Preview of Award 1115245 - Annual Project Report

Cover

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Project Title:	Increased Connectivity in a Polar Desert Resulting from Climate Warming: McMurdo Dry Valley LTER Program
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Submitting Official (if other than PD\PI):	Diane M McKnight Principal Investigator
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Signature of Submitting Official (signature shall be submitted in accordance with agency specific instructions)	Diane M McKnight

Accomplishments

*** What are the major goals of the project?**

The LTER monitoring and core manipulative experiments focus on the response of communities and ecosystem processes to changes in environmental and climatic conditions and how the geographically isolated populations connect to the landscape. This helps us understand the Dry Valley ecosystem responses to climate variation and human impact. More specifically, the subhypotheses of MCM4 are:

H1. Pulse events (wind and melt) increase hydrological and biological connectivity across landscape units.
H2. Summer pulses of liquid water produce transient moist habitats with altered biological diversity and ecological complexity.
H3. Increased connectivity enhances rate, variance and the coupling of biogeochemical processes across the landscape.
H4. The emergence of wetted habitats varies with local geography (i.e., slope, aspect, elevation and geomorphology) and history of landscape development.

LTER observational studies mainly target the spatial distribution of mesofauna, their phylogeography, how they are adapted to survive in the harsh conditions experienced in the Dry Valleys and how they are affected by increased ecological connectivity.

*In continuance of past annual reports whereby the reporting period has lagged by one full field season, this submission presents Accomplishments and Participants sections specific to the 2011-2012 field season (April 2011 - March 2012), all other sections reflect the actual reporting period of April 2012 - March 2013. All sections will be aligned for the April

2013 - March 2014 submission.

*** What was accomplished under these goals (you must provide information for at least one of the 4 categories below)?**

Major Activities: Continuation of Monitoring Activities and Long-term Data Analysis.

We installed a telemetry system to provide year-round data collection of six stream, twelve meteorological, and two lake sites in the Taylor, Wright, and Miers Valleys. The meteorological and glacier mass balance measurements were continued. The Geochemistry team also conducted chemical analysis of water samples for major ions and dissolved organic carbon for the on-going monitoring programs of the LTER.

Streams and Lakes: We continued the operation of fourteen existing stream gages in Taylor and Wright Valleys. We constructed two new stream gages upstream of existing gages in the anticipation of continued rise of Lake Fryxell. We installed a new stream gage on Adams Stream, a glacial meltwater stream flowing into Lake Miers in Miers Valley. We removed one stream gage at House Stream that has been in operation since 1993 due to degradation of the control and the inability to maintain the stage-discharge rating due to lake level rise. We purchased, installed, and operated a new streamflow database software program which retains all previous data work-ups and enables the LTER to remain current with standard USGS streamflow techniques.

Microbial mats in the stream were sampled over the 2011-12 field season at the 16 established transects, 3 new transects, and the two long-term rehydration experiments (Relict Channel and Wormherder) to continue the long-term monitoring program. In addition, live diatom cultures from these mats have been maintained at the University of Colorado to facilitate laboratory experiments.

Members of the LTER limnology group continued long-term measurements of primary-secondary production, nutrients, ions, carbon-nitrogen budgets, and physical limnology in four lakes in the McMurdo Dry Valleys, during the months of November and December 2011, and early January 2012. They also continued core measurements in Lake Miers, a lake included in MCM IV at which long-term measurement began during the 2008-2009 season.

During the 2011-12 field season, the Geochemistry team sampled the streams and ponds in the Taylor Valley. The team collected samples from the streams to look at various in-stream processes. Several streams were sampled along transects from the source at the glacier down to the mouth to look at the downstream variability of chemistry. Two streams were sampled near the mouth of the stream over a 24-hour period to assess diel variability. These two streams were sampled daily during the flow season to assess seasonal variability. Samples were collected from the hyporheic zones of the stream channel to assess mixing of waters between the stream channel and the active wetted margins along the edges of the streams. Samples were analyzed for major ions, stable isotopes of oxygen and deuterium of the water and other analytes.

LTER technician Amy Chiuchiolo and PI John Priscu, in collaboration with MCM LTER PIs Dr. Peter Doran and Dr. Michael Gooseff, and MCM LTER PhD student Maciej Obryk, spent time between 15 April 2011 and 31 March 2012 calculating long-term temperature changes in the Taylor Valley lakes (Lake Fryxell, Lake Hoare, East Lobe Boney, West Lobe Bonney) using 21 years of CTD data that were collected as part of the core LTER limnological monitoring program. Temperature

measurements from the SeaBird SBE 25 Sealogger CTD SBE 01-01/F temperature sensor were used to calculate the annual heat content (cal) in each lake between 1989 and 2011.

Manipulative Experiments and Biodiversity

Microbial Diversity: We have extracted and sequenced approximately 300 DNA samples for the project to develop a baseline of microbial diversity in the valleys. Samples have come from all recognized habitats in the MDV and detailing the diversity and distribution of small subunit rRNA genes throughout the valleys will allow us to assess hydrological and biological connectivity across landscape units.

We continue to analyze the microbial community composition and biodiversity data from our manipulative experiments SWEPT and Lake ICE to investigate the effect of summer pulses of moisture, nutrients, and material on the microbial communities in both the terrestrial and aquatic environments. Microbial protein synthesis, expression, and activity monitoring, coupled with similar measurements in our manipulative experiment Lake ICE allow us to determine how increased connectivity affects microbial response and biogeochemistry across the landscape.

During the 2011-2012 field season, Dr. Hans-Peter Grossart from the Leibniz-Institute of Freshwater Ecology and Inland Fisheries in Berlin, Germany, worked as a collaborator with John Priscu, studying the diversity and ecological role of aquatic fungi in the lakes. Samples were collected at almost all core monitoring depths and fractionated in >5.0µm + <5.0>0.2µm fractions for DNA analysis. Samples were collected at a few selected depths and fractionated in >5.0µm + <5.0>0.2µm fractions for RNA analysis. Calcofluor White and Dapi stains were used to stain cells for fungal and bacterial counts. BrdU, a synthetic nucleoside that is an analogue of thymidine, was used in incubations for determination of active fungi and bacteria. Samples for cultivation were collected from a few selected depths and were cultivated using selective media. Dr. Grossart also collected cyanobacteria biofilm and sediment samples from the lake shores at Lakes Fryxell, East Lobe Bonney, West Lobe Bonney and Mummy Pond. These samples will be analyzed with molecular methods for fungal biodiversity.

Stoichiometry Experiment: Established in 2006-07 in Fryxell and Bonney Basins, this experiment aims to determine which nutrients (i.e. carbon, nitrogen, or phosphorus) limit various aspects of soil biogeochemistry and biota in these two basins. Our hypothesis is that additional carbon will stimulate biogeochemical processes and faunal populations in both basins, but nitrogen will secondarily limit these soil properties in Fryxell Basin, while phosphorus will secondarily limit these properties in Bonney Basin. In total, 112 samples (one per plot) were collected from the experiment in the first year prior to the application of the various treatments to determine initial soil biogeochemical properties and faunal community structure. In addition, *in situ* soil respiration rates were measured shortly after the treatments were applied. Nutrients were added in the 2008-09 field season according to the experimental design, and the first samples were collected this season. After samples had been collected nutrients were applied again followed by soil respiration measurements. Nutrients were added, soil samples were taken and soil respiration rates were measured again in the 2009-2010 and 2011-2012 season.

