

## The Latitudinal Gradient Project (LGP): Summary of progress to date and proposed activities

Shulamit Gordon<sup>1</sup> and Megan R. Balks<sup>2</sup>

<sup>1</sup>Antarctica New Zealand, Private Bag 4745, Christchurch, New Zealand ([s.gordon@antarcticanz.govt.nz](mailto:s.gordon@antarcticanz.govt.nz))

<sup>2</sup>Earth and Ocean Sciences, University of Waikato, Private Bag 3105, Hamilton, New Zealand ([m.balks@waikato.ac.nz](mailto:m.balks@waikato.ac.nz))

**Summary** The Latitudinal Gradient Project (LGP) is a framework for interdisciplinary and international work towards the common goals of understanding the complex marine, terrestrial, and freshwater ecosystems that exist along the Antarctic latitudinal gradient, and determining the effects of environmental change on Antarctic ecosystems. Development of the LGP framework was prompted by Antarctic scientists who identified the need for co-ordinated research along the latitudinal gradient. The LGP is currently working towards study of five sites along the Victoria Land coast. The information gained will increase our understanding of polar ecosystems and help create a predictive knowledge of the effects of environmental change on these ecosystems. The LGP's success is dependent on the interdisciplinary aspects of the project and the interaction of researchers at each site. Researchers are welcome to join LGP and contribute to extension of the LGP to other regions of the Antarctic continent. Further information is available at [www.lgp.aq](http://www.lgp.aq).

**Citation:** Gordon, S., and M.R.Balks (2007), The Latitudinal Gradient Project (LGP): Summary of progress to date and proposed activities: *in* Antarctica: A Keystone in a Changing World – Online Proceedings of the 10<sup>th</sup> ISAES, edited by A.K. Cooper and C.R. Raymond et al., USGS Open-File Report 2007-1047, Extended Abstract 192, 3 p.

### Introduction

The Latitudinal Gradient Project (LGP) developed from discussions that commenced in January 1999 between scientists and national Antarctic programmes working in the Ross Sea region. The LGP is a framework that is not run by any one organization or individual. Each of the collaborators conduct their research within their own programs, but their goals work towards answering the key questions asked by the LGP. The national Antarctic programs involved in the LGP have taken different approaches to supporting the LGP-related research. Antarctica New Zealand is the project facilitator for the New Zealand portion of the LGP and provides logistical support to New Zealand events working within the framework of LGP. A New Zealand LGP Science Steering Committee (LSSC) has been formed to co-ordinate the group of New Zealand LGP researchers towards attaining the scientific goals of the project. Collaboration and interdisciplinary research are fostered and encouraged by the LSSC. The USA Office of Polar Programs is supporting research that falls under the LGP framework through its regular science and logistics application process. The Italian Antarctic Programme supports many events along the Victoria Land coast that contribute to the goals of the LGP.

The disciplines represented within the LGP framework include; limnology and oceanography, marine and terrestrial ecology, physiology and genetics, soil science and microbiology, meteorology and climate modeling, glaciology and geomorphology, and sediment- and ice-core paleoclimatology. The LGP contributes to the overall aims of the EBA (Evolution and Biodiversity in the Antarctic – a Scientific Committee for Antarctic Research programme).

### General hypothesis and key questions

The LGP has defined an overarching, general hypothesis that “Ice-driven dynamics control the structure and function of ecosystems (marine, terrestrial and freshwater) near the limits of life at high latitudes”. From the general hypothesis, eight key questions have emerged. They are:

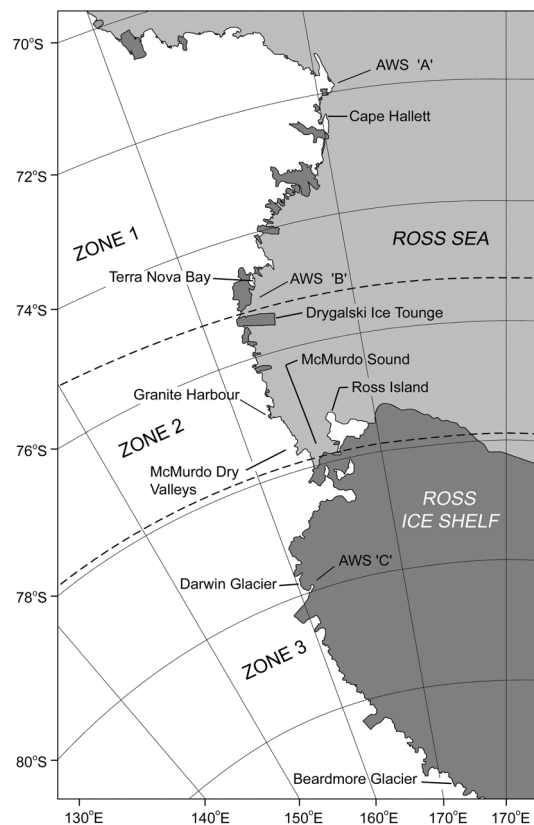
1. What aspects of and to what extent does ecosystem structure and function (diversity/complexity) change with latitude, and why?
2. What is the role of persistent, large-scale ice structures in defining community composition along Victoria Land (e.g. Drygalski ice tongue)?
3. How do ice dynamics (e.g. movement, melt, accumulation and ablation) influence ecosystems and ecosystem processes?
4. How does climate affect the availability and composition of free water and how does this change in space and time?
5. How does climate affect the predictability, persistence and extent of sea ice cover along the latitudinal gradient?

