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PRISCU, JOHN C. [ED.]. 1998. **Ecosystem dynamics in a polar desert: The McMurdo Dry Valleys, Antarctica.** Antarctic Research Series, v. 72. American Geophysical Union. xi + 369 p. US\$70. ISBN 0-87590-884-5.

There was a time not so long ago when polar lakes were touted as models of simplicity due to their low biodiversity, limited catchment inputs, and brief season of biological production. The lakes of the McMurdo Dry Valleys (MDV), a region of largely ice-free land on the coast of Antarctica, were regarded as the extreme endpoint of such uncomplicated ecosystems because their highly stratified, liquid water habitats were apparently sealed off from the surrounding environment by thick perennial lake ice (Koob and Leister 1972). These notions have been eroded by ongoing studies over the last three decades, and nowhere more so than in the MDV. This volume describes modern research in this unique region and makes it clear that land, ice, water, and biota must be viewed as component parts of a strongly interlinked complex ecosystem.

The volume contains contributions from more than 50 researchers. It begins with three articles on the physical properties of the MDV. The striking lack of snow and ice is the result of low precipitation, a negative water balance, and the presence of the Transantarctic Mountain Range at the head of the valleys, which blocks ice flow into the region from the vast Antarctic ice sheet. How this polar desert was formed is more controversial, and two competing hypotheses have been offered: that the valleys were cut by ancient fluvial processes or by a series of glaciation events. The first article in the book makes a strong argument for the latter, concluding from a detailed geomorphological analysis of the northern MDV system that wet-bed glacial erosion sculpted this dramatic landscape more than 9 million years ago. The second article provides a detailed analysis of solar radiation fluxes into the valleys, and establishes the themes of strong physical-biotic coupling and spatial variability, even within a single valley. This section of the book is completed by an article on the alpine glaciers that flow into the valleys and describes their pivotal role in controlling the supply of water into the MDV ecosystem via ephemeral meltwater streams.

The next set of papers focuses on the dry valley streams. Since the International Geophysical Year in the late 1950s, geochemists have been fascinated by the unusual solute characteristics of the ice-covered lakes of the region, but the origin and evolution of these chemical properties have remained elusive. Results presented here show how subtle variations in stream chemistry can translate into major differences in the chemical evolution of their receiving lake waters. The theme of high sensitivity is continued in the following article on the pattern of stream flow into one of the MDV lakes and underscores the large interannual variations in discharge that were first described in Trevor Chinn's seminal work in the 1970s. Three decades later there is still no predictive model describing the effects of climate variations on peak stream flow in this region; the authors also observe that the concept of base flow is more complicated than at lower latitudes because it is strongly influenced by storage and the precarious balance between freezing and melting within the hyporheic zone. Three articles then deal with the microbial mat communities that coat the streambeds of the region. These studies similarly conclude that subtle physical differences translate into large effects: for example, small-scale hydrological features may cause the large visual differences in mat community structure, slight temperature variations can tip the balance between phototrophy and respiration in the thick microbial mats toward net accumulation or loss, and in-stream nitrogen dynamics are highly sensitive to water

retention time as well as to a complex amalgam of processes such as freeze-concentration and hyporheic exchange. So much for polar ecosystems being simple!

Much of the remainder of the book focuses on the ice-capped lakes of the region, with articles on their unusual temperature and salinity profiles; bio-optical characteristics; bacterial, metal, and nutrient cycling properties; distribution and ecophysiology of the phytoplankton; community structure of heterotrophic protists; and physical processes in the overlying ice, itself a highly structured microhabitat for life. Again, the old concept that MDV lakes are simple-model ecosystems turns out to be quite misleading. Despite their lack of fish and arthropods, these lakes contain complex microbial ecosystems in which freeze-thaw cycles and prolonged ice cover complicate rather than simplify ecosystem structure and dynamics. Many paradoxes and unknowns remain. For example, turbulent mixing is almost absent from these highly stratified lakes, yet recent atmospheric contaminants have been detected in their bottom waters. Phytoplankton live in an extreme shade environment, yet like their Arctic lake counterparts they have anomalously low light-capturing efficiencies and quantum yields for photosynthesis. Attempts to understand the microbial biodiversity, food web processes, benthic-pelagic interactions, continuous winter processes, and legacy of earlier ecosystems in the valleys (Moorhead et al. 1999) have clearly only just begun.

Two articles provide an introduction to the ancient soils of the dry valleys and their microinvertebrate communities. A chapter on environmental management issues and the detailed steps that have been implemented to protect the unique values of this region follows. The book concludes with a synthesis article that reiterates the need to view the MDV as a complex interlinked system that, as elsewhere in the polar regions (Vincent and Hobbie 2000), is increasingly subject to the effects of human disturbance throughout the globe.

A CD-ROM accompanies the volume and provides the text of all the abstracts and some supplementary material, such as sample output from GIS-based simulations. The inclusion of the disk is an innovative idea, although it would have benefited from the complete text of all articles, ground-level photos of the study sites, and hot-links to relevant homepages on the Web for updates. Overall, this book is very well thought out and presented. It provides a rich synthesis of information from many disciplines and is a timely contribution to the understanding of not-so-simple polar ecosystems.

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