Land than previously found in those further south (Ian Hogg and Mark Stevens).
- B-15 iceberg had a significant negative impact on the Adélie penguin demographic rates and foraging behaviour in the southern Ross Sea (Phil Lyver).

3 How do snow and ice dynamics influence ecosystems and ecosystem processes?

- Fungi living in Antarctic soils have a higher abundance and diversity when soil moisture levels are relatively higher (Roberta Farrell).
- In aquatic meltwater ponds, organisms themselves affect the environment through their productivity, e.g. by raising the pH and dissolved oxygen concentrations through photosynthesis (Brian Sorrell and Ian Hawes).

4 How does climate affect the availability and composition of free water?

- Moisture in the form of blowing snow is available to wet rock surfaces more often than had previously been supposed, even during times of negative rock temperatures (Christine Elliott).
- Nitrate and calcium concentrations of inland and coastal aquatic meltwater ponds are observed to increase both with latitude and with distance from the coast (Jenny Webster-Brown).

5 How does climate affect the predictability, persistence and extent of sea ice cover?

- Methane Sulfonate concentration in ice core samples derived from the Ross Sea region are shown to be correlated with sea ice extent, making it a valid proxy to reconstruct sea ice extent in the past (Nancy Bertler).

6 How are key marine biological processes influenced by sea ice conditions?

- No distinct interannual differences in the composition of the marine meroplankton community at sites studied along the Victoria Land coast for two consecutive seasons were observed within sites, but significant differences were observed between sites (Mary Sewell).
- Low salinity, high visible and UVB radiation, and changing temperatures impact the productivity of sea ice microbial communities and this may influence summer bloom events (Ken Ryan).

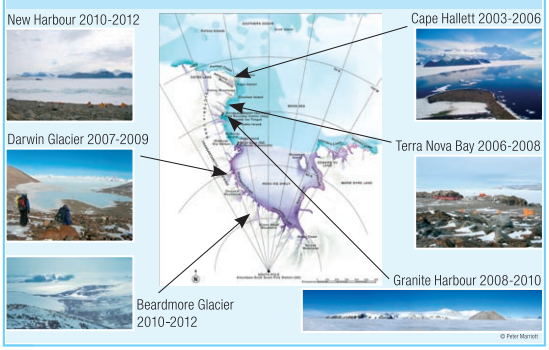
7 How does soil development influence terrestrial ecosystems?

- Soils at Cape Hallett are strongly affected by the penguin population, with high phosphorous levels that are not seen at many sites further south (Jackie Aislabie).
- Distribution of metazoan and microbial communities in Northern and Southern Victoria Land are linked to the source of organic matter and soil geochemistry - penguin rookery soils have distinct, low-diversity soils relative to nearby soils with no marine influences (Jeb Barrett, Byron Adams, Craig Cary, Ross Virginia and Diana Wall).

8 To what extent are past conditions preserved in paleoindicators?

- Snow pit analysis was undertaken on the Towles Glacier (south of Cape Hallett) to ascertain snow accumulation rate and isotopic ratios and relate these to actual temperature records from Cape Hallett. Results pending. (Berry Lyons, Andrew Fountain).
- Antarctic scallops and other calcium carbonate-utilising species are used as proxies of the isotopic ratios present in water masses at the time of shell deposition (Mariachiara Chiantore).

LGP Study Sites



Outcomes

1. 70 LGP-related publications since 2006 (incl. 2006 Special LGP Edition of *Antarctic Science*).
2. 24 participating scientists from New Zealand, Italy and USA (and growing!).
3. Baseline data sheets for all sites; Metadata submitted to Antarctic Master Directory.
4. LGP website: **www.lgp.aq** outlines LGP hypothesis and goals, contains links to site information, data, researchers, meetings, conferences, publications.
5. Major contributor to SCAR's 'Evolution and Biodiversity in the Antarctic' programme.

LGP Projects and Participants

Marine Research

Gene Drift in Ross Sea Organisms (Craig Marshall, University of Otago, NZ)

Patterns in the Abundance of Ross Sea Meroplankton (Mary Sewell, University of Auckland, NZ)

Sea Ice Algal Productivity (Ken Ryan, Victoria University of Wellington, NZ)

Coastal Benthic Ecosystem Structure and Function (Vonda Cummings & Simon Thrush, National Institute of Water and Atmospheric Research, NZ)

Lipid Metabolism and Adaptation in Antarctic Fish (Victoria Metcalf, Lincoln University, NZ)

Benthic Community Structure and Dynamics (Riccardo Cattaneo-Vietti, Università di Genova, Italy)

Echinoderm and Mollusc Ecology (Mariachiara Chiantore, Università di Genova, Italy)

Adélie Penguin Population Dynamics (Phil Lyver, Landcare Research, NZ & David Ainley, H.T. Harvey & Associates, USA)

Terrestrial Research

Natural Spatial Subsidies in Soils (Ashley Sparrow, University of Canterbury, NZ)

Predicting Terrestrial Biocomplexity (Craig Cary & Allan Green, University of Waikato, NZ; & Bryan Storey, University of Canterbury, NZ)

Soils of Ice-Free Regions (Jackie Aislabie, Landcare Research, NZ)

Soil Biodiversity (Diana Wall, Jeb Barrett & Byron Adams, Long Term Ecological Research project, USA)

Inland Aquatic Ecosystems (Brian Sorrell & Ian Hawes, National Institute of Water and Atmospheric Research, NZ; and Jenny Webster-Brown, University of Auckland, NZ)

Evolution and Dispersal of Algae (Phil Novis, Landcare Research, NZ)

Biodiversity and Performance of Lichens and Mosses (Allan Green, University of Waikato, NZ)

Biology of Antarctic Springtails (Brent Sinclair, University of Nevada, USA)

Vegetation Community Monitoring (Nicoletta Cannone, Università Milano Bicocca, Italy)

Physical Rock Weathering (Christine Elliott, University of Canterbury, NZ)

Ecosystem Functioning of Terrestrial Microorganisms (Roberta Farrell, University of Waikato, NZ & Robert Blanchette, University of Minnesota, USA)

Terrestrial Biodiversity of Southern Victoria Land (Ian Hogg, University of Waikato, NZ & Mark Stevens, Massey University, NZ)

Climate Research

NZ International Trans Antarctic Scientific Expedition (Nancy Bertler, Victoria University of Wellington, NZ)

Snow Pit and Automatic Weather Station analysis (Berry Lyons & Andrew Fountain, Long Term Ecological Research project, USA)

Various Automatic Weather Station data collection projects (Italy, US, NZ)