Biocomplexity of Soil Fauna: This study was conducted in collaboration with the New Zealand Antarctic team led by Ian Hogg. The study aimed to determine the biogeography of biota throughout South Victoria Land and the end product will be a model which will be used to determine the factors underlying biocomplexity in the

Dry Valleys, including species distribution and belowground community composition. Our role was to extract, count and identify the soil mesofauna to assure methods and analyses were comparable to the LTER data. Another 60 samples for this project were processed off the continent in 2012, which was not the preferred method. The culture of tardigrades on algae was established and continues at CSU. Cultures of *Plectus* spp. were established and continues at CSU and BYU. These cultures have been used to describe the lifecycle of *P. murrayi*, and explore transcriptional profiling relative to environmental stress, including freezing and desiccation.

Specific Objectives: Specific Project Objectives

Meteorological Stations: Because of rising lake level at Lake Hoare and the anticipated flooding of the meteorological station, the Beacon Station was relocated to the new site for the Lake Hoare station -- on a hill near the edge of the lake. This station will run simultaneously with the current Lake Hoare station to establish an overlapping record to quantify any differences due to station location. We hope the overlap runs for two years.

Microbial Biodiversity in Streams and Soils: Our goals were to determine how flow and geomorphology explain the observed variation in microbial communities within the Dry Valleys. Specifically, how might different community types respond to flow variables as well as nutrient availability in terms of their biomass, community composition, and species interactions.

Active layer surface moisture was measured in vicinity of Lake Fryxell camp: a comprehensive permafrost and active layer profile, and a soil moisture monitoring array. The profile installation was designed to limit perturbation to the ice-cement/soil habitat system by placing excavated soil in an insulated cooler. Sensors (Onset HOBO 12-bit temperature sensors and Campbell Scientific TDR soil moisture probes) were installed in November.

Miers Elevational Transect: In Miers Valley a new long-term monitoring transect was installed this season. The aim is to get a better understanding of the soil biodiversity in this Valley and to investigate how environmental change will impact this biodiversity in Miers compared to Taylor Valley. Three sites along the valley slope were selected, one at low, medium and high elevation. At each site, three soil polygons were selected in each of which three soil samples were collected.

Pulse Press Project: This new experiment will investigate the effects of soil wetting either through continuous flow of water or through intermittent pulses of water. We have established 3 plots (~5 m wide and 15 m long) on a hill slope adjacent to Many Glaciers Pond near the mouth of Taylor Valley. One of these plots will be a control plot (the C-plot) for high water application and it will receive controlled water application each season, the second plot will receive water every year (the H-plot) and the third plot will be the pulse plot (L-plot, for low water application) receiving water application once every 2-3 years. Water from the pond will be pumped uphill into a 1000 gallon black plastic tank and then slowly released by gravity from the tank into a trench approximately 3 m above the press and pulse plots. As the water leaves the tank, it will flow through a UV irradiance system (inline) in an attempt to kill off any bacteria or plankton that are collected from the pond. In this way, we can ensure a more pure treatment to the soils. That is, any response of microbial community changes in the press and pulse plots can be attributed to the effects of the water, rather than introduction from the pond. Time 0 Sampling – prior to 01 January 2012, we sampled soils in 4 longitudinal transects extending from uphill to

downhill at every 0.5 meter along the length of the plot (i.e., 4 'replicate' samples from the same distance down the slope of the hill).

In January 2012, we instrumented one transect of each of the plots with thermocouples (to measure soil temperature), soil moisture and temperature probes, and soil tension sensors. All sensors are connected to multiplexers and a single Campbell Scientific datalogger at each plot. We expected to instrument our sites with a combination of soil moisture and temperature probes at 5 cm, 20 cm, and 35 cm below the soil surface, but soil thawed depths were generally less than 20 cm.

Ecological History: Work on the environmental history of the McMurdo Dry Valleys is helping to bridge the gap between LTER science and social science. In the MCM IV Renewal Proposal we suggested that the McMurdo Dry Valleys offer an excellent place for thinking about the integration of science and social science as a result of the relatively simplified history of the region. Although only in its early stages our research is already starting to raise new science questions that can be asked about the McMurdo Dry Valleys. This work also offers an example of using science to better understand history by using LTER science to examine the validity of historical documents such as Griffith Taylor's original sledging diaries. We are starting to make plans for a digital archive of historical photos of the Dry Valleys that will be useful both to scientists and environmental historians. As our research continues, opportunities for integrating science and social science will continue to increase.

Significant Results:

Climate Drivers of Dry Valley Ecosystems: The solar radiation intensity is increasing and has done so for the past decade whereas summer air temperatures have not exhibited a trend during the same period. Together these conditions are increasing heat to the lakes, soils, and to the glaciers. Glacier melt has been increasing. The cause of the increasing solar radiation is unclear at this time. We think that warming soils and warming stream waters might be causing subsurface ice to melt creating substantial geomorphic change in places. We consider these changes analogues for what future warming air temperatures may cause.

The overall trend of glacier mass balance is for increasingly negative balances, that is, glaciers losing mass. Winter snow fall remains low and increased summer losses result in negative balances. However the small magnitude of the negative balance ~10 cm water equivalent averaged over the glacier is very small compared to the thickness of these glaciers consequently little or no change in glacier extent.

At this point in our LTER project, we have been collecting data for 2 decades, and a little over one decade ago, our system experienced a significant 'flood year' due to intense warm and sunny conditions for a few weeks during the austral summer. The result was very high streamflows, significant rise in lake levels, and an increase in snow and ice melt across the landscape. This past year we have been carefully analyzing the historic record of lake level and lake heat content changes over the past decades. Lake levels have risen several meters since the 1970s, demonstrating that there has been a net positive energy balance across this landscape (i.e., more melt water is generated and transferred to the lakes than is removed annually by evaporation in the summer and sublimation of the ice cover year-round). The record shows clear departures from this overall rising trend, particularly in the 1990s.

We deployed an in-situ nitrate analyzer in Von Guerard Stream during the 2011-12 field season and tracked changes in stream nutrient concentrations with variability in stream discharge and solute flux. Our conclusions from this work are that

primary productivity is not a strong control on nutrient retention in these streams, as there is consistent re-aeration from the atmosphere and very little dissolved oxygen deficit that occurs on a diel basis.

Stream Microbial Mats: The four main microbial mat types (red, orange, green, and black) collected from transects since the 1993-1994 field season and through 2011-2012 were analyzed to elucidate relationships between mat biomass and 20 years of flow measurements. Additionally, the presence/absence of different mat types were compared against flow, nutrient, and substrate variables to identify factors that promote mat persistence. We found that overall, mat communities are positively correlated with greater average discharges, although the amount of variation explained differs in magnitude based on stream geomorphology

To compliment these analyses, we analyzed the elemental (C:N:P) and stable isotopic (C and N) compositions of different mat types sampled at transects throughout the Dry Valleys to identify differences between assemblages and under different nutrient concentrations. We found that mat types differ in both their nutrient ratios and isotopes. Green mats were low in both C:N and C:P ratios, while black mats are variable in C:P but not C:N, and orange mats variable in C:N and not C:P. Green mats also have the lowest δ13C signatures, while orange have greatest, while black are intermediate. All mats are variable in their δ15N signatures with the exception of black mats, which are close to the atmospheric standard, and may suggest fixation. Mat δ15N signatures become more enriched towards the Ross Sea for all mat types, and this trend is particularly strong for orange mats. This may suggest that nitrogen cycling in mats is tighter towards the coast where nitrogen is less available than it is towards Taylor Glacier. Conversely, there was little variation in δ13C isotopes over Taylor Valley, suggesting mat habitat or community type is more important than geographic location for this analyte. Despite these differences in isotopic signatures over a gradient on nutrients, mat nutrient stoichiometry remained relatively unchanged.

