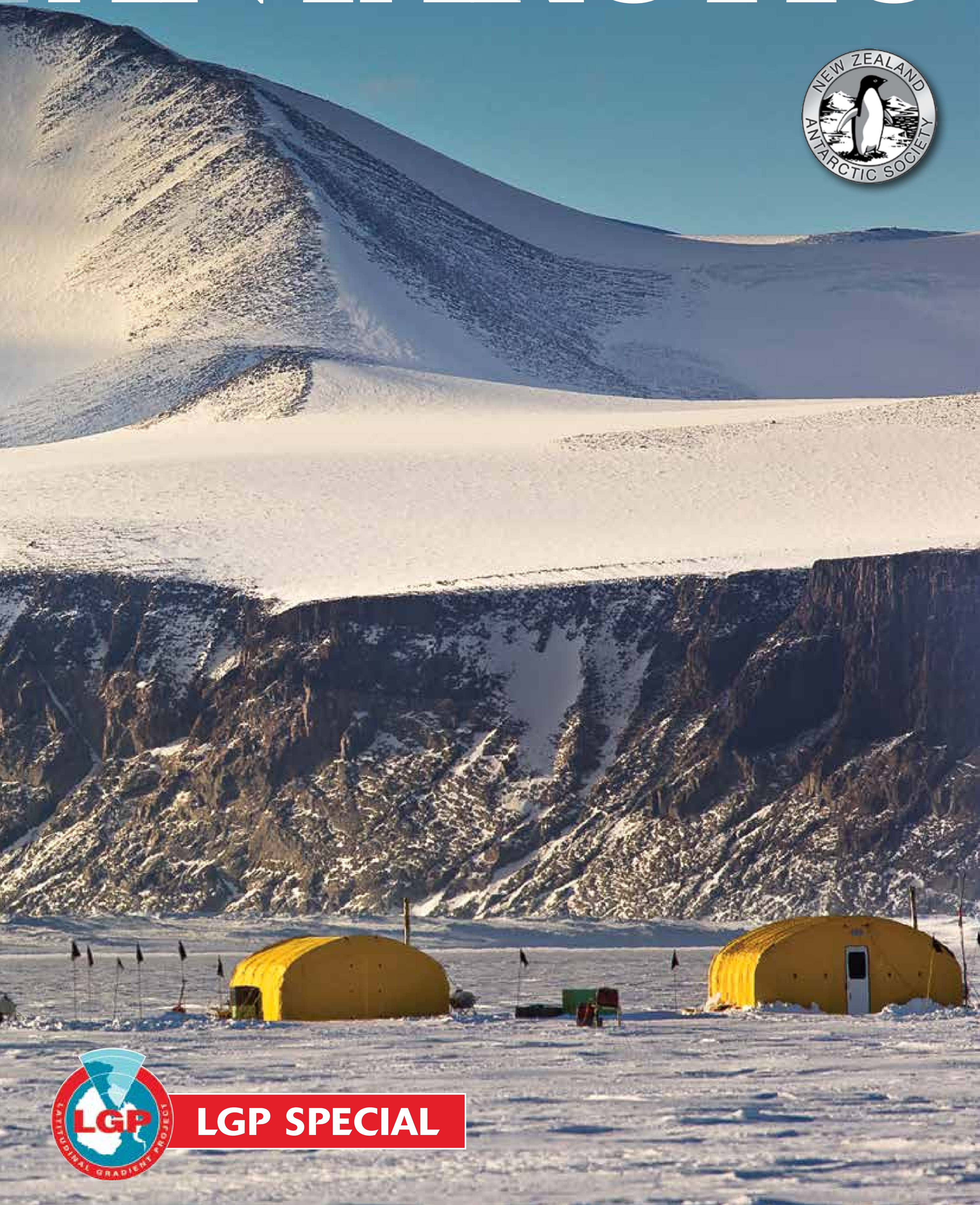
Vol 28, No. 2, 2010

THE MAGAZINE OF THE NEW ZEALAND ANTARCTIC SOCIETY

ANTARCTIC



LGP SPECIAL

www.antarctic.org.nz

ANTARCTIC

is published quarterly by the New Zealand Antarctic Society Inc.

ISSN 0003-5327

The New Zealand Antarctic Society is a Registered Charity CC27118

Please address all publication enquiries to:

PUBLISHER: Gusto

P.O. Box 11994, Manners Street
Wellington

Tel (04) 4999 150, Fax (04) 4999 140
Email: leigh@gustodesign.co.nz

EDITOR: Natalie Cadenhead

P.O. Box 404
Christchurch 8140
New Zealand

Email: ncadenhead@canterburymuseum.com

ASSISTANT EDITOR:

Janet Bray

INDEXER:

Mike Wing

PRINTED BY:

Format, Wellington

This publication is printed using vegetable-based inks onto media gloss, which is a stock sourced from sustainable forests with PEFC (Programme for the Endorsement of Forest Certification), EMAS (The EU Eco-Management & Audit Scheme) & ISO accreditations. *Antarctic* is distributed in flow biowrap.

Cover photo: *Granite Harbour Campsite. Antarctica New Zealand Pictorial Collection: K0430910_GH camp 30a*

Patron of the New Zealand Antarctic Society:
Patron: Professor Peter Barrett, 2008.
Immediate Past Patron: Sir Edmund Hillary.

NEW ZEALAND ANTARCTIC SOCIETY LIFE MEMBERS

The Society recognises with life membership, those people who excel in furthering the aims and objectives of the Society or who have given outstanding service in Antarctica. They are elected by vote at the Annual General Meeting and are restricted to 15 life members at any time.

Current Life Members by the year elected:

1. Bernard Stonehouse (UK), 1966
2. John Claydon (Canterbury), 1980
3. Jim Lowery (Wellington), 1982
4. Iris Orchard (Canterbury), 1990
5. Robin Ormerod (Wellington), 1996
6. Eric Gibbs (Wellington), 1997
7. Baden Norris (Canterbury), 2003
8. Bill Cranfield (Canterbury), 2003
9. Randal Heke (Wellington), 2003
10. Bill Hopper (Wellington), 2004
11. Malcolm Laird (Canterbury), 2006
12. Arnold Heine (Wellington), 2006
13. Margaret Bradshaw (Canterbury), 2006
14. Ray Dibble (Wellington), 2008
15. Norman Hardie (Canterbury), 2008

Volume 28, No 2, 2010
Issue 212

CONTENTS



The Latitudinal Gradient Project – A Framework for Collaboration

Shulamit Gordon and Clive Howard-Williams

The Latitudinal Gradient Project (LGP) has been a flagship science project for Antarctica New Zealand since its first Antarctic field season in 2003/2004, when eight separate science events were supported over a three month period, at a camp located 600 km north of Scott Base on Seabee Hook at Cape Hallett. Since then, seven more seasons of research have been dedicated to the LGP at three other sites along the Victoria Land coast.

