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> *Away to the south, the Uinta Mountains stretch in a long line; high peaks thrust into the sky, and snow-fields glittering like lakes of molten silver; and pine forests in somber green; and rosy clouds playing around the borders of huge, black masses; and heights and clouds, and mountains and snow-fields, and forests and rock-lands, are blended into one grand view.*
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> *–John Wesley Powell, 24 May 1869 (Powell, 1875)*

The Uinta Mountains are a spectacular and unique range of the Rocky Mountain system. Running east-west for more than 150 km across northeastern Utah and northwestern Colorado, they contain the highest summits in Utah (elevations greater than 4000 m a.s.l.), vast areas of alpine tundra, glacial lakes, immense compound cirques, and deep fluvial canyons. The range forms the northern and southern boundaries for many forest species common to the Colorado Plateau and the northern Rockies, respectively. It is also characterized by steep temperature and moisture gradients and is situated at the boundary between three air masses of the interior western United States (Mitchell, 1976). Indeed, the Uinta Mountains are an exceptional natural laboratory where questions germane to ecology, climatology, geology, and numerous other disciplines in alpine research can be effectively investigated. For example, recent research in the Uinta Mountains spans topics ranging from Pleistocene glacial chronology and climate (e.g., Munroe et al., 2006); to studies of lake and fluvial-sediment records exploring the impact of grazing, air-quality changes (e.g., Moser, 2005), and geomorphic processes on sedimentation (e.g., Carson, 2005); to Holocene treeline elevation responses to climate change (Siderius, 2004). In an effort to provide a forum in which researchers interested in these and other topics could meet to share and discuss their research, Jeff Munroe organized **UINTAS 2006**: **the Uinta Interdisciplinary Assessment Symposium**. This special section of *Arctic, Antarctic, and Alpine Research* includes 10 articles describing results of Uinta Mountain research presented at the symposium, all of which either build upon previous studies in the range or explore topics of alpine research, chiefly geomorphology, limnogeology, biogeography, paleoclimatology, and ecology. The underlying goal of this special section is to highlight the importance of current and future research in this relatively understudied, yet accessible, region of western North America.

A Brief History of Uinta Mountain Research

The history of scientific exploration of the Uinta Mountains began in the late 19th and early 20th centuries, when numerous famous geologists including John Wesley Powell (Powell, 1875), Ferdinand Vandeveer Hayden (Hayden, 1872), and Wilmot Bradley (Bradley 1936) explored the range and made seminal contributions to our understanding of the origin and evolution of it and other Laramide mountain ranges. Although no glaciers remain in the Uinta Mountains, W. W. Atwood (1909) documented extensive Late Pleistocene moraines that attest to the former areal coverage of more than 2000 km^2 of glacial ice, situated only a few tens of kilometers east of pluvial Lake Bonneville. Geologists have also puzzled for more than a century about the

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anomalous east-west orientation of the Uinta Mountains, the origin of the broad summit upland that characterizes much of the crest of the range, and the dramatic bisecting of the eastern part of the range by the Green River (e.g., Hansen, 1969). Yet over this time interval, three seminal U.S. Geological Survey reports (Atwood, 1909; Bradley, 1936; Hansen, 1969) comprised the main body of published literature on the geology of the Uinta Mountains. Other investigations, conducted primarily by land managers of the U.S. Forest Service, were reconnaissance in nature or were designed with the goal of producing inventories of natural resources.