We examined the relationship between diatom community composition and flow intermittency in seven Dry Valley streams along a gradient in flow. Multivariate analyses showed that diatom community composition was correlated with flow intermittency. In particular, two genera represented by numerous endemic species in Dry Valley habitats, *Hantzschia* and *Luticola*, had high abundances in moderately and highly intermittent streams, respectively. These results indicate that multiple metrics of biodiversity may be useful in assessing the response of diatom communities to changing hydrologic regime, and the hydrologic regime plays an important role in the Dry Valleys by maintaining heterogeneity in habitats and allowing endemic species to persist.

Using these results as a predictive framework, we looked for patterns between diatom communities and bacteria in Dry Valley microbial mats. Specifically, they examined the relationships between diatoms and bacteria at the community and taxon levels using high-throughput pyrosequencing for bacteria and morphological identification for diatoms. They found significant relationships between diatom communities and the communities of cyanobacteria and heterotrophic bacteria, as well as species interactions. However, the strength of correlations between heterotrophic bacteria and diatoms varied along a hydrologic gradient, indicating that flow regime may influence the overall community structure. Phylogenetic consistency in the co-occurrence patterns suggests that the associations are ecologically relevant.

All lakes showed increasing heat content over the past decade. Correlations

between heat content, air temperature and lake ice thickness showed a correlation between heat content and ice thickness, with heat content increasing as ice thickness decreased over the past decade.

Tardigrade trophic interactions: After two observations of tardigrades attacking nematodes in the Crary Lab during the 2011-2012 field season, the Wall lab set up an experiment to test whether tardigrades have the potential to reduce numbers of nematodes, using existing cultures of *Acutuncus antarcticus* tardigrades and *Plectus murrayi* nematodes. The experiment is in an initial phase where we are developing a methodology to incubate nematodes in the presence or absence of tardigrades and recover nematodes and tardigrades afterwards to determine changes in abundance.

Pulse Press Project: Results for soil moisture, salinity (electrical conductivity of 1:2 soil: water extract), and pH indicate that there is high spatial variation in soil salinity (consistent with previous studies in this region of Taylor Valley, that salinity is generally higher near the crest of slope and lower near the lake margin, and the plots which have similar spatial pattern of salt distribution but vary in mean salt content. The mean EC (micro S/cm) value for the control plot (control) was 122 +/- 78; for the L treatment, 189 +/- 169; and for the H treatment, 113 +/- 112. The amount of soluble salts in the plots should be sufficient to examine mobilization and movement in response to the water addition treatment levels.

Key outcomes or Other achievements:

Stream Ecosystem Responses: Our research indicates that flow regime is important to regulating and maintaining microbial communities in the Dry Valleys, both at the community- and taxon-scales. Collectively, these results for trends in biomass and elemental composition allow us a better picture of long term trends, as well as ecosystem connectivity throughout the Dry Valleys.

Soil Biocomplexity: The preliminary distributional maps for soil mesofauna indicate landscape-scale patterns for all species, suggesting that dispersal limitation may limit species presence within some areas. At smaller scales we observed associations between some species and disassociations between others, suggesting that local properties or biotic interactions may influence community composition here consistent with other data. The data collected this season support the earlier findings. In addition we found a nematode species (*Cuticularia* sp.) previously not recovered from any of the Dry Valleys. This raises questions about how thoroughly the Dry Valleys have been sampled for invertebrate taxa, as well as dispersal, range expansion, and invasive species.

Paleolimnology: An historical diatom record for Lake Fryxell is now complete. It shows that the early lake stage, ca. 35,000 cal years BP of the record is characterized by Mayamea atomus f. permitis, a species rarely reported in modern Antarctic Dry Valley environments. An extended period from ca. 35,000 to 19,000 cal years BP is characterized by low diatom abundance, with dominant taxa Luticola spp., Muelleria spp., and Diadesmis contenta. The modern assemblage was established ca. 13,000 cal years BP, after two relatively brief transitional stages. One key species for this recent period, Navicula lineola var. perlepida, is absent in surface sediments and the modern environment, indicating an environmental change within the last several centuries. The diatom assemblage is compared to modern diatom communities in Dry Valley streams, which provide the most complete information on diatom distributions in this region. Although precise environmental interpretation of the core is hampered by limited knowledge of environmental constraints on many of the diatom taxa present in the lake core, the data provide important new insights into the history of Glacial Lake Washburn.

We have also completed work on a new Lake Hoare record. Up to 2.3m long sediment sequences were recovered from the deepest part of Lake Hoare in Taylor Valley, southern Victoria Land, Antarctica. Sedimentological, biogeochemical, and mineralogical analyses revealed a high spatial variability of these parameters in Lake Hoare. Five distinct lithological units were recognized. Radiocarbon dating of bulk organic carbon samples from the sediment sequences yielded apparently too old ages and significant age reversals, which prevented the establishment of reliable age-depth models. However, cross correlation of the sedimentary characteristics with those of sediment records from neighboring Lake Fryxell indicates that the lowermost two units of the Lake Hoare sediment sequences were probably deposited during the final phase of proglacial Lake Washburn, which occupied Taylor Valley during the late Pleistocene and early Holocene. High amounts of angular gravel and the absence of fine-grained material imply a complete desiccation with subaerial conditions in the Lake Hoare basin in the middle of the Holocene. The late Holocene (< c. 3300 calendar yr BP) is characterized by the establishment of environmental conditions similar to those existing today. A late Holocene desiccation event, such as proposed in former studies, is not indicated in the sediment sequences recovered.

*** What opportunities for training and professional development has the project provided?**

We have provided numerous opportunities for training of undergraduate and graduate students and post-doctoral fellows as described in the following examples:

An opportunity for undergraduate involvement was provided through REU funds to Ran Li, a student in the Statistics department at Penn State. She carefully analyzed time series data from our database of meteorological, hydrological, and limnological data using the Extremes Toolkit, created and provided by UCAR (http://www.assessment.ucar.edu/toolkit/). Much of the data collected does not fit the classical distributions of extreme value theory (e.g., Generalized Extreme Values Distribution), and therefore are difficult to analyze. Conclusions from this work are being refined.

Caitlin Wolf and Terril Yazzie, female minority undergraduates at University of New Mexico, have mastered basic molecular biology techniques and are learning how to analyze biodiversity data. Both have applied graduate school.

At Ohio State University, three undergraduate students continue to analyze both stream and lake water samples for dissolved Si and titration alkalinity. This is part of our on-going monitoring program of the biogeochemistry of the MCM aquatic ecosystems. Ms. Leslie and Ms. Brown continue their graduate research.

At the University of Colorado, two undergraduate students have been involved in studying algae in the lakes (Frank Dragotta) and stream (Josh Darling).

During the summer of 2011, John Priscu invited Paloma Lopez, an undergraduate student in Biology at the University of California, Santa Cruz, to work in the lab under the mentorship of PhD student Alex Michaud. Paloma was funded though the MARC (Minority Access to Research Careers) program. She worked on a project characterizing a red pigmented bacteria isolated from a hailstone, and learned standard microbiology lab techniques including cultivation, phenotypic characterization, and molecular methods that will be valuable in her future as she explores a career in microbiology.

We have mentored one post-doc, Jon Telling, who was engaged cryoconite research to establish linkage between the biogeochemistry in the cryoconite holes and the biology within the holes. His interaction with the various PI's of this interdisciplinary project has expanded his perspective on how his skills and knowledge can be of value to other disciplines. In addition, he has written several proposals and scientific papers, thus becoming an active member of the science.