This edition of *Antarctic* summarises the key aspects of LGP research, describing findings in the marine, terrestrial and freshwater ecosystems and highlighting the achievement of logistically supporting the diverse groups of scientists.

The 1500 kms of the Victoria Land coastline which spans from Cape Adare (71° S) in the north to the La Gorce Mountains (85° S) in the south presents an ideal natural laboratory to study environmental change. Recognising this, a group of New Zealand, American and Italian scientists proposed a project that used this latitudinal (north-south) gradient as a proxy for environmental change. Rather than waiting for global warming to occur, it was suggested that sites at more northerly locations could be examined to determine what we might find at more southerly sites should such change occur.

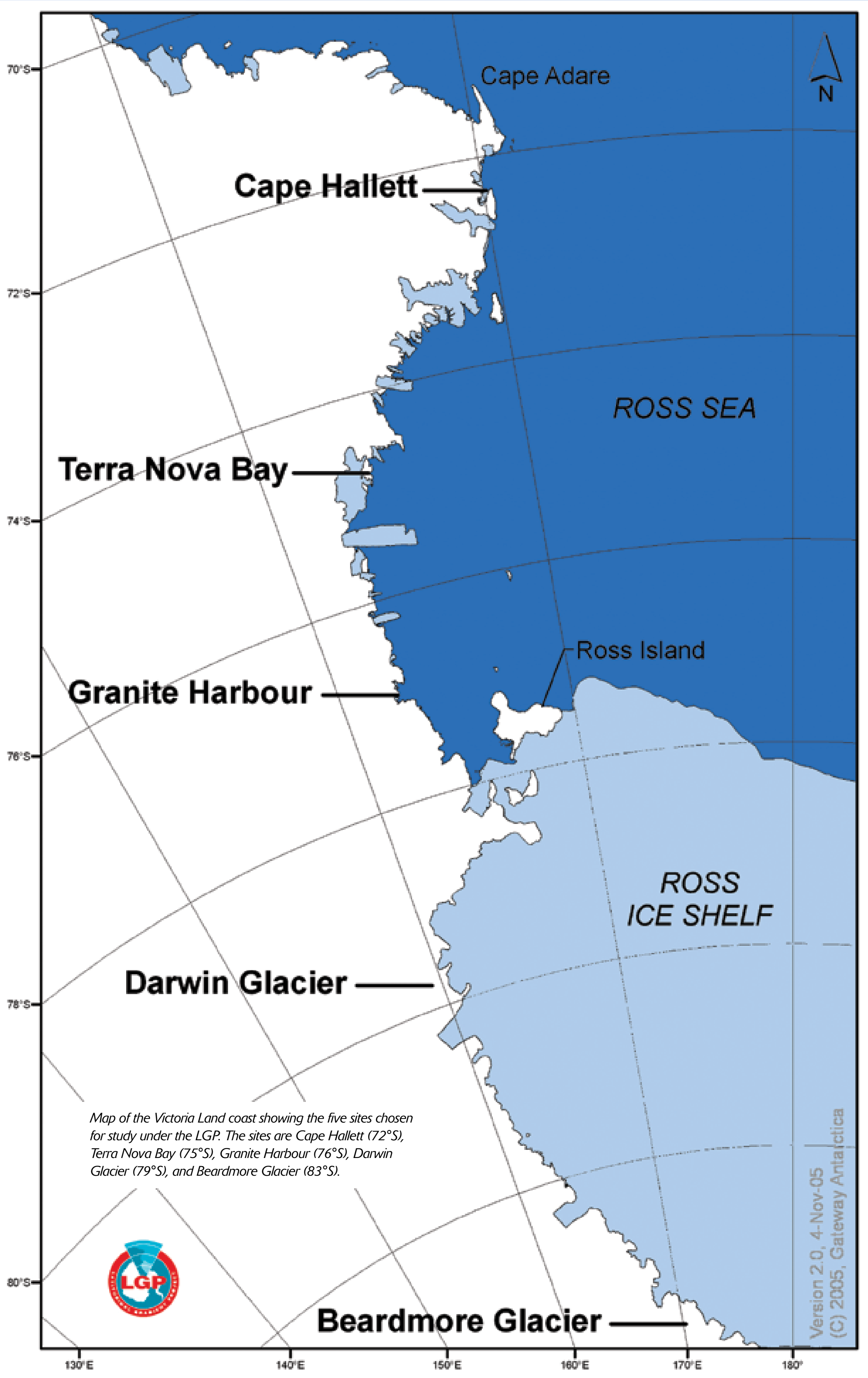
Five research sites were chosen for study to contribute to our understanding of the marine, terrestrial and freshwater ecosystems along the coastline. This information would then be used to determine the impacts of environmental change on these ecosystems. All research conducted aims to answer at least one of the eight key questions that the LGP poses:

1. How does ecosystem structure and function change with latitude, and why?
2. What is the role of persistent, large-scale ice structures in defining community composition?
3. How do snow and ice dynamics influence ecosystems and ecosystem processes?
4. How does climate affect the availability and composition of free water?
5. How does climate affect the predictability, persistence and extent of sea ice cover?
6. How are key marine biological processes influenced by sea ice conditions?
7. How does soil development influence terrestrial ecosystems?
8. To what extent are past conditions preserved in paleo-indicators?

What is so special about this project is that it not only brings together researchers from different disciplines, it also fosters international collaborations between the three nations operating in the Ross Sea region – New Zealand, the USA and Italy. Camps established at each site housed several New Zealand events at one time and some US events. This immediately enabled discussions and idea-sharing among groups that would not have otherwise interacted, and led to some fruitful partnerships. At sea, New Zealand and Italy shared resources in terms of research vessels, with scientists from each nation working from each other's vessels along the northern Victoria Land coastline.

This framework of resource sharing and collaboration ensured that research is supported more efficiently, and that the scope of the science will reach a wider audience. Outcomes from the LGP have been well reported in the Scientific Committee of Antarctic Research (SCAR) meetings (the LGP is a significant project of the international SCAR biology programme *Evolution and Biodiversity in the Antarctic*) as well is in discipline-specific forums. Special editions of the journal *Antarctic Science* have been dedicated to reporting the outcomes of the LGP giving more standing and visibility to the project.

