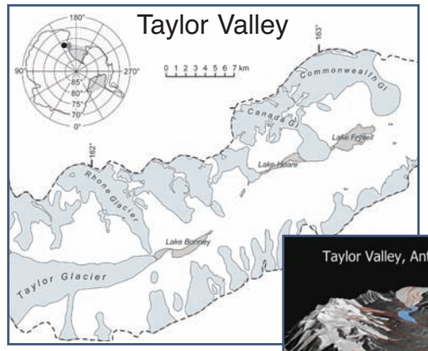
McMurdo Dry Valleys

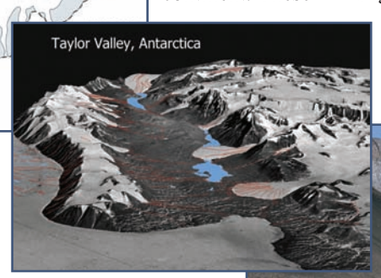
Long Term Ecological Research

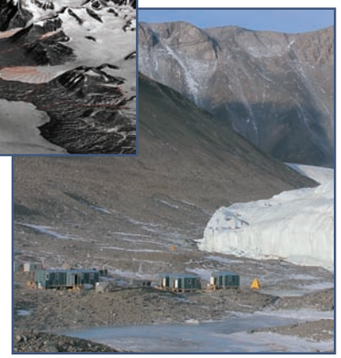
The McMurdo Dry Valleys (MCM) Long Term Ecological Research (LTER) Program is an interdisciplinary and multidisciplinary study of the aquatic and terrestrial ecosystems in an ice-free region of Antarctica. MCM joined the National Science Foundation's LTER Network in 1993.

Site Description

The McMurdo Dry Valleys (77°30'S 163°00'E) on the shore of McMurdo Sound, 2,200 miles (3,500 km) due south of New Zealand, form the largest relatively ice-free area (approximately 4,800 km^2) on the Antarctic continent. These ice-free areas of Antarctica display a sharp contrast to most other ecosystems in the world, which exist under far more moderate environmental conditions. The average temperature is -19˚C, maximum: 11.8˚C, minimum: –65˚C.







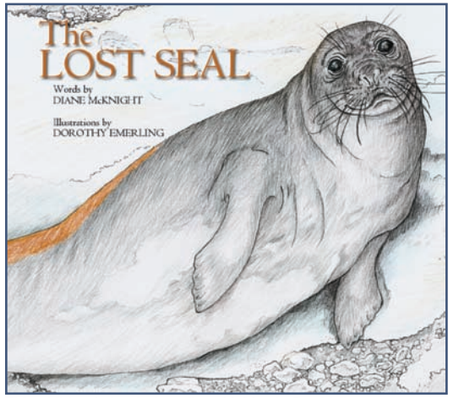
Lake Hoare remote field camp in Taylor Valley. Photo: Amy Chiuchiolo.

Travel to the Dry Valleys

Research is conducted at MCM during spring and summer (October through February) by approximately 30 scientists. Participating scientists first travel through the U.S. Antarctic Program in Christchurch, New Zealand, and then on to McMurdo Station, Antarctica via military aircraft. Researchers are transported to the McMurdo Dry Valleys via helicopter and live and work in remote camps.

Education and Outreach

From Internet web journals about life in Antarctica, to assisting high school students with chemical analysis of stream samples, to an interactive educational CD for high school teachers based on MCM research, scientists at MCM strive to engage the public's interest in science and ecology. MCM researcher Diane McKnight has also published a children's book, The Lost Seal, which describes a true encounter between researchers and a live seal in the dry valleys. The story features artwork by children from four countries and introduces readers to Antarctic science. On the web at: www.mcmlter.org/lostseal.



This children's book describes McMurdo Dry Valleys research and features artwork by elementary school children from countries all over the world that have been involved in research in the dry valleys of the Antarctic.