The Priscu Lab has continued to provide opportunities for training and development in microbiology to high school students over the past year. From November 2011 – March 2012, Alex Michaud, a PhD student in the Priscu Lab, mentored Chase Jordan, an 8th grader at the Chief Joseph Middle School in Bozeman, MT in investigating the diversity and abundance of ice nucleation active bacteria. Chase won a blue ribbon, gold medal (first overall), and was nominated for the Broadcom Masters competition at the regional science fair. He will be competing at the Montana state science fair in March 2012.
Alex is currently mentoring Sean Erwin, an 8th grader at the Greater Hartford Academy of Math and Science in Hartford, Connecticut, on experimental induction, observation, and quantification of bacterial ice nucleation.

*** How have the results been disseminated to communities of interest?**

We have participated in numerous opportunities for presetning our research results to the broad ecological and earth science communities as described in the following examples:

Diana Wall was invited to give the following talks:

- *Soil invertebrates and climate change in hot and cold deserts.* Society of Experimental Biology Symposium on Physiology of Environmental Gradients, Salzburg, Austria, June 2012.
- *Life in an Extreme Desert Ecosystem: the McMurdo Dry Valleys*. Department of Geology, Portland State University, Portland, May 2012.
- *Soil biodiversity: is it critical for ecosystem functioning and sustainability*. Earth Day 2012 Symposium. Purdue University, April 2012.
- *Soil biodiversity, natural capital, and ecosystem services.* Planet under Pressure Meeting, London, March 2012.
- *Linking soil biodiversity and Terrestrial Ecosystem Science*.
- Department Nematology, University of California, Riverside, February 2012

Diana Wall served as a member of McMurdo Area Users Committee, the Scientific Committee on Antarctic Research (SCAR) Development Council, USA Standing Committee on Life Sciences, NRC Committee on Future Science Opportunities in Antarctica and the Southern Ocean, New Zealand Antarctic Research International Science Panel, Scientific Committee on Antarctic Research (SCAR) Antarctic Ecosystem Thresholds and Resilience (AntETR), Life Sciences Program.

Diana Wall was an Invited Participant, Antarctic Thresholds – Ecosystem Resilience and Adaptation Scientific Writing Group, Scientific Committee on Antarctic Research, Germany, October.

Diana Wall was an Invited Participant, NRC Workshop on Legacy and Lessons of the International Polar Year 2007-2008, Washington, DC, June.

Diana Wall was an Invited Participant, Antarctic Conservation for the 21st Century workshop, Scientific Committee on Antarctic Research, Kruger National Park, South Africa, May.

Diana Wall organized (with Richard Bardgett, Wim van der Putten, Johan Six and Luca Monaterelli) the Open Meeting of the Global Soil Biodiversity Initiative, London, March 2012.

Ross Virginia contributed to the organization and participated in a workshop on polar governance issues focused on the Antarctic treaty system and comparisons with Arctic governance arrangements.

Byron Adams, Diana Wall, Jeb Barrett and Andrew Fountain hosted a workshop to develop a Terrestrial Observation Network for the McMurdo Dry Valleys. Portland, OR, July 2012.

*** What do you plan to do during the next reporting period to accomplish the goals?**
No change.

Products

Journals

Stanish, Lee F.; Kohler, Tyler J.; Esposito, Rhea M. M.; Simmons, Breana L.; Nielsen, Uffe N.; Wall, Diana H.; Nemergut, Diana R.; McKnight, Diane M. (8/1/12). Extreme streams: flow intermittency as a control on diatom communities in meltwater streams in the McMurdo Dry Valleys, Antarctica. *CANADIAN JOURNAL OF FISHERIES AND AQUATIC SCIENCES*. 69 (8), 1405-1419.

Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Michaud, Alexander B.; Sabacka, Marie; Priscu, John C. (11/1/12). Cyanobacterial diversity across landscape units in a polar desert: Taylor Valley, Antarctica. *FEMS MICROBIOLOGY ECOLOGY*. 82 (2), 268-278.

Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Dolhi, J. M., N. Ketchum, R.M. Morgan-Kiss (4/20/12). Establishment of Microbial Eukaryotic Enrichment Cultures from a Chemically Stratified Antarctic Lake and Assessment of Carbon Fixation Potential. *Journal of Visualized Experiments*. Not Set Not Set.

Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = No ; DOI: 10.3791/3992

Sabacka, Marie; Priscu, John C.; Basagic, Hassan J.; Fountain, Andrew G.; Wall, Diana H.; Virginia, Ross A.; Greenwood, Mark C. (6/15/12). Aeolian flux of biotic and abiotic material in Taylor Valley, Antarctica. *GEOMORPHOLOGY*. 155 102-111.

Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Thurman, Jill; Parry, Jacqueline; Hill, Philip J.; Priscu, John C.; Vick, Trista J.; Chiuchiolo, Amy; Laybourn-Parry, Johanna (11/1/12). Microbial dynamics and flagellate grazing during transition to winter in Lakes Hoare and Bonney, Antarctica. *FEMS MICROBIOLOGY ECOLOGY*. 82 (2), 449-458.

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Fountain, Andrew G.; Campbell, John L.; Schuur, Edward A. G.; Stammerjohn, Sharon E.; Williams, Mark W.; Ducklow, Hugh W. (4/1/12). The Disappearing Cryosphere: Impacts and Ecosystem Responses to Rapid Cryosphere Loss. *BIOSCIENCE*. 62 (4), 405-415.

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Magalhaes, Catarina; Stevens, Mark I.; Cary, S. Craig; Ball, Becky A.; Storey, Bryan C.; Wall, Diana H.; Tuerk, Roman; Ruprecht, Ulrike (9/19/12). At Limits of Life: Multidisciplinary Insights Reveal Environmental Constraints on Biotic Diversity in Continental Antarctica. *PLOS ONE*. 7 (9), 1-5.

Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Chown, S. L., J. E. Lee, K. A. Hughes, J. Barnes, P. J. Barrett, D. M. Bergstrom, P. Convey,3 D. A. Cowan, K. Crosbie, G. Dyer, Y. Frenot, S. M. Grant, D. Herr, M. C. Kennicutt, M. Lamers, A. Murray, H. P. Possingham, K. Reid, M. J. Riddle, P. G. Ryan, Lo (7/13/12). Challenges to the future conservation of the Antarctic. *Science*. 337 (6091), 158-159.

Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1126/science.1222821

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Status = PUBLISHED; Acknowledgment of Federal Support = Yes

Stanish, L. F., O'Neill, S. P., Gonzalez, A., Legg, T. M., Knelman, J., McKnight, D. M., Spaulding, S. and Nemergut, D. R. (9/24/12). Bacteria and diatom co-occurrence patterns in microbial mats from polar desert streams. *Environmental Microbiology*. 15 1115–1131.

Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/j.1462-2920.2012.02872.x

Priscu, J.C. and K.P. Hand (4/1/12). The microbial habitability of extraterrestrial icy worlds: A view from Earth. *Microbe*. 7 (4), 167-172.

Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

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Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.3354/ame01604

Fierer, N., J. W. Leff, B. J. Adams, U. N. Nielsen, S. T. Bates, C. L. Lauber, S. Owens, J. A. Gilbert, D. H. Wall, and J. G. Caporaso (12/26/12). Cross-biome metagenomic analyses of soil microbial communities and their functional attributes. *Proceedings of the National Academy of Sciences of the United States of America*. 109 (52), 21390–213.

Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1073/pnas.1215210110

Books

Book Chapters

Mulder, C. Boit, A. Mori, S. Vonk, J.A. Dyer, S.D. Faggiano, L. Geisen, S. González, A.L. Kaspari, M. Lavorel, S. Marquet, P.A. Rossberg, A.G. Sterner, R.W. Voigt, W. Wall, D.H. (2012). Distributional (In)Congruence of Biodiversity-Ecosystem Functioning. *Global Change In Multispecies Systems Advances i.* Woodward, Guy ; Jacob, Ute. Elsevier. 1.

Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = Yes ; ISBN: 9780123969927.

Thesis/Dissertations

Conference Papers and Presentations

Howkins, Adrian (8/1/12). *Putting the 'Long Term' in the LTERs:History in and of the LTER network*. Ecological Society of America Annual Conference. Portland, OR.

Status = OTHER; Acknowledgement of Federal Support = Yes

Howkins, A., Lyons, B., Fountain, F. (7/1/12). *Griffith Taylor's Missing Lake: An Example of How History Can Influence Science in McMurdo Dry Valleys*. SCIENTIFIC COMMITTEE ON ANTARCTIC RESEARCH OPEN SCIENCE CONFERENCE. Portland, OR.

Status = OTHER; Acknowledgement of Federal Support = Yes

Howkins, A. (4/1/12). *Taylor's Valley: Integrating Science, Society, and the Environment in the early human history of the McMurdo Dry Valleys, Antarctica*. International Polar Year. Montreal, Canada.

Status = OTHER; Acknowledgement of Federal Support = Yes

Howkins, Adrian (4/1/12). *Bringing to life a 'Valley of the Dead': exploration and environmental change in the McMurdo Dry Valleys, Antarctica*. Organization of American Historians Annual Meeting. Milwaukee, WI.

Status = OTHER; Acknowledgement of Federal Support = Yes

Kohler, T. J. and D. M. McKnight (9/1/12). *MICROBIAL MAT NUTRIENT STORAGE IN THE MCMURDO DRY VALLEYS, ANTARCTICA*. Long Term Ecological Research (LTER) All Scientists Meeting,. Estes Park, CO.

Status = OTHER; Acknowledgement of Federal Support = Yes

Mass, A., D. McKnight, and E. Simmons (9/1/12). *USING NARRATIVE TO DEVELOP ENVIRONMENTAL EMPATHY: STORIES ABOUT POLAR REGIONS IN THE LTER SCHOOLYARD BOOK SERIES*. Long Term Ecological Research (LTER) All Scientists Meeting. Estes Park, CO.

Status = OTHER; Acknowledgement of Federal Support = Yes

Stanish, L.F., T. M. Legg, D. R. Nemergut, S. P. O'Neill, and A. Gonzalez-Peña (8/1/12). *THE UTILITY OF C-SCORE ANALYSIS FOR EXAMINING BACTERIAL CO-OCCURRENCE PATTERNS IN LARGE SEQUENCING DATASETS*. Ecological Society of America Annual Meeting. Portland, OR.

Status = OTHER; Acknowledgement of Federal Support = Yes

Kohler, T. J., L. F. Stanish, D. Liptzin, J. L. Baeseman, and D. M. McKnight (4/1/12). *MICROBIAL MAT RESILIENCE IN MCMURDO DRY VALLEY STREAMS, ANTARCTICA*. International Polar Year. Montreal, Canada.

Status = OTHER; Acknowledgement of Federal Support = Yes

Stanish, L.F., C. Washenberger, S. P. O'Neill, A. Gonzalez-Peña, T. M. Legg, J. Knelman, D. M. McKnight, S. Spaulding, and D. R. Nemergut (4/1/12). *BACTERIAL AND DIATOM CO-OCCURRENCE PATTERNS IN STREAM MICROBIAL MATS FROMT THE MCMURDO DRY VALLEYS, ANTARCTICA*. International Polar Year. Montreal, Canada.

Status = OTHER; Acknowledgement of Federal Support = Yes

Fountain, A.G. (12/1/12). *Tracking glacier change*. American Geophysical Union Meeting. San Francisco, CA.

Status = OTHER; Acknowledgement of Federal Support = Yes

Fountain, A.G. and Cryets, T. (12/1/12). *Englacial Matters*. American Geophysical Union Meeting. San Francisco, CA.

Status = OTHER; Acknowledgement of Federal Support = Yes

Fountain, A., Basagic, H., Thoryneycroft, K., McCabe, G., Fagre, D. (10/1/12). *The spatial variation of glacier retreat across the Rocky Mountain West, USA*. MtnClim Meeting. Estes Park, CO.

Status = OTHER; Acknowledgement of Federal Support = Yes

Fountain A.G., Basagic, H.J., Hoffman, M. (7/1/12). *Glacier Change in the McMurdo Dry Valleys, Beginning of the End?*. ? Scientific Committee on Antarctic Research Symposium. Portland, OR.

Status = OTHER; Acknowledgement of Federal Support = Yes

Hoffman, M., Fountain A.Liston, G. (7/1/12). *Spatial variations in glacier runoff in the McMurdo Dry Valleys*. Scientific Committee on Antarctic Research Symposium. Portland, OR.

Status = OTHER; Acknowledgement of Federal Support = Yes

Fountain A.G., Pettersson, R., Levy, J. (7/1/12). *A landscape on the threshold of change: The McMurdo Dry Valleys*.

Scientific Committee on Antarctic Research Symposium. Portland, OR.

Status = OTHER; Acknowledgement of Federal Support = Yes

Levy, J., Fountain, A., Welch, K., Lyons, W.B. (7/1/12). *Hyper-saline "wet patches" in taylor Valley, McMurdo Dry Valleys: Groundwater formation in the absence of precipitation*. Scientific Committee on Antarctic Research Symposium. Portland, OR.

Status = OTHER; Acknowledgement of Federal Support = Yes

Levy, J., Fountain, A., Welch, K., Lyons, W.B. (7/1/12). *Water track control of active layer thermal properties and ecosystem structure in taylor Valley, McMurdo Dry Valleys, Antarctica: Hydrological connectivity along permafrost hillslopes*. Scientific Committee on Antarctic Research Symposium. Portland, OR.

Status = OTHER; Acknowledgement of Federal Support = Yes

Lyons, W., Virginia, R., McKnight, D., Doran, P., Fountain, A., Gooseff, M., Priscu, J., Wall, D. (5/1/12). *Ecosystem Change in Taylor Valley, Antarctica: Twenty Years of Long-Term Monitoring and Interdisciplinary Research*. International Polar Year Symposium. Montreal, Canada.

Status = OTHER; Acknowledgement of Federal Support = Yes

Langford, ZL, MN Gooseff, and DJ Lampkin. (12/1/12). *Characterizing spatiotemporal dynamics of wetted soils across a polar desert landscape, McMurdo Dry Valleys, Antarctica*. American Geophysical Union. San Francisco, CA.

Status = OTHER; Acknowledgement of Federal Support = Yes

Li, R, and MN Gooseff (12/1/12). *Extreme Values Analysis of McMurdo Dry Valleys Long Term Ecological Research (LTER)*. American Geophysical Union Fall Meeting. San Francisco, CA.

Status = OTHER; Acknowledgement of Federal Support = Yes

Bernzott, ED, MN Gooseff, and DM McKnight (8/1/12). *Nutrient cycling in glacial meltwater streams of the McMurdo Dry Valleys of Antarctica is strongly dependent on stream-sediment interactions*. Ecological Society of America Annual Meeting. Portland, OR.