Now in its ninth season, with groups set to be supported in the Beardmore Glacier region out of a US-run camp, the LGP community is looking to the future. Workshops are being planned to discuss the overall outcomes of the project, and discussions are underway on the future direction the LGP. The exciting science reported in this issue will help guide the LGP community in making such decisions and lead us into a new era of discovery.



Map of the Victoria Land coast showing the five sites chosen for study under the LGP. The sites are Cape Hallett (72°S), Terra Nova Bay (75°S), Granite Harbour (76°S), Darwin Glacier (79°S), and Beardmore Glacier (83°S).

Freshwater Ecosystem Research in the LGP

Ian Hawes (Aquatic Research Solutions Ltd), Phil Novis (Landcare Research Ltd), Jenny Webster-Brown (University of Canterbury), Susie Wood (Cawthron Institute Ltd)

One of the benefits of new research opportunities is that they allow us re-evaluate what (we think) we know. The LGP initiative provided us with such an opportunity. After many years of studying the characteristics of Antarctic meltwaters and their ecosystems in the McMurdo Sound area, we now had the chance see whether the "rules" that we had deduced for these systems applied equally well to aquatic environments at other latitudes in the Ross Sea region. This has refined our understanding of how physical and climatic conditions influence the characteristics of freshwater ecosystems.

Antarctic aquatic ecosystems are profoundly affected by the balance between ice and water. This balance might be expected to change with latitude, with more northerly sites tending to be warmer and wetter for longer than the more southerly sites. Temperature and water availability are not the only factors likely to affect ecosystem structure however, which will also respond to nutrient availability and the degree of isolation from propagule sources, for example. To be able to recognise these effects, we needed to identify habitat types that are common and replicated across the region. We chose the small melt-water ponds that freeze solid in winter and are replicated in most ice-free areas in Antarctica, and the cryoconite holes (small meltwater bodies with a sediment base, frozen into the surface of glaciers) that dot the ablation zones of glaciers at all latitudes. We also

Sampling of microbial mats and sediment on a supraglacial pond. © Jenny Webster-Brown, Antarctica NZ Pictorial Collection: K081B 09/10 elected to focus attention on the occurrence and state of *Nostoc*, a readily identifiable colonial cyanobacterium (blue-green algae). *Nostoc* offers a good case study of the effect of local environmental regimes on diversity and ecological function. It is frequently encountered in terrestrial areas of Victoria Land, growing where water is available; populations are found on soils only periodically irrigated by melting snow and ice, and also where they are submerged permanently in liquid water in summer but frozen in winter.

Climatologically, differences between the LGP sites used so far are small, despite the range of latitude. Mean-degree-days-above-freezing is a useful indicator of the prevalence of liquid water. Degree-days-above-freezing is the product of temperature and time for periods when temperature exceeds zero. These data are taken from LGP sites at Hallett and Darwin and from Lake Brownworth in the McMurdo Dry Valleys and all are close to sea level. Although variable at all sites, in recent years Cape Hallett has had a mean of 12 degree days above freezing (± 11), Wright Valley, McMurdo Sound 12 ± 10 and the Darwin Glacier 9 ± 3. Freshwater habitats also show physical similarities between the LGP sites. At all sites we found ponds with a range of summer ice-cover thickness, and some with temperature and salinity stratification of the water column with depth. Physical attributes such as ice thickness/cover and water temperature appear to vary as much within LGP sites as between them. Consistent differences do emerge however, in aspects of chemistry and biology. A "mature" sea level pond in the McMurdo Dry Valleys (78° S), for example, tends to have a thick and well developed microbial mat, whereas those from the Darwin region (80° S) tend to have poorly structured and relatively low biomass mats. The Darwin ponds do however, appear to be similar to inland ponds at high elevation at the more northerly sites, both habitats which are far from the influence of open sea water and are colder. As yet we have not accessed lowland sites that are substantially colder

Hypolithic microbial rock life © Anne Jungblut, Antarctica NZ Pictorial Collection: K081B 09/10

Highly developed cyanobacterial-dominated microbial mats in Macaw Pond near Miers Valley. © Anne Jungblut, Antarctica NZ Pictorial Collection: K081B 09/10

Nostoc *mat at Pyramid Trough © Anne Jungblut, Antarctica NZ Pictorial Collection: K081B 09/10*

Continued over ▶▶

than McMurdo Sound. Inland ponds have exceptionally high nitrogen contents, poorly developed microbial mats with low biomass, few diatoms and few cyanobacteria capable of fixing nitrogen. Nitrate:chloride ratios are high in inland water and low at the coast, due to the different balance of exposure to chloride from seawater aerosols and nitrate derived from upper atmospheric processes. Nitrogen appears to dictate ecosystem structure more than either temperature or water availability.

The physical properties of cryoconites of the same size (>35 cm diameter), and the same altitude (~400 m), in the Koettlitz Glacier in McMurdo Sound and on the Diamond Glacier in the Darwin region, were similar, showing no significant difference in average depth to the sediment (~40cm) or ice cover thickness (~30cm). The chemistry, biomass, productivity and taxonomic characteristics of these cryoconites were also found to be alike, but provided another example of local variability outweighing latitudinal effects. A measure of acidity (pH) identified distinctively low pH (<6) and high pH (>9) cryoconites within a few kilometres of each other; DNA fingerprinting showed that differences in genetic diversity of bacteria in the cryoconites was greater for cryoconites of different pH, than between the sites. Water chemistry emerged as a more powerful control on microbial ecology than latitude.

DNA fingerprinting techniques were also used to survey the genetic diversity of *Nostoc* from sites between 72° S and 78° S. Again, genetic diversity was affected more by local environmental conditions than by latitude. Colonies collected from ponds are more closely related to each other than to those from irrigated soil, regardless of the latitude. For instance, samples from irrigated soil at Cape Hallett and Taylor Valley group close together despite the geographic separation.

To date the LPG has afforded us access to the northern part of the sector, where the availability of liquid water is an important variable that determines ecosystem characteristics, but given the presence of water, aquatic habitats tend to be chemically and physically similar and support similar microorganisms. What we have seen as we begin to move into the southern part of the sector, where the Ross Ice Shelf isolates ponds from the influence of the ocean, is that pond chemistry and biology begins to change, and systems at sea level become increasingly similar to inland systems further north. Is this driven by climate, proximity to the ocean, isolation? As the LGP moves south we hope to access aquatic ecosystems in areas with significantly colder climate and more limited water availability, to determine whether the trends seen so far in latitude and altitude will continue or if other significant changes will occur.