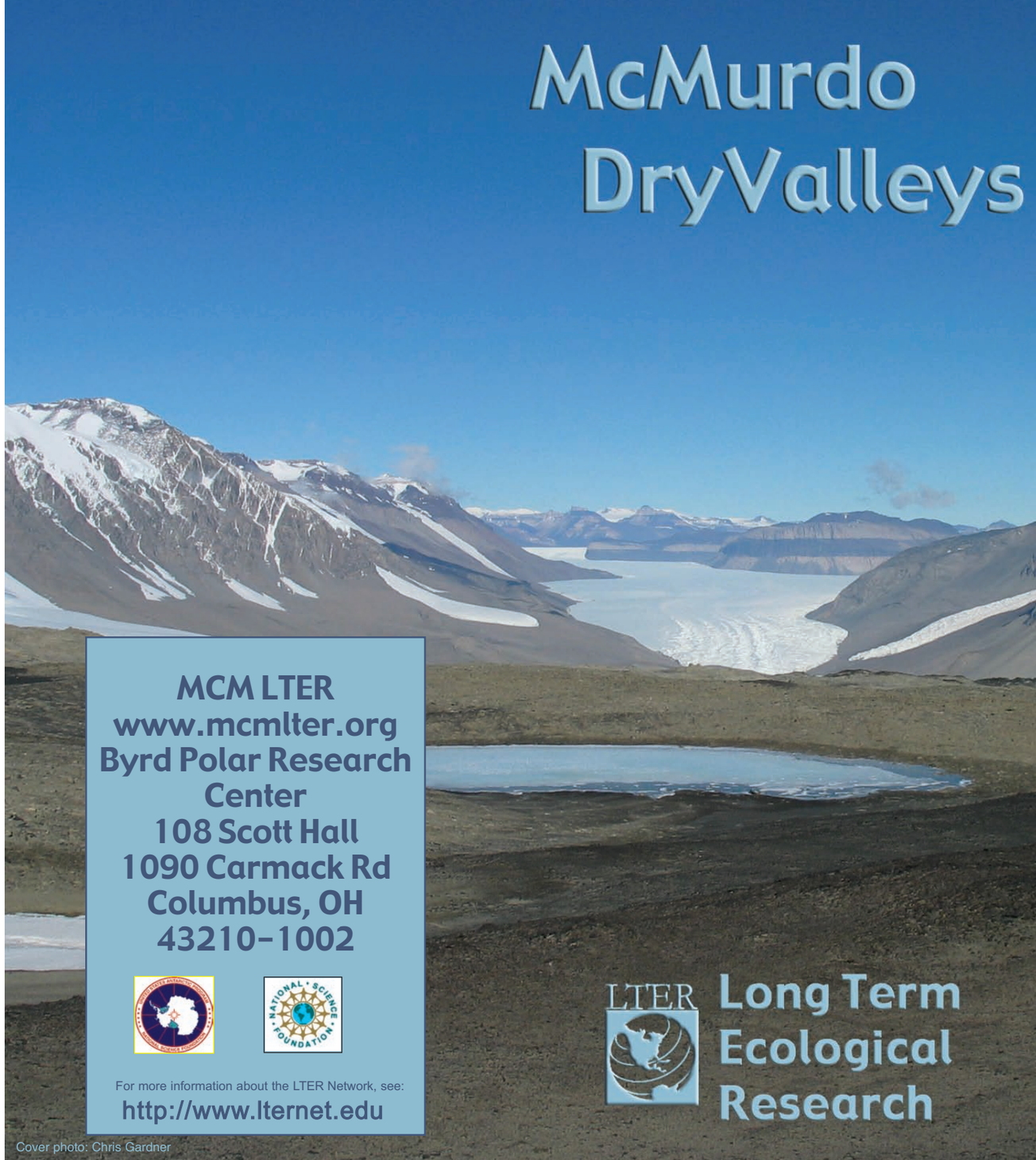
Suggested Reading

Doran, P.T. et al. (2002) Antarctic climate cooling and terrestrial ecosystem response. Nature, 415: 517-520.

Foreman et al. (2004) Impact of episodic warming events on the physical, chemical and biological relationships of lakes in the McMurdo Dry Valleys, Antarctica., Aquatic Geochemistry, 10: 239-268.

Fountain, A.G. et al. (1999) Physical controls on the Taylor Valley Ecosystem, Antarctica. Bioscience, 49: 961-971.

Priscu, J.C. (editor) 1998. Ecosystem Dynamics in a Polar Desert: the McMurdo Dry Valleys, Antarctica. Vol 72. American Geophysical Union, Washington, DC. 369 pp.



