Chapter 12: Effects of Climate Change on Cultural Resources in the Northern Rockies Region

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Background and Cultural Context in the Northern Rockies Region

People have inhabited the Northern Rocky Mountains of the United States since the close of the last Pleistocene glacial period, some 14,000 years B.P. (Fagan 1990; Meltzer 2009). Evidence of this ancient and more recent human occupation is found throughout the Forest Service, U.S. Department of Agriculture (USFS) Northern Region and the Greater Yellowstone Area, hereafter called the Northern Rockies region. Each of the five subregions, and the public and private lands they now encompass, contains thousands of years of human history.

The Northern Rockies region is the ancestral homeland or aboriginal territory of the Arikara, Assiniboine, Bannock, Blackfeet, Chippewa-Cree, Coeur d'Alene, Crow, Hidatsa, Kiowa, Kootenai, Mandan, Nez Perce, Northern Cheyenne, Pend d'Oreille, Salish, Shoshone, Sioux and other Plains, Intermountain, and Columbia Plateau American Indian Tribes (DeMallie 2001; Schleiser 1994; Walker 1998). Beginning in the 18th century, the region was explored and then settled by people of French, British, Irish, Scottish, Chinese, German, Scandinavian, and other ancestries (White 1993). The region then, as today, was a diverse blend of cultural backgrounds and