Status = OTHER; Acknowledgement of Federal Support = Yes

Langford, ZL, MN Gooseff, and DJ Lampkin (7/1/12). *Characterizing spatiotemporal dynamics of wetted soils across a polar desert landscape, McMurdo Dry Valleys, Antarctica*. SCIENTIFIC COMMITTEE ON ANTARCTIC RESEARCH OPEN SCIENCE CONFERENCEand. Portland, OR.

Status = OTHER; Acknowledgement of Federal Support = Yes

Gooseff, MN, JC Priscu, A Chiuchiolo, PT Doran, and M Obryk (7/1/12). *Decadal heat accumulation in ice-covered lakes of the McMurdo Dry Valleys, Antarctica*. SCIENTIFIC COMMITTEE ON ANTARCTIC RESEARCH OPEN SCIENCE CONFERENCE. Portland, OR.

Status = OTHER; Acknowledgement of Federal Support = Yes

Gooseff, MN, D Van Horn, DM McKnight, K Welch, and WB Lyons (7/1/12). *Recent development of thermokarst on previously stable streambanks in Taylor Valley, Antarctica*. SCIENTIFIC COMMITTEE ON ANTARCTIC RESEARCH OPEN SCIENCE CONFERENCE. Portland, OR.

Status = OTHER; Acknowledgement of Federal Support = Yes

Levy, J, A Fountain, M Gooseff, J Barrett, D Wall, U Nielson, B Adams, and WB Lyons (6/1/12). *Active layer processes in the McMurdo Dry Valleys, Antarctica: Decadal trends and experimental responses to changes in soil moisture.*. 10th

International Conference on Permafrost. Salekhard, Russia.

Status = OTHER; Acknowledgement of Federal Support = Yes

Langford, ZL, MN Gooseff, and DJ Lampkin (9/1/12). *Characterizing spatiotemporal dynamics of wetted soils across a polar desert landscape, McMurdo Dry Valleys, Antarctica*. . LTER All Scientists Meeting. Estes Park, CO.

Status = OTHER; Acknowledgement of Federal Support = Yes

Gooseff, MN, S Godsey, JE Barrett, and A Lewkowicz (4/1/12). *The Influence of Snow, Water Bodies, and Permafrost Degradation on Shallow Soil Energy and Hydrology in the Arctic and Antarctic*. European Geosciences Union Annual Meeting. Vienna, Austria.

Status = OTHER; Acknowledgement of Federal Support = Yes

Gooseff, MN, E Bernzott, DM McKnight, and WB Lyons (4/1/12). *Using Multiple Tracer Approaches to Investigate the Influence of Stream-Groundwater Exchange on Biogeochemical Cycling in the McMurdo Dry Valleys, Antarctica*. European Geosciences Union Annual Meeting. Vienna, Austria.

Status = OTHER; Acknowledgement of Federal Support = Yes

Sylvain, Z.A., Wall, D.H., Cherwin, K.L., Peters, D.P.C., Sala, O.E. and Reichmann, L.G. (9/1/12). *Soil animal community structuring along an LTER cross-site moisture gradient*. LTER All Scientists Meeting. Estes Park, CO.

Status = OTHER; Acknowledgement of Federal Support = Yes

Sylvain, Z.A., Wall, D.H., Cherwin, K.L., Peters, D.P.C., Sala, O.E. and Reichmann, L.G. (7/1/12). *Patterns of soil community structure differ by scale and ecosystem type along a large-scale precipitation gradient*. Annual Meeting of the Ecological Society of America. Portland, OR.

Status = OTHER; Acknowledgement of Federal Support = Yes

Virginia, R. A. and J. I. Bradley-Cook (9/1/12). *Polar amplification and consequences for soil carbon cycling. Symposium on Ecosystem Change in Polar and Alpine Environments*. 4th International EcoSummit 2012- Ecological Sustainability Restoring the Planet's Ecosystem Services,. Columbus, Ohio.

Status = OTHER; Acknowledgement of Federal Support = Yes

Virginia, R. A. and M. Kelly (5/1/12). *. Polar environmental trends and their policy implications*. Sierra Club. Hanover, NH.

Status = OTHER; Acknowledgement of Federal Support = Yes

Mikucki, J., E. Auken, K. Sorensen, R. Virginia, S. Tulaczyk, and P. Kyle (7/1/12). *Resistivity mapping in the McMurdo Dry Valleys reveals significant hydrological connectivity in the subsurface environment.*. SCIENTIFIC COMMITTEE ON ANTARCTIC RESEARCH OPEN SCIENCE CONFERENCEPlant and Soil Science Department. Portland, OR.

Status = OTHER; Acknowledgement of Federal Support = Yes

Lyons, W. B., R. A. Virginia, D. M. McKnight, P. T. Doran, A. G. Fountain, M. N. Gooseff, J. C. Priscu, and D. H. Wall (4/1/12). *. Ecosystem change in Taylor Valley, Antarctica: Twenty years of Long-term monitoring and interdisciplinary research*. International Polar Year Symposium. Montreal, Canada.

Status = OTHER; Acknowledgement of Federal Support = Yes

Virginia, R. A. M. R. Albert, M. P. Ayres, I. Baker, N. B. Duthu, X. Feng, M. A. Kelly, L. A. Grenoble, A. Lynge, and T. Pars (4/1/12). *Innovation and international partnerships for interdisciplinary graduate training in polar environmental change*. International Polar Year Symposium. Montreal, Canada.

Status = OTHER; Acknowledgement of Federal Support = Yes

Virginia, R. A. (10/1/12). *Going North: Energy development above the 48th parallel*. Panel presentation, Center for Global Affairs. New York, NY.

Status = OTHER; Acknowledgement of Federal Support = Yes

Kohler, T. J., and D.M. McKnight (3/1/13). *. HYDROLOGIC CONTROLS ON MICROBIAL MAT COMMUNITIES IN THE MCMURDO DRY VALLEY STREAMS OF ANTARCTICA*. Hydrologic Sciences Symposium. Boulder, CO.

Status = OTHER; Acknowledgement of Federal Support = Yes

Kohler, T. J., L. F. Stanish, and D. M. McKnight (2/1/13). *MICROBIAL MAT PERISTENCE AND CHANGE FROM TWO LONG-TERM EXPERIMENTS IN THE MCMURDO DRY VALLEY STREAMS OF ANTARCTICA*. Association for the Sciences of Limnology and Oceanography Aquatic Sciences Annual Meeting. New Orleans, Louisiana.

Status = OTHER; Acknowledgement of Federal Support = Yes

Stanish, L. F., T. J. Kohler, D. R. Nemergut, and D. M. McKnight (2/1/13). *THE LEGACY CONTINUES: PROBING THE BACTERIAL COMMUNITIES IN STREAM MICROBIAL MATS ACROSS AN EXPERIMENTALLY REACTIVATED STREAM CHANNEL*. Association for the Sciences of Limnology and Oceanography Aquatic Sciences Annual Meeting. New Orleans, Louisiana.

Status = OTHER; Acknowledgement of Federal Support = Yes

Khan, A. L., Y. Ding, R. Jaffe, and D. M. McKnight (2/1/13). *USING BLACK CARBON AS A TRACER OF HUMAN IMPACT IN THE MCMURDO DRY VALLEYS, ANTARCTICA*. Association for the Sciences of Limnology and Oceanography Aquatic Sciences Annual Meeting. New Orleans, Louisiana.