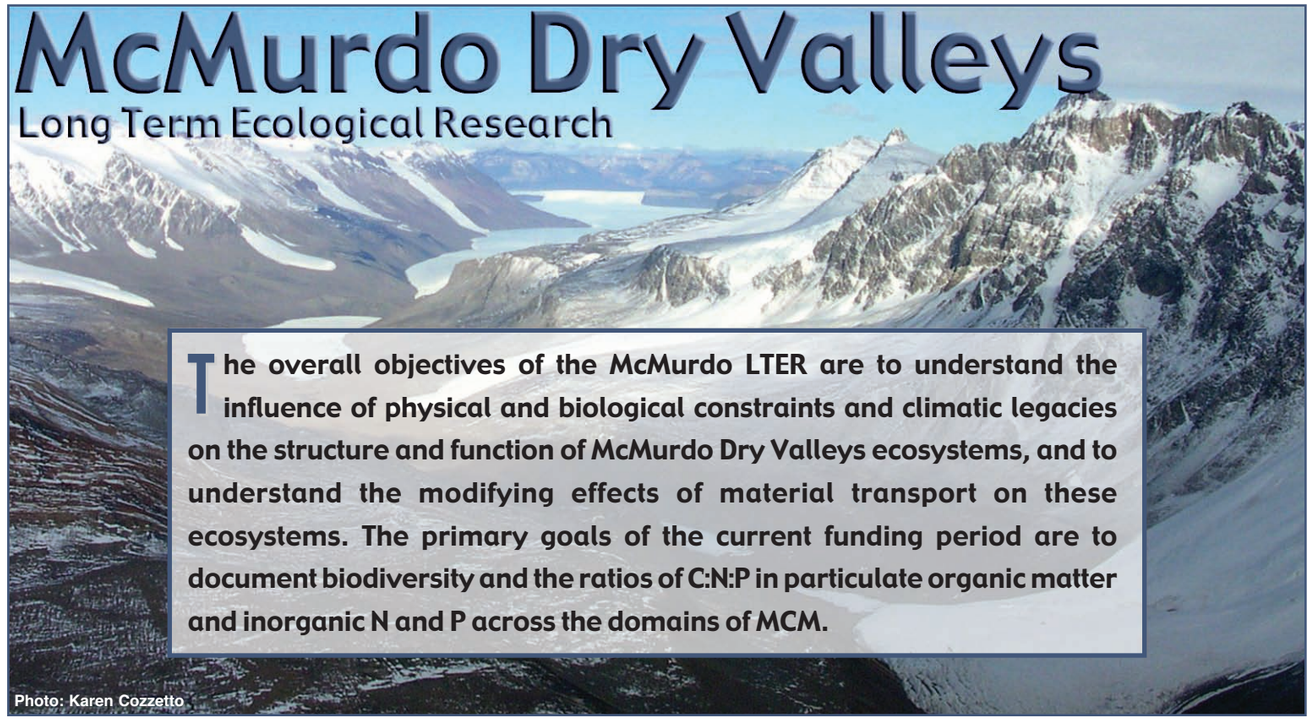
MCM LTER
www.mcmlter.org
Byrd Polar Research Center
108 Scott Hall
1090 Carmack Rd
Columbus, OH
43210-1002

For more information about the LTER Network, see:
http://www.lternet.edu

LTER Long Term Ecological Research

Cover photo: Chris Gardner

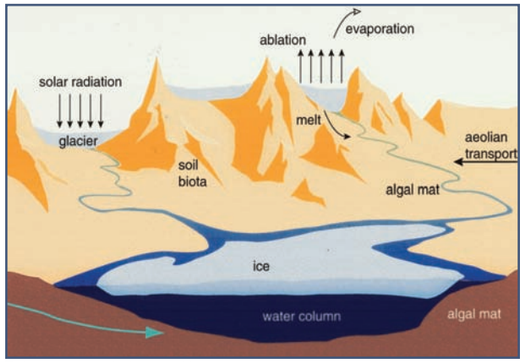
McMurdo Dry Valleys
Long Term Ecological Research



The overall objectives of the McMurdo LTER are to understand the influence of physical and biological constraints and climatic legacies on the structure and function of McMurdo Dry Valleys ecosystems, and to understand the modifying effects of material transport on these ecosystems. The primary goals of the current funding period are to document biodiversity and the ratios of C:N:P in particulate organic matter and inorganic N and P across the domains of MCM.

Photo: Karen Cozzetto

Subtle changes in temperature, precipitation, and albedo have a major influence on the hydrologic cycle, biogeochemistry, and productivity within the McMurdo Dry Valleys. For example, decadal-scale cooling significantly reduced stream flow, lowered lake levels, and increased lake ice thickness, which in turn reduced lake primary productivity and decreased soil biomass. The unusually warm austral summer of 2001-2002 greatly increased glacier melt, which rapidly restored lakes to levels that existed at the onset of MCM research. The increased meltwater enhanced productivity and related biogeochemical processes across the landscape. These events emphasize the sensitivity of the MCM ecosystem to even small variations in climate, and the importance of the transition between solid and liquid water.