Sampling from a cryoconite hole.
© Anne Jungblut, Antarctica NZ Pictorial Collection: K081B 09/10

Perceptions and Reality:

A new understanding of terrestrial life in the Ross Sea Region

Ian Hogg, Allan Green, Bryan Storey, Jackie Aislabie, Mark Stevens, Craig Cary, Megan Balks

"We have seen no living thing, not even a moss or a lichen…it is certainly a valley of the dead". Such were the observations of Robert Falcon Scott when he first discovered the Dry Valleys in 1903. He could be forgiven for such a conclusion as, at first glance, most Antarctic terrestrial environments reveal very little. Most of the year-round terrestrial life is hidden and requires closer inspection to reveal the myriad organisms including microscopic bacteria, nematode worms, mites and springtails (all <1 mm), as well as the familiar lichens and mosses.

Continued over ▶▶

Bryan Storey and David Fink (ANSTO) sampling for cosmogenic dating at Diamond Hill. © Kurt Joy, Antarctica NZ Pictorial Collection: K056C 08/09

Various lichen and moss species found at Battleship Promontory in the Dry Valleys, including Lecanora expectans, Caloplaca citrina and Buellia frigid.

Hidden life:

The "soils" that are found in Antarctica do not resemble those which would be recognisable in more temperate regions of the world. In the Ross Sea region, the soil, in the few places where it is found, more closely resembles coarse sand that you might expect to find on New Zealand's west coast beaches. Nevertheless, recent microbiological work has found that, surprisingly, the diversity and activity of bacteria in these simple soil systems actually rivals that of common garden soils in New Zealand.

Despite this activity, much of the landscape is dry, very dry and most life exists where there is at least some access to water such as near glaciers, meltwater streams or even small snow patches. This access need only be intermittent. Such is the case with nematode worms and lichens which can sit dormant for months, even years, until moisture returns. As a consequence, growth rates tend to be slow. For example, the sort of lichen that grows on the roof of one's house or driveway in New Zealand will manage a radial growth rate (growth away from the centre) of roughly 5 mm per year. In contrast, growth rates of lichens in the Dry Valleys are about 0.01 mm per year, or 1 mm per century. These are possibly the slowest growing lichens in the world and, because some are several centimetres across, they might even be some of the oldest.

Drier than dry:

There is a place drier than the Dry Valleys. Work in the Darwin Glacier area (79° S) has revealed that vegetation was almost completely absent, with the normally resilient lichens confined to a small number of locations inland. At the richest site near Diamond Hill vegetation was confined to cracks, sides and bottoms of depressions in the granite. Mosses are absent, springtails are absent. What is present in unexpected abundance is the so-called hypolithic community, algae and other associated microbes growing under transparent or translucent pebbles in a sort of mini-greenhouse.

Because it is so dry and bordered by a large ice-covered area to the north, the Darwin region presents a barrier to the movement of terrestrial organisms along the Ross Sea coast, rather than the bridge that was first expected. Indeed, recent genetic work on mites has also pointed to this barrier and has suggested that if a bridge does exist, it is likely connected to more southerly areas along the Transantarctic Mountains.

The ancient squatters:

Today, less than one percent of the total Antarctic land mass is exposed rock suitable for terrestrial life. It has generally been assumed that during the ice ages, this area would have been even further reduced or non-existent. If true, where did the life we find along the latitudinal gradient come from and why is it as rich at 84° S as it is at 78° S, yet the species found in these areas are so different? The answer: it appears they are ancient squatters and remnants of a biota that has been associated with the Antarctic continent for millions of years. Biologists had suspected that this was a logical explanation for the patterns observed, however it was hard to justify this

Glacial moraines on patterned ground in the Darwin Mountains bordering the Hatherton Glacier. The moraine ridges show the extent of Antarctic ice during previous glacial advances. Images courtesy Bryan Storey.

explanation when glaciers were supposed to have covered most of the exposed ground.

Fortunately, recent geological work has made two very important findings that have helped to corroborate the "squatter" explanation: firstly, the glaciers did not completely cover all of the ice-free areas of the Ross Sea region, particularly higher altitude areas; and secondly the ice-free regions have been ice-free for much longer than previously thought. This crucial piece of the puzzle was determined by looking at glacial moraines, which indicate where the edges of the glaciers would have reached. The second piece of the puzzle was solved by using "cosmogenic" dating techniques which look at radioactive signatures to find out how long rocks have been exposed to the sun's cosmic rays – and we're talking millions of years. Thus, it is likely that these exposed areas would have served as refuges for plants and animals as the glaciers advanced during the ice ages. Although large low-lying areas would have been denuded as the glaciers advanced, life would have been preserved on the higher peaks and could colonise exposed areas following the retreat of the glaciers. The patterns we see today bear witness to these past events and explain the differences we observe between Northern and Southern Victoria Land in the northern Ross Sea region as well as the Queen Maud Mountains further south.

We can even see these tidings of a distant past on a finer scale. In Taylor Valley, two different maternal lineages from the same species of springtail, trace the ancient shoreline of a glacial lake. Ancestral individuals would have been separated during the ice-ages and then genetically diverged. One was the resident type in Taylor Valley and the other from a neighbouring area. However, as the glacial lake melted towards the end of the last ice age (roughly 20,000 years ago), the neighbouring strain would have been able to gain access to this "new" terrain by floating on meltwater around the edge of the lake. Here they "met" the resident Taylor Valley strain and co-exist to this day.

Even lichens which can disperse themselves by small spores can be easily blown about by the wind. So, one would expect these organisms to get about very easily. In fact the very opposite seems to be true. Genetic studies of a common lichen species in the Dry Valleys have shown that isolated populations are genetically distinct from each other. This suggests that dispersal or colonisation is not so easy or common as previously thought. Instead, the landscape is covered with a mosaic of genetically distinctive populations reflecting past and present conditions at these sites.

We have always worried about letting foreign organisms into Antarctica but it now seems likely that another major quarantine risk may be that of mixing up local populations and destroying possibly millions of years of history and local adaptation. This is one of the many challenges facing those responsible for protecting Antarctica's unique terrestrial environments and indeed, ultimately, New Zealand. Ongoing research, as part of Antarctica New Zealand's Latitudinal Gradient Project, is a key component of this decision-making process.