Status = OTHER; Acknowledgement of Federal Support = Yes

McKnight, D. M., Doran, P.T., Fountain, A. G., Lyons, W.B., Priscu, J. C., Virginia, R. A., Wall, D. H. (2/1/13). *WHARTON TRIBUTE: LONG-TERM MONITORING OF TWENTY YEARS OF ECOSYSTEM CHANGE IN TAYLOR VALLEY, ANTARCTICA*. Association for the Sciences of Limnology and Oceanography Aquatic Sciences Annual Meeting. New Orleans, Louisiana.

Status = OTHER; Acknowledgement of Federal Support = Yes

Lyons, W. B., Welch, K. A., McKnight, D. M., Doran, P.T., Priscu, J.C., Fountain, A. G. (2/1/13). *GEOCHEMICAL DYNAMICS OF LAKE HOARE, ANTARCTICA: SENSITIVITY TO CLIMATE VARIATION: WHARTON TRIBUTE*. Association for the Sciences of Limnology and Oceanography Aquatic Sciences Annual Meeting. New Orleans, Louisiana.

Status = OTHER; Acknowledgement of Federal Support = Yes

Barrett, J. E., Virginia, R. A., Wall, D. H., Gooseff, M. N., Takacs-Vesbach, C. (2/1/13). *WHARTON TRIBUTE: THE LEGACY OF AQUEOUS ENVIRONMENTS ON SOILS OF THE MCMURDO DRY VALLEYS*. . Association for the Sciences of Limnology and Oceanography Aquatic Sciences Annual Meeting. New Orleans, Louisiana.

Status = OTHER; Acknowledgement of Federal Support = Yes

Doran, P.T., Obryk, M. K., Priscu, J. C. (2/1/13). *WHARTON TRIBUTE: ROBOTIC 3D BIOGEOCHEMISTRY IN AN ICY WORLD ANALOG LAKE OF EAST ANTARCTICA*. Association for the Sciences of Limnology and Oceanography Aquatic Sciences Annual Meeting. New Orleans, Louisiana.

Status = OTHER; Acknowledgement of Federal Support = Yes

Hawes, I., Howard-Williams, C., Jungblutt, A., Doran, P. (2/1/13). *WHARTON TRIBUTE:LAMINATED*

PHOTOSYNTHETIC MICROBIAL MATS IN LAKE HOARE, ANTARCTICA. Association for the Sciences of Limnology and Oceanography Aquatic Sciences Annual Meeting. New Orleans, Louisiana.

Status = OTHER; Acknowledgement of Federal Support = Yes

Adams, B. J., Adhikari, B. N., Wall, D. H., Virginia, R. A. (2/1/13). *WHARTON TRIBUTE: THE RELEVANCE OF BOB'S DRY VALLEYS TO ASTROBIOLOGY - IF MULTICELLULAR ANIMALS LIVE(D) ON MARS, THIS IS HOW THEY COULD DO IT*. Association for the Sciences of Limnology and Oceanography Aquatic Sciences Annual Meeting. New Orleans, Louisiana.

Status = OTHER; Acknowledgement of Federal Support = Yes

Virginia, R. A., Wall, D. H. (2/1/13). *WHARTON TRIBUTE: THE LEGACY OF ANTARCTIC LAKES ON SOIL HABITATS: FROM ECOLS TO LTER*. Association for the Sciences of Limnology and Oceanography Aquatic Sciences Annual Meeting. New Orleans, Louisiana.

Status = OTHER; Acknowledgement of Federal Support = Yes

Wall, D. H., Virginia, R. A. (2/1/13). *WHARTON TRIBUTE: THE LEGACY OF ANTARCTIC LAKES ON SOIL BIODIVERSITY AND THE LTER*. Association for the Sciences of Limnology and Oceanography Aquatic Sciences Annual Meeting. New Orleans, Louisiana.

Status = OTHER; Acknowledgement of Federal Support = Yes

Castendyk, D.N., Gallagher, H. A., Priscu, J. C., Lyons, W.B. (2/1/13). *EFFECTS OF INTERFLOW ON A SHALLOW TRANSITION ZONE WITHIN A PERMANENTLY ICE-COVERED, MEROMICTIC LAKE IN THE MCMURDO DRY VALLEYS, ANTARCTICA*. Association for the Sciences of Limnology and Oceanography Aquatic Sciences Annual Meeting. New Orleans, Louisiana.

Status = OTHER; Acknowledgement of Federal Support = Yes

Other Publications
Alia Khan Adrian Howkins Berry Lyons (7/1/12). *Taylor's "missing" lake: Integrating history into LTER research in the McMurdo Dry Valleys*. LTER Network News Spring 2012, Vol. 25 No. 2.

Status = ACCEPTED; Acknowledgement of Federal Support = Yes

Technologies or Techniques
Nothing to report.

Patents
Nothing to report.

Inventions
Nothing to report.

Licenses
Nothing to report.

Websites
Title: McMurdo Dry Valleys Long Term Ecological Research

URL: http://www.mcmlter.org/

Description: Project webpage.

Title: Priscu Research Group

URL: http://www.homepage.montana.edu/~lkbonney/

Description: The Priscu Research Group website (http://www.homepage.montana.edu/~lkbonney/) was created and is maintained by the Limnology Component of the LTER. This is a general website covering all aspects of Antarctic research that is often used for outreach projects. It receives numerous hits, many which have resulted in requests for images which are now published in textbooks, journals, magazines, and which have been used in numerous outreach products.

Title: The World of Nematodes

URL: http://nemablog.wordpress.com/

Description: The field season of 2011-12 was documented on our blog, which was originally created to increase the public awareness of research undertaken in Antarctica related to the MCM LTER. The blog is for instance followed by several public school classes, which correspond with us during and outside the field season. This field season resulted in many communications with the public.

Title: Biologists in Antarctica

URL: http://biologistsinantarctica.blogspot.com/p/about-biologists.html

Description: This is a blog targeted at elementary and middle school children in inner-city Detroit and rural Virginia to expose traditionally underrepresented groups in university and science curriculum to polar and soil research.

Title: P3 Long-Term Soil Wetting Experiment

URL: http://p3mcmlter.wordpress.com/

Description: The P3 blog is being used to document site visits and data collection for the long-term P3 experiment that was initiated in January 2012. In this experiment we will be monitoring temperature, soil moisture, and soil tension in 3 hillslope plots and experimentally manipulating water content in 2 of these plots. One will have intermittent wetting (pulse) and the other will have more regular wetting (press). We will also collect soil samples regularly for biogeochemical and biological analyses.

Other Products

Nothing to report.

Participants

Research Experience for Undergraduates (REU) funding

How many REU applications were received during this reporting period? 8

How many REU applicants were selected and agreed to participate during this reporting period? 4

What individuals have worked on the project?