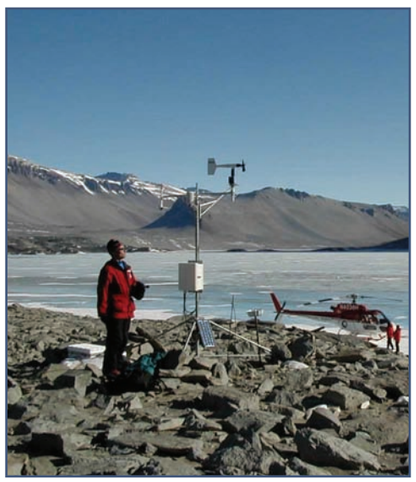
This conceptual diagram illustrates modern ecosystem processes in the McMurdo Dry Valleys..

Meteorology

Local meteorology drives and shapes all ecological systems. The McMurdo LTER Automatic Weather Network currently consists of 13 permanent stations logging every 15 minutes, as well as temporary snow fences and roving stations. A large climatic gradient exists in Taylor Valley, strongly influencing stream flow and soil ecosystems.

Glaciers

Glaciers cover about one third of the McMurdo Dry Valleys. These large reservoirs of water can be released through melting, and they are fundamental to the hydrology and biology of the valleys because they are the only significant source of water to the streams and lakes. Therefore, understanding the controls of meltwater generation is fundamental to studying the dry valleys ecosystem. The glacier studies currently in progress in the valleys include yearly mass balance measurements and the biogeochemistry of cryoconite holes.



An investigator examines the Lake Vanda Meteorological Station. Photo: Bert Vermillion.

Lakes

The MCM lakes program is focused on understanding the ecosystem structure and function of the microbe-dominated lakes in the McMurdo Dry Valleys, where few metazoans exist within the water columns. Specifically, this project collects long-term data on the physical and chemical conditions within the lakes and relates them to biological diversity and rate processes. The lakes, being the terminus of the hydrological continuum in the MCM, are reservoirs of history and are the only environments within the study site that contain liquid water and support metabolic activity throughout the year. Temporal data on lake level, ice thickness, and PAR closely reflect changes in climate and associated hydrology within the study area.

Graduate students drill a sampling hole in the frozen ice cover of Lake Fryxell. Photo: Amy Chiuchiolo

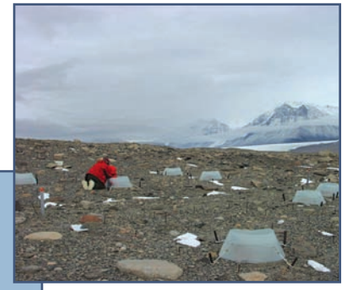
Streams

Numerous ephemeral streams link the glaciers and lakes within the dry valleys for four to ten weeks during the austral summer. These streams recharge the dry valley lakes and are important sources of nutrients to the lakes. A network of 18 gauging stations continuously measure streamflow throughout the austral summer. Additional long-term monitoring also includes a variety of biologic and geochemical measurements. Despite the extreme harshness of the environment, a total of 30 taxa of cyanobacteria and chlorophytes and 38 species of diatoms are present in the dry valley streams.

Soils

Soils account for the majority of the valley surface area. Dry valley soils are generally poorly developed, coarsely textured, high in soluble salts with permafrost at 10-30 cm depth, and support low rates of biological activity. Despite a general appearance of uniformity, Antarctic soils have a high degree of spatial and temporal heterogeneity in soil properties, moisture regimes, and biological composition. The majority of soils sampled across the valleys support up to three invertebrate taxa (tardigrades, rotifers, nematodes), but in contrast to other ecosystems, many soils lack invertebrates. Globally, there are no other soil systems where nematodes represent the top of the food chain and where food webs have such simple structure. The primary research goal is to understand the ecosystem processes controlling the distribution, abundance, and activity of soil biota.

These two photos depict the extreme stream flow variation that occurs, dependent on summer climate. Above: the Onyx River on 20 Nov 2001, middle of the austral spring. Below: the Onyx River at the onset of summer, 26 Dec 2001. Photos: Chris Jaros.



Left: The endemic nematode *Scottnema lindsayae* is the largest predator in the McMurdo Dry Valleys. Above: A student collects samples from soil warming chambers near Lake Fryxell. Photo: Holly Zedah.