For further information visit:
http://nztabs.ictar.aq/

Marine Research in the LGP

Vonda Cummings, Phil Lyver, Victoria Metcalf, Ken Ryan, Mary Sewell

New Zealand's marine LGP researchers have been investigating potential latitudinal patterns in many aspects of marine life, ranging from microbes to penguins. Our research is mainly focused on three different locations along the Victoria Land coast – Cape Hallett, Terra Nova Bay and Granite Harbour.

Collectively our studies encompass a range of ecological niches: in and around the sea ice (algae/viruses, bacteria, protists (one-celled organisms)); in the water (meroplankton); on the seafloor (organisms and their habitats); and also include penguins, which utilise a number of these environments. While some patterns are apparent (or not!) already, most projects are just now at the stage of analysing their multi-year, multi-site datasets. Once our analyses are finalised, we plan a comprehensive, multidisciplinary evaluation of the marine ecosystems from our LGP study locations, with the ultimate aim of better understanding how they might be influenced by future environmental change.

Sea ice flora and fauna

Antarctic sea ice supports a complex community of algae, bacteria, viruses and protists. Since sea ice covers 13 % of the Earth's surface, the bacteria and algae growing within it are a major food source for grazing zooplankton, particularly during the darkness of winter when the water

Adélie penguin colony at picturesque Cape Hallett.
© Rachel Brown, Antarctica NZ Pictorial Collection: K002 04/05

lacks other food sources. Studies by Dr Ken Ryan (Victoria University of Wellington) have focused on the biodiversity, physiology and metabolic activity of the sea ice community, and the amphipods that graze the biomass at the bottom of the ice.

A recent PhD by Andrew Martin, one of Ken's team, has shown that bacterial metabolic activity in sea ice is unexpectedly high, and it responds rapidly to changes in environmental conditions. The responses of the sea ice community to environmental stresses have been a major focus in recent years, and it is hoped to be able to use sea ice microbes as a sensitive real-time indicator for climate change.

A major finding has been the first discovery of bacteria able to generate cellular energy from light at all depths in sea ice. Proteorhodopsins (PRs) are membrane-bound proteins that function as light-driven proton pumps that allow bacterial cells to generate energy in the form of simple energy-storing molecules in the cell. Blue and green PR bacteria thus occupy niches that differ in light quality, and this also forecasts a significant functional role for PR in this important Antarctic habitat.

Additional studies have revealed the presence of Archaea bacteria in sea ice. These are a very ancient and primitive group of single celled organisms first found around deep sea volcanic vents. Modern studies are revealing that they are much more widespread than previously thought. Previous evidence has been quite fragmentary but it is now clear that they are common in sea ice, although their role is not understood as yet. DNA profiling (yes just like forensics) of sea ice microbes at the community level has shown distinct differences in community structure from site to site. While sites close to each other tend to cluster together in analyses, there is no real pattern with latitude. There are considerable vertical gradients of temperature, light, salinity, and availability of nutrients within and at all sites and the community structure is quite different in different niches within the ice.

Meroplankton

A research team from the University of Auckland led by Dr Mary Sewell has been examining the meroplankton, which are the larval stages of benthic invertebrates and fish, at the LGP sites. The first challenge in studying the meroplankton is the annual sea ice – this can be over three metres thick and provides a major barrier between the scientists and the seawater they wish to sample. Mary's team have been using a collapsible plankton net that descends in a closed position through a hole drilled through the ice, and then opens under the ice to collect a plankton sample.

Sampling at Cape Hallett, Terra Nova Bay and Granite Harbour has revealed a number of interesting trends. Firstly, there are major changes in the abundance of the meroplankton with the latitudinal gradient. The highest numbers of larvae per plankton haul are found at Cape Hallett, with lower numbers moving south, and the lowest abundance in McMurdo Sound near Scott Base. At the same time there are major changes in the dominant

Continued over

View down a hole in sea ice. Total light decreases with depth with blue light becoming increasingly dominant. A meter reads red, green, blue and PAR wavebands of light. Image courtesy Ken Ryan.

members of the meroplankton, with numerical dominance by barnacle larvae at Cape Hallett, fish larvae at Terra Nova Bay, and larval polychaetes in McMurdo Sound.

With the sampling of the last marine LGP site at Granite Harbour in 2009, Mary is about to begin the complex process of analyzing the meroplankton data set – three sites x two years, with many larval types at each site. The multivariate data analysis, when completed, will provide information on key differences in the meroplankton community with latitude, and provide information critical to predictions on how the plankton might change under the influence of climate change.

Seafloor communities

Research by NIWA's Antarctic marine ecology team, led by Dr Vonda Cummings, has focused on benthic (seafloor) invertebrate communities and their habitats, and especially on understanding how they are influenced by environmental conditions.

Study of eight locations along the Ross Sea coast have demonstrated there is no simple, linear change in species abundance or distribution as you move north or south along the Victoria Land Coast. Rather, the influences of environmental variables that affect availability of food are more relevant than latitude.

Not surprisingly, sea ice is particularly important: by limiting the amount of underwater light, and thus the productivity of the ecosystem, sea ice conditions can affect the type and amount of food available to benthic organisms. By constructing food webs at each location, the team has found differences in predominant food sources and between-species relationships along the coast which reflect natural differences in sea ice. Analyses of variation in benthic communities and their habitats in relation to the duration, extent and persistence of ice cover have revealed highly complex interactions between species and their environment. Work is currently underway to tease apart these interactions and use this knowledge to create ecological models to help predict how future environmental change might affect coastal benthic ecosystems.

Sea ice dynamics have the potential to profoundly influence ecosystem function as well as community composition. Nested within the NIWA project, Dr Victoria Metcalf (Lincoln University) is investigating how the key biological process, metabolism, is affected in key benthic organisms. This research focuses on common and ubiquitous benthic fish species such as *Trematomus bernacchii* and invertebrates such as *Laternula elliptica*, *Sterechinus neumayeri* and *Adamussium colbecki*.

Victoria's team has been employing real-time Polymerase Chain Reaction (PCR) technologies to look at key metabolic genes used by these species.

Trematomus Bernacchii *with a starfish. © Victoria Metcalf, Antarctica NZ Pictorial Collection: K058 05/06*

In a site where sea ice is a non-permanent seascape feature and food resources are plentiful, gene activity levels may be expected to differ from that of a site which has year-round sea ice cover and limited resources. Such a metabolic 'signature' might be shared across species at a site or in likelihood be species specific as the target species hold different ecosystem roles. In analyses to date however, no molecular level metabolic differences between species from sites that differ in sea ice cover are obvious.