This situation began to change in the 1990s, due in part to the establishment of mutually beneficial interactions between land managers of the Ashley, the Uinta, and Wasatch-Cache National Forests and academic researchers with interests in the late Quaternary history, landscape evolution, and geoecology of the Uinta Mountains. For example, glacial geologists took advantage of the vast expanse of public land in the range (including the High Uintas Wilderness Area, which covers nearly 200,000 ha [500,000 acres]) and exceptional preservation of landforms to remap in more detail the glacial record first described by Atwood (1909) and apply modern techniques to reconstruct the timing and extent of past glaciations (e.g., Munroe et al., 2001; Laabs, 2004). Similarly, geomorphologists took advantage of abundant fluvial records in the Uinta Mountains; Carson (2005) studied flood conveyance and sedimentation in alpine streams in the northern part of the range, Schmidt et al. (2005) explored causes of stream-channel adjustment in southern drainages, and Larsen et al. (2006) characterized the role of climate and geology in driving hillslope/mass-wasting processes near Dinosaur National Monument. In addition, biogeographers developed lacustrine and treeline-based records of late Holocene climate change for the interior western United States (e.g., Moser, 2005; Siderius, 2004), which provide significant contributions to a region where alpine paleoclimate data are sparse. As all of these projects were largely carried out on National Forest land, the Forest Service quickly realized the potential value of merging academic research interests with their land management needs, and offered logistical support and local expertise in exchange for research products that could not be obtained internally. Application of this approach expanded rapidly after 2000, and by 2006 more than a dozen academic researchers with expertise in geology, biogeography, and Earth system science were actively pursuing projects in the Uinta Mountains. Several of these projects provided critical data for a GIS-enabled land-system inventory developed by the Ashley National Forest.

Objectives and Outcomes of UINTAS 2006

The rapid growth in cross-disciplinary scientific interest in the Uinta Mountains inspired the conception of **UINTAS 2006: the Uinta Interdisciplinary Assessment Symposium**. The symposium was held on 19–21 May 2006 at the Snowbird Resort in Utah, with support from NSF-EAR, the USDA Forest Service, Middlebury College (Middlebury, Vermont), and Gustavus Adolphus College (St. Peter, Minnesota), and was designed to bring together Uinta Mountain researchers (based in government or academic institutions) from a wide range of disciplines and provide a forum in which they could easily share and discuss data. Altogether, 40 people, including professionals, technicians, and graduate students attended with mutual goals of (1) participating in information exchange among major research groups working in the Uinta Mountains; (2) outlining the next generation of innovative, collaborative research projects in the range; and (3) building bridges between academic researchers and Forest Service land managers. Progress toward these goals was facilitated by formal research presentations by academic and government scientists, and by discussions of where future research should be directed to best fill perceived data gaps.

Over the course of the conference an overarching philosophy of collaboration between academic and government-based (chiefly U.S. Forest Service) research developed. It was recognized that researchers are an integral part of, and essential partners in, effective public land management. It also became clear that effective decisions by natural resource managers must be grounded in a sound understanding of the ecosystem and its responses to natural stress, human-induced stress, and restoration actions. Therefore, effective management actions require interaction between ecosystem researchers, who study cause-and-effect relationships, and resource managers, who apply the results. Resource managers need to recognize the merits of experimental research if they are to have success in reversing human impacts on natural ecosystems. On the other hand, researchers must recognize that resource managers rely heavily on applied research and need results quickly, even if the results are partial. The constraints of funding, public concern, and other controlling factors may not allow management actions to wait for a high degree of scientific certainty; otherwise important management actions may be based strictly upon observational data or preliminary conceptual models.

Contents of this Special Section

Nineteen formal research presentations were made during the course of the symposium. The papers in this special section of *Arctic*, *Antarctic*, *and Alpine Research* span the breadth of topics covered, from fluvial and glacial geology, to soils and geobotany, to historical and paleoclimatology. The first paper in the issue by Carson (2007) identifies causes of the variability in maximum annual discharge in Uinta Mountain streams since 1960, a timely study given the increasing demands for water resources in the Colorado River, Great Basin, and other major watersheds of the western United States. Papers by Refsnider et al. (2007) and Laabs et al. (2007) describe patterns of glaciation in space and time in the westernmost part of the Uinta Mountains. Refsnider et al. describe glacial geology and ice reconstructions of the upper Provo River drainage (southwestern part of the range), an area dominated by outlet glaciers of a broad ice field during the Last Glacial Maximum. They find that glacier equilibrium lines during this time were much lower than in valleys in the eastern part of the Uinta Mountains, which may be attributed to a regional climatic influence of pluvial Lake Bonneville in the western part of the range. Laabs et al. present cosmogenic surface-exposure ages of moraine boulders in the Bear River valley (northwestern part of the range) and suggest that ice retreat following the local Last Glacial Maximum may have occurred somewhat earlier than in valleys in the southern part of the range. They attribute this finding to a variable influence of Lake Bonneville on glacier mass balance in the western Uinta Mountains.