Name	Most Senior Project Role	Nearest Person Month Worked
Hassan Basagic	Technician	8

Thomas Nylen	Technician	4
Andrew G Fountain	Co PD/PI	12
Emily Bernzott	Graduate Student (research assistant)	3
Zach Langford	Graduate Student (research assistant)	3
Adam Wlostowski	Graduate Student (research assistant)	3
Ran Li	Research Experience for Undergraduates (REU) Participant	3
Terril Yazzie	Undergraduate Student	7
David Van Horn	Postdoctoral (scholar, fellow or other postdoctoral position)	12
Inigo San Gil	Other Professional	12
Steven Crisp	Graduate Student (research assistant)	3
Chris Jaros	Technician	12
Tyler Kohler	Graduate Student (research assistant)	12
Berry Lyons	Co PD/PI	3
Deborah Leslie	Graduate Student (research assistant)	3
Kathleen Welch	Technician	12
Sue Welch	Technician	3
Christopher Gardner	Graduate Student (research assistant)	3
Devin Castendyk	Faculty	3
Adrian Howkins	Co PD/PI	3
John C Priscu	Co PD/PI	3
Amy Chiuchiolo	Technician	12
Hans Peter Grossart	Faculty	3
Katherina Hell	Graduate Student (research assistant)	12

Paloma Lopez	Undergraduate Student	3
Diana Wall	Co PD/PI	3
Ross Virginia	Co PD/PI	3
John Barrett	Co PD/PI	3
Byron Adams	Co PD/PI	3
Martijn Vandegehuchte	Postdoctoral (scholar, fellow or other postdoctoral position)	12
Cecilia Tomasel	Technician	3
Sabrina Saurey	Graduate Student (research assistant)	3
Zachary Sylvain	Graduate Student (research assistant)	3
Alia Khan	Graduate Student (research assistant)	3
Adam Altrichter	Graduate Student (research assistant)	6
Janna Wandzilak	Undergraduate Student	3
Anya Gleizer	Undergraduate Student	3
Ruth Heindel	Graduate Student (research assistant)	3
Jeremy Whiting	Undergraduate Student	2
Mac Martin	Undergraduate Student	2
David Mason	Undergraduate Student	2
Kevin Garland	Undergraduate Student	2
Ryan Carlson	Undergraduate Student	2
Travis Burk	Undergraduate Student	2
Nick Potter	Undergraduate Student	2
Kyle Pelletier	Undergraduate Student	2
Deena Garland	Graduate Student (research assistant)	2
Caitlin Wolf	Undergraduate Student	12

Tracy Smith	Graduate Student (research assistant)	3
Kyrie Ivanovich	Undergraduate Student	2
Kathleen Woods	Undergraduate Student	3
Kelsey Bisson	Undergraduate Student	2
Taewook Kim	Undergraduate Student	2
Radu Herbei	Faculty	1
Frank Dragotta	Research Experience for Undergraduates (REU) Participant	6
Josh Darling	Research Experience for Undergraduates (REU) Participant	6
Maciek Obryk	Graduate Student (research assistant)	3
Hilary Dugan	Graduate Student (research assistant)	3
Joey Hudek	Undergraduate Student	3
Cristina D Takacs-Vesbach	Co PD/PI	3
Diane M McKnight	PD/PI	3
Michael N Gooseff	Co PD/PI	3

What other organizations have been involved as partners?
Nothing to report.

Have other collaborators or contacts been involved? N

Impacts

What is the impact on the development of the principal discipline(s) of the project?

Our glacier and meteorological work contributes to the environmental monitoring of a polar desert, a very sensitive region to climate change. Summer air temperatures are just below freezing such that any small increase in air temperature results in a non-linear response in melting with cascading effects on streams and enclosed lakes.

Our work on the energy balance modeling is unique in that it addresses the transition zone between ice at below freezing temperatures to melting temperatures. This contrasts with most energy balance work on glaciers that addresses either polar glaciers that are well below freezing or temperate glaciers that are at the melting point. Our work points to the importance of subsurface heating of ice by solar radiation that penetrates the ice to shallow depths. In addition, the sensitivity of glacier ablation and melt to wind speed is of utmost importance. Higher wind speeds with cool temperatures increase subsurface heat loss and reduced ablation and melt. Lower wind speeds reduce the heat

loss to the atmosphere and increases the melt and ablation of the ice surface. This model will now be applied to understand current hydrology in the valley, past and anticipated future changes.

In September 2012, at the LTER All Scientists Meeting Adrian Howkins organized and chaired a 2-hour workshop titled "Environmental History in the LTER Network." This workshop brought together around fifteen scholars from around the LTER network for a discussion of the role of environmental history scholarship in the LTER network. The discussions laid the basis for future inter-site collaborative research in the field of environmental history.

Diana Wall was a Member, PCAST Working Group on Biodiversity Preservation and Ecosystem Sustainability: Report to President's Council of Advisors on Science and Technology (PCAST), Washington, DC. *Sustaining Environmental Capital: Protecting Society and the Economy*

What is the impact on other disciplines?

The findings from the LTER have led to integration of soils and sediment research, linkages of above and belowground research, climate change, glaciology, hydrology and biogeochemistry with biogeography and molecular biology. The complexity of the interactions over spatial and temporal scales with water and temperature are being modeled for soil biota.

The research into water tracks opens a new area of research of shallow groundwater flow, previously ignored. While the water flux of the water tracks is very small compared to streams its solute content is equivalent, if not more, than that of the streams making them critical to our understanding of the chemical evolution of the lakes. The presence of water tracks also helps to pattern life in the soils by controlling the location and magnitude of soil moisture and salinity. The tracks seen in the Dry Valleys are important analogues for 'streaks' observed on Mars and may help to explain their formation and physical processes.

Virginia, R. A. and K. S. Yalowitz (Editors). 2012. *A New Paradigm for Arctic Health: Challenges and Responses to Rapid Climate, Environmental and Social Change.* Workshop Report of an International Conference, May 23-25, 2011, Dartmouth College, Hanover, NH and the University of the Arctic Institute for Applied Circumpolar Policy, http://iacp.dartmouth.edu/news/17-arctic-health-challenges-and-responses-to-rapid-climate-environmental-and-social-change

What is the impact on the development of human resources?

The involvement of students and early career scientists in this work is key. Not only does this work help fund their education directly, and provides hands-on experience in participating in a research project, but it also provides valuable experience working in a professional environment that stresses self-reliance. The international quality of the project including travel provides an important growth experience.

Post-doc, graduate and undergraduate students, and technicians gave oral presentations and posters at several meetings over the last year, including meetings hosted by the Ecological Society of America and the Society of Nematologists. Moreover, members of the Wall lab were involved in organizing a symposium at the Ecological Society of America meeting.

Training of undergraduate and graduate students in polar science with an emphasis on geological and ecosystem science. Perhaps more importantly it illustrates the need for testing, discovery and hypothesis testing.

Virginia contributed to the Association of Early Career Polar Scientists (APECS) as a Faculty Mentor, a reviewer for student travel grants to the IPY 2012 Meeting, Montreal, and by giving a Webinar in the APECS Career Development Series.

What is the impact on physical resources that form infrastructure?

Nothing to report.

What is the impact on institutional resources that form infrastructure?

Nothing to report.

What is the impact on information resources that form infrastructure?
Nothing to report.

What is the impact on technology transfer?
Nothing to report.

What is the impact on society beyond science and technology?

In September 2012 at the LTER ASM in Estes Park, at a two session workshop of the LTER Arts and Humanities working group organized by Fred Swanson, Adrian Howkins presented on the Environmental History work taking place at the MCM site and on the context of how this might fit into the broader objectives of the working group. This working group continues to offer an excellent opportunity for networking with other LTER sites, and learning about the arts and humanities work that is taking place. The McMurdo Dry Valleys present unique challenges for arts and humanities work due to their isolated location. A key message this workshop remains that arts and humanities activities offer numerous opportunities for taking LTER science to a much wider audience.

Changes

Changes in approach and reason for change
Nothing to report.

Actual or Anticipated problems or delays and actions or plans to resolve them
Nothing to report.

Changes that have a significant impact on expenditures
Nothing to report.

Significant changes in use or care of human subjects
Nothing to report.

Significant changes in use or care of vertebrate animals
Nothing to report.

Significant changes in use or care of biohazards
Nothing to report.