Adélie penguins

Landcare Research's Adélie penguin research team, led by Dr Phil Lyver, in collaboration with US Adélie penguin researchers, have been studying how Adélie penguin demographic rates, foraging behaviour and population abundance respond to abiotic and biotic conditions that are mediated by climate change across a latitudinal gradient in the Ross Sea.

Breeding adult survival was lowest at the smallest colony (4,000 pairs) and similar for the medium (45,000 pairs) and large colonies (155,000 pairs), despite increased foraging effort required to breed at the largest colony. The temporary grounding of two mega-icebergs off four colonies on Ross and Beaufort Islands demonstrated that dispersal of breeding birds was generally low (<1%), except during years of difficult environmental conditions (i.e. the iceberg years) when penguin movements increased, especially away from the smallest colony. Contrary to what was previously thought, breeding penguins do not always return to the same breeding site each year.

Scientists from Landcare Research New Zealand get ready to weigh an Adélie penguin chick. © Rachel Brown, Antarctica NZ Pictorial Collection: K002 04/05

Using these sorts of data the US/NZ team predict that Adélie penguin colonies north of 70° S will decrease or disappear as the Earth's average tropospheric temperature reaches 2° C above pre-industrial levels (ca.1860). Estimates suggest these climate effects will impact 75 % of Adélie penguin colonies. Decreased persistence of pack ice north of the Antarctic Circle will limit the foraging capacity of Adélie penguins because these birds require daylight in their wintering areas to feed. Ultimately, this will lead to declines in population growth.

Collecting plankton samples with a net at Granite Harbour. © Mary Sewell, Antarctica NZ Pictorial Collection: K018 09/10

International cooperation makes LGP science possible

Shulamit Gordon, LGP Project Manager, Antarctica New Zealand

It is not only the scientific collaborations that have been essential to the success of the Latitudinal Gradient Project (LGP). Without the support of the US, Italian and German Antarctic programmes in assisting the New Zealand Antarctic Programme to set up its land-based camps, little of the research would have been possible. Cooperative logistical support between these national Antarctic programmes has meant that New Zealand could support science in a way not possible by itself.

The support of three seasons of research at the most northerly site, Cape Hallett, was a particular tour de force with respect to the input of various logistical agencies. Located 600 km north of Scott Base, the camp was located precariously on the edge of a beach off Seabee Hook. The cargo to set up this camp had a long and arduous voyage: packed up in Christchurch; loaded on to the US cargo ship *MV American Tern* in January 2003; transported to the Italian Terra Nova Bay Station (since re-named Mario Zucchelli Station) by the South African operated, Italian contracted, SAFAIR L100 Hercules in November 2003; flown by two US contracted twin otters to the sea ice off Seabee Spit on Edisto Inlet; and finally traversed piece by piece by skidoo to the camp site. Additional cargo was dropped off (literally!) by a Royal New Zealand Air Force Hercules air-drop in December 2003 and by the US Coast Guard vessel in February 2004. The scientists were mostly transported to and from Cape Hallett by Italian contracted twin otters and helicopters.

After each season, the cargo was packed away and over-wintered on the beach, and was finally sent back to Christchurch in February 2006 after being loaded on to the Italian vessel *RV Italica* by a Helicopters New Zealand helicopter. This return cargo included remnants of the original US/NZ Cape Hallett station, the last structures of which were taken down over three years by teams who worked out of the LGP camp. All would agree that without such inter-agency cooperation, the three seasons of support at Cape Hallett would never have been possible.

The second LGP site was at the German summer-only station, Gondwana, situated 10 km across the bay from Mario Zucchelli. This station is used every three to four years by the German Antarctic programme, and they very generously allowed the LGP to use the station as a heated operational base with

kitchen, bathroom, living room and laboratory facilities inside, while Scott Polar tents were pitched outside for accommodation. This time, cargo was flown to the station in a US contracted Basler (DC-3), and once again, with endless generosity, the Italian Antarctic programme transported passengers and cargo from their runway, across the bay to Gondwana by pisten bully and loader. After the second season, the Italians transported the cargo back to Christchurch on the *RV Italica* in February 2008. We were also treated to some technological wizardry when the Italians bored holes into the sea ice for experiments using a massive ice screw powered by a telehandler.

Support provided by the US Antarctic Program was integral to the success of the LGP camps in the Darwin Glacier region, providing Basler and twin otter flights to transport cargo, passengers and fuel to a site that is known for its temperamental weather including high winds.

The camps at Granite Harbour in the 2008/09 and 2009/10 seasons were a purely kiwi affair. The excitement of transporting the cargo with Hagglünds towing multiple sleds over the apparently smooth (though often rough) sea ice provided ample opportunity for kiwi ingenuity and team work.

Unloading LGP gear from the Basler aircraft at Terra Nova Bay runway.
© Shulamit Gordon, Antarctica NZ Pictorial Collection: K003 06/07

The final, most southerly LGP site in the Beardmore Glacier region will again rely on support from the US Antarctic Program. In the 2010/11 season, the US is planning a significant camp in this region that will have helicopter and fixed wing capabilities to send individual groups out to field sites. Two New Zealand and one US event linked to the LGP will be supported from this camp, working as far south as the Scott Glacier.

This international support and generosity is provided in goodwill. The New Zealand Antarctic Programme has such a good relationship with these partners because it is able to 'pay its way' by contributing valuable services or support in return. There is an understanding that our role as National Antarctic Programmes is to provide the best possible support to our scientists and often-times, international logistics collaboration is the most effective and rewarding way to do this.

Field camp on a snow bank near the Darwin Glacier.
© Jenny Webster-Brown, Antarctica NZ Pictorial Collection: K081B 09/10

Phillip Law

On 28 February 2010 the Antarctic community lost an Australian pioneer when "Mr Antarctica", Phillip Law died at age 97.

Law's Antarctic career began when he was lecturing at Melbourne University in late 1947 as the Australian government began an expedition to establish meteorological and scientific research stations on Heard Island and Macquarie Island in the sub-Antarctic. In addition the government intended to search for a suitable site to establish a permanent station on the Antarctic mainland.

After being accepted on the expedition Law continued to work in the Antarctic arena, becoming the first Director of the Australian Antarctic Division in 1949, a position he held for 17 years. His many achievements included working on the establishment of three Australian continental bases; securing national commitment and funding for Antarctic research; beginning the National Antarctic Research Expeditions (ANARE); and leading 23 expeditions to Antarctica and the sub-Antarctic. Law is quoted as saying "I thought it would be fascinating to get into the Antarctic work. It would be wonderful to be able to marry my scientific interests with my interests in sport and physical activities and my sense of adventure." In addition to his love of the outdoors, Law was known for his photographic skills and his habit of taking a piano accordion with him on his journeys.

Law left the Antarctic Division in 1966 at the age of 55, returning to an academic position in the Victorian education system before retiring in 1977. He was awarded a CBE in 1961 and a Polar Medal in 1969, both for his substantial contribution to the Australian Antarctic programme. In 1975 he was made an Officer of the Order of Australia (AO) and in 1995 received the highest award in the Australian honours system – a Companion of the Order of Australia.

Phillip Law in Antarctica. Image courtesy National Library of Australia: 9/004 Box 8 Series 9

"Smooth as polished gun metal". Photograph courtesy Mary Livingston

Iceberg Finale

By Mary Livingston

Smooth as polished gun metal cut by crystal air
The sea shines.
Ice shards rise and fall like spindrift
In a restless breeze
A casual decor to mask
The cry of a wilderness in despair.

Stringed cellos prepare their deep thrum
In perfect harmony
With the earth's unheeded call
A haunting song wells up
From a world not wanting to die.

The orchestra stirs
And ancient galleons free at last
Sweep into view with heads held high
Their aching waltz devastating and slow
Bring breathless thrall to the emptiness.

But the day's stillness deceives.
The southern ocean storms swell and beat.
Snow-white robes burn in the sun's cold heat
Deep through the folds of dark blue ice
Until the polar night engulfs all.

Far beneath the waves
The deeply scored rocks
Are all that remain witness
To the final steps of the ice-kings

As the music fades to a whisper
They bow low to modest applause
And are gone.
But for the soughing wind
All is silent on the empty dance floor.

Through the Pack Ice

By Mary Livingston

Silent sugar cakes with turquoise skirts
Fill every horizon.
They swing aside effortlessly
Before the prow
Or so it seems

Yet a dark red trail
Of the grazed hull bleeding
Leaves anxious hearts beating
As we push on through
The glittering hue

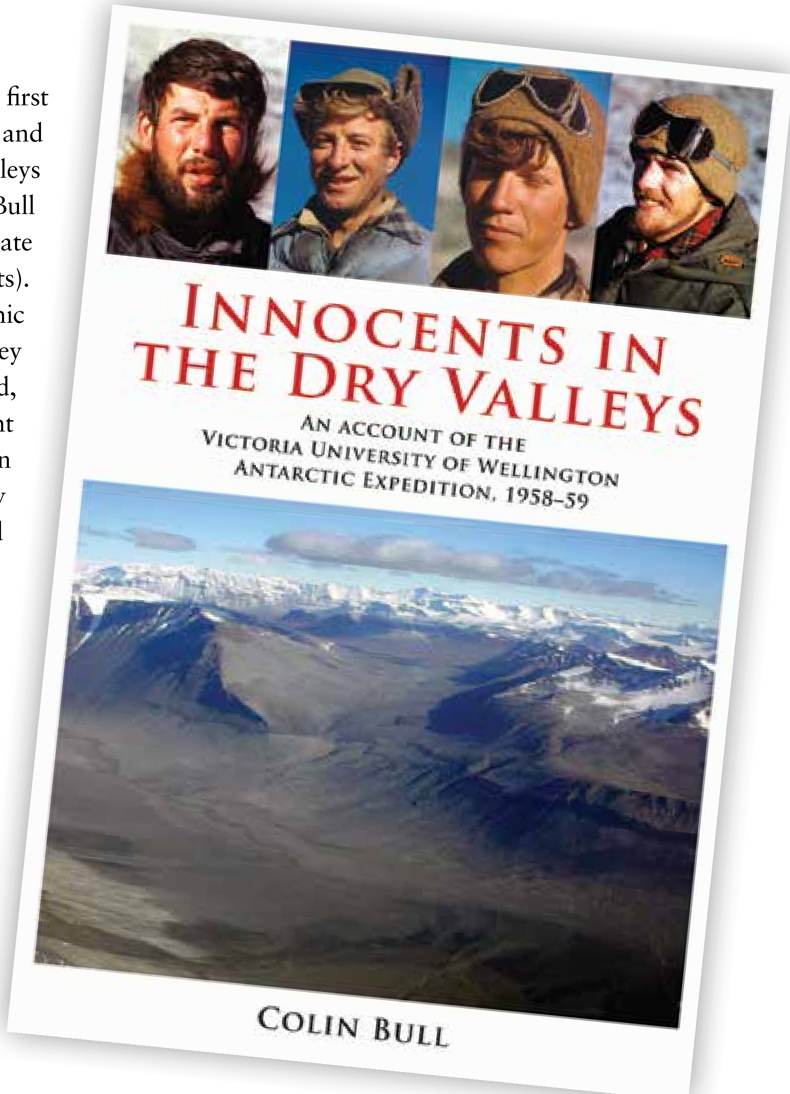
On the bridge the powerful shake their heads
And whisper their unease
But the ice is loose and yields.
The air is still; blue water gleams
And finally opens again

Pack ice with its "turquoise frill". Photograph courtesy Mary Livingston

Innocents in the Dry Valleys

An Account of the Victoria University of Wellington Antarctic Expedition 1958-1959

By Colin Bull



This book provides a first-hand account of the first official Victoria University Antarctic expedition, and their pioneering work in the Wright and Victoria Valleys in the late 1950's. The team consisted of Colin Bull (physicist), Dick Barwick (biologist), and graduate students Peter Webb and Barry McKelvey (geologists). Their names are forever associated with geographic features in the area such as Bull Pass, McKelvey Valley, Barwick Valley, and the Webb Glacier. Indeed, for those who have worked in or visited the Wright Valley, the book provides fascinating background on the many geographic features that were named by this group. Lake Vanda, for example, was named for a lead dog from one of Bull's own expeditions in Greenland; the name had always been something of a mystery to those of us who have worked on this unusual lake. Sponsor's Peak in the upper Victoria Valley is named in recognition of the generous contributions made by various companies to enable the two month expedition to be mounted on a shoestring budget of only $1000!

Equally fascinating are the tales of their adventures while working in this area. Split into two teams (the "seniors" Bull and Barwick and the young students Webb and McKelvey), they covered an enormous area of the Wright and Victoria Valleys, even traversing the Wilson Piedmont Glacier to get to the American's Marble Point Station, where they were prevailed upon to take a shower before spending too much time in the company of the incumbent station personnel! While it is good to know that some aspects of Antarctic fieldwork haven't changed, many of their more ambitious cross-country adventures, as well as entertainments such as tossing dead seals about the camp, would never conform to current field event protocols.

The tale is told by the most senior member of the expedition, Colin Bull, relying on what must have been extraordinarily detailed diaries kept by each of the party. In some ways the level of detail in which every activity is described does detract somewhat from the read. The writing style also has a tendency to be laboured and hindered by the use of obscure words ("contubernial"?). However, this aside, the tale is a great one and this book is a valuable record of an expedition which was the first of many for Victoria University and laid the foundations for the reputation this University now has for Antarctic research.

Book review by Ian Hogg and Jenny Webster-Brown.

Victoria University Press. Paperback, colour and B&W photographs, maps, 267pp. RRP NZ$50

The Arctic: The Complete Story

By Richard Sale

If you are looking for a general introduction to the Arctic it would be hard to go beyond this book. I say general introduction because this is neither a scholarly reference book, nor a 'coffee table' spectacular. In fact, it is an interesting mixture of the two. The text is woven between the spectacular scenic and wildlife photos on almost every page. Add good colour maps and historical photographs and the reader ends up with a lasting picture of the Arctic domain, its peoples, its animals and birds. Extensive ice-free areas, abundant wildlife and the native peoples of the Arctic provide a complete contrast to Antarctica.

The book is in five parts: Part 1 – *The Natural Environment* describes the geography, geology, ice, snow and climate with perhaps the only missing area being the Oceans. *Human History of the Arctic* covers a brief but well written survey of Arctic exploration and an introduction to the history of the native peoples of the Arctic realm. There is a strange (and slightly irritating) 9-page 'brief history of Antarctica' that really doesn't fit and is so brief I had to wonder why this was included.

Almost half the book is devoted to Part 3 – *Habitats and Wildlife*. An interesting first chapter called 'After the ice' sets the scene for the modern Arctic world following the last ice age. A systematic approach to all the birds and terrestrial and marine mammals follows. While relatively comprehensive, it is an introduction, not a guide book to the wildlife. Again, there is an insert on Antarctic wildlife that is too short to do justice to the topic and really doesn't fit.

Part 4 – *A Traveller's Guide to the Arctic* provides a glimpse of the places and features of interest accessible to most experienced travellers. The final section of the book, *A Vulnerable Ecosystem*, discusses the exploitation of the Arctic from whaling and fishing to mineral exploitation. The sensitivity of the Arctic to pollution is illustrated by reference to the Arctic Ozone depletion, nuclear weapons and cold war legacies and, more recently, the rapid rate of climate change. It will certainly be of considerable interest to *Antarctic* readers.

The Introduction states that the book "celebrates the Arctic". I certainly agree with this, and (apart from the few minor irritations on the Antarctic inclusions) I finished the book with a clear image of this wonderful part of planet earth. It is a great book for polar enthusiasts.

Book reviewed by Clive Howard-Williams.

Published by Frances Lincoln Ltd., London, 2008.
Photographs by Per Michelsen and Richard Sale
632 pages (including Index) (ISBN 13: 978-0-7112-2707-1)
RRP $125 NZD

New Zealand Antarctic Society Membership

The New Zealand Antarctic Society Inc was formed in 1933. It comprises New Zealanders and overseas friends, many of whom have been to the Antarctic and all of whom are interested in some phase of Antarctic exploration, history, science, wildlife or adventure.

A membership to the New Zealand Antarctic Society entitles members to:

- *Antarctic*, the quarterly publication of the Society.

It is unique in Antarctic literature as it is the only periodical which provides regular and up to date news of the activities of all nations at work in the Antarctic, Southern Ocean and Subantarctic Islands. It has worldwide circulation.

- Attend occasional meetings and fun events which are held by the Auckland, Wellington, Canterbury and Otago Branches of the Society.

OFFICERS 2009–2010 (ELECTED)
President Graham White
North Island Vice President Nicola Jackson
South Island Vice President Julie Battersby
National Secretary Linda Kestle
National Treasurer Lester Chaplow
Immediate Past President Norm McPherson

OTHER POSITIONS (APPOINTED)
Editor Antarctic Natalie Cadenhead
Membership Secretary Lester Chaplow
Publications Officer John Parsloe
Web Administrator Malcolm Macfarlane

BRANCH CHAIRPEOPLE
Auckland Graham White
Canterbury Julie Battersby
Wellington Jud Fretter

www.antarctic.org.nz

You are invited to join – please write to:

NATIONAL SECRETARY
New Zealand Antarctic Society
P.O. Box 404, Christchurch 8140, New Zealand
Email: secretary@antarctic.org.nz

All administrative enquiries, enquiries regarding back issues and Overseas Branch enquiries should be directed to the National Secretary.

ANTARCTIC Magazine correspondence and articles should be addressed to:

EDITOR: Natalie Cadenhead
New Zealand Antarctic Society
P.O. Box 404, Christchurch 8140, New Zealand
Email: ncadenhead@canterburymuseum.com
www.antarctic.org.nz

ADVERTISING ENQUIRIES: Gusto
Tel: 0064 4 4999 150
Email: leigh@gustodesign.co.nz
Deadline: 20th of preceding month

ADVERTISING RATES:

Full Page Colour	NZ$700
Half Page Colour	NZ$400
Full Page Black & White	NZ$300
Half Page Black & White	NZ$250
Situations Vacant (20 lines)	NZ$50
Inserts by arrangement	

Claims for missing issues can be considered only if made immediately after receipt of the subsequent issue.

MEMBERSHIP APPLICATION

Name:
Address:

Email:
Phone:

Students (with ID)	NZ$40
Unwaged	NZ$40
NZ (Individual)	NZ$70
NZ (Family)	NZ$80
NZ (Institutions)	NZ$180

International members add NZ$15 to the relevant New Zealand membership category

Referral Source:

Payment by:
- ☐ Cheque *(payable to NZ Antarctic Society)*
- ☐ Mastercard / Visa / AMEX
- ☐ Direct Deposit to NZAS Account

Card No.:

Expiry Date: /

Card Security Code:
(the last three numbers on the back of Visa/Mastercard or four numbers from the front of the Amex card

Signature:

Society Account Details are:
02 0800 0685108-02
New Zealand Antarctic Society Inc.
BNZ, Christchurch Branch