Climatic perspectives of the present and past for the Uinta Mountains are described in a paper by MacDonald and Tingstad (2007), whereas Munroe (2007a) and Porinchu et al. (2007) provide the groundwork for future paleoclimate research. MacDonald and Tingstad use historical and tree-ring records from eastern and western locations in the Uinta Mountain region to explore the influence of regional and global-scale climate patterns on climatic variability. They correlate extreme drought conditions to low sea-surface temperatures in the eastern Pacific; they also recognize that, despite the occurrence of extreme drought conditions in the 20th century, this time interval was relatively moist compared to the previous three centuries. Munroe describes changes in the organic content of alpine lake sediments and identifies the significant influence of watershed characteristics (e.g., elevation, hydrologic through-flow) on organic sedimentation, providing a useful guide for inferring past climate from Uinta Mountain and other lake sediment records. Finally, Porinchu et al. use a calibration set of subfossil chironomids from 51 lakes to develop an inference model for making late Pleistocene and Holocene climate reconstructions.

Properties and processes of soil development are described in papers by Munroe (2007b) and Douglass and Mickelson (2007). Munroe characterizes soils formed in sorted polygons in unglaciated areas of the alpine zone and develops a model for soil formation over glacial-interglacial cycles. Douglass and Mickelson describe soil formation in Pleistocene moraines of the West Fork Beaver Creek drainage, identify the dominant soil-forming processes of the late Quaternary, and provide an index of soil properties that can be used to distinguish ages of moraines.

Papers by St. Clair et al. (2007) and by Shaw and Long (2007) describe present-day ecological patterns in the Uinta Mountains. St. Clair et al. explore lichen community structure and the influence of numerous environmental factors on lichens in an alpine tundra zone in the northern part of the range. They find that grazing (by sheep), plant cover, rock cover, and the timing of snow melt all influence the distribution of lichens. Shaw and Long provide an overview of vegetation patterns in the Uinta Mountains based on a broad-scale spatial and vertical analysis of vegetation in the range; their research highlights unique distributions of forest species in the range compared to other Rocky Mountain ranges and is a useful contribution to our understanding of Rocky Mountain ecology.

A final anecdote readily illustrates the rationale behind **UINTAS 2006** and this special section. In the fall of 1870, Ferdinand Vandeveer Hayden led the eponymous Hayden Survey into the northern Uintas from Fort Bridger, Wyoming. Over the course of three different trips, this survey explored the Bear River, the Blacks Fork/Smiths Fork, and the Henrys Fork/Beaver Creek, before heading east to Browns Park, and on to Cheyenne (Hayden, 1872). Hayden was awestruck by the scenery in the High Uintas, and provided detailed descriptions in his final report of the landscapes he witnessed. It is fascinating, though, that he failed to acknowledge the abundant evidence for alpine glaciation throughout the range. Indeed, throughout his report he notes the ‘‘large semicircular notches’’ at the valley heads, yet he attributes the origin of these basins to landsliding. He even mentions that some of these slides ‘‘…seem to fall down gradually, something like the movement of a glacier, a certain distance each year…’’ but he seems to miss the connection that the notches are cirques, and that at least some of his landslide deposits are actually of glacial origin.

How did Hayden miss the evidence of glaciation? He was certainly a perceptive geologist, and decades had passed since Agassiz (1840) had presented his Ice Age theory to the stunned audience at Neuchatel. Perhaps most notably, the U.S. Government Survey of the 40th Parallel under the direction of Clarence King had visited the Uintas the year before and cataloged abundant evidence of former glaciers (King, 1878). Was this oversight by Hayden a result of ineffective communication? How much more would they have learned if Hayden and King had worked together in the Uintas? These questions are clearly rhetorical, but the fast-paced and interdisciplinary style of scientific inquiry practiced in the 21st century makes this example from the past even more relevant today. **UINTAS 2006** undoubtedly improved communication between researchers active in Uintas, and it is our hope that publication of this special section makes the results of this work accessible to the broader scientific community.

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