6. How are key marine biological processes (such as respiration, photosynthesis and reproduction) influenced by sea ice conditions?
7. To what extent does soil development (e.g. degree of weathering, carbon content and nutrient accumulation) change with latitude and therefore influence terrestrial ecosystems?
8. To what extent are past conditions along the Victoria Land coast preserved in paleoindicators (e.g. glacial, lacustrine and marine cores, and biological records)?

It is envisaged that these key questions are to be the driving force for the studies undertaken within the framework of the LGP, however additional questions are encouraged and will be sought as our understanding of the ecosystems under study increases.

### Site locations

Five locations, ranging from 72 ° S to 83 ° S, along the Victoria Land coast, have been chosen for specific study under the LGP (Figure 1). It is intended that the sites will be studied sequentially for 2-3 years each. To date, three field seasons have been completed at Cape Hallett (the northern-most site), and one season near Terra Nova Bay by marine participants, along with some preliminary work in the Darwin Glacier area. In the 2007-08 and 2008-09 summers it is planned to focus terrestrial work in the Darwin Glacier region. Workers in other regions of Antarctica are welcome to contribute to LGP to broaden the range of sites covered.



**Figure 1.** Research sites currently under study or planned for study under LGP (source, [www.lgp.aq](http://www.lgp.aq)).

### Results

The research undertaken within the framework of the LGP can be divided into marine, terrestrial, and climate-related research. The marine research undertaken to date includes work related to latitudinal gene drift in notothenioid fish species, latitudinal patterns in the abundance of Ross Sea meroplankton, Antarctic sea ice, algal productivity and global climate change, Antarctic aquatic coastal ecosystems, the structure and dynamics of benthic communities, the population structure of echinoderm and mollusc communities, and reproductive ecology and its consequences on

population isolation. Terrestrial research to date includes work on; environmental protection of ice-free regions of Antarctica, soil biodiversity and response to climate change: a regional comparison of Cape Hallett and Taylor Valley, the influence of climate-related environmental processes on inland Antarctic aquatic ecosystems, evolution and dispersal of algae along a latitudinal gradient, biodiversity and performance of lichens and mosses, biology of Antarctic springtails, and vegetation communities for the monitoring of environmental conditions and climate change effects. Climate-related research includes; climate variability along the Victoria Land Coast - NZ ITASE, snow pit isotope analysis and results from Automatic Weather Stations.

Data and publications arising from the LGP, along with a number of previously existing databases of relevance to the LGP, are available through the LGP website at [www.lgp.aq](http://www.lgp.aq). Publications include a 2006 special edition of *Antarctic Science* (Vol 18, part 4) that includes 18 papers that summarize some of the work of the first three years of the LGP (2002-2005) between McMurdo Sound and Cape Hallett (Howard-Williams et al., 2006). A range of other workshop reports, meeting minutes and other reports are also provided through the website.

## **Conclusion**

The Latitudinal Gradient Project has been successful in providing a common umbrella and theme for research groups working within scientific disciplines ranging from marine biology to soil development. The LGP allows smaller research groups to combine logistic support and contribute to a larger programme. There have been good scientific outcomes in terms of advancing science, publications, and in encouraging increased interaction between scientists from varying disciplines. With the proven format there is now an opportunity to extend the concept beyond the Victorialand coast to encapsulate the entire Antarctic region and we welcome expressions of interest from people who would like to contribute to, or become part of, the LGP.

**Acknowledgements:** We wish to thank Antarctica New Zealand, PNRA (The Italian Antarctic Programme) and The U.S. National Science Foundation Office of Polar Programs for their assistance with and support of the LGP. We also wish to thank the over 100 scientists who have thus far participated in, and contributed to the LGP.

## **References**

Howard-Williams, C., D.Peterson, W.B. Lyons, R. Cattaneo-Vietti, S.Gordon 2006. Measuring ecosystem response in a rapidly changing environment: The Latitudinal Gradient Project. *Antarctic Science* 18(4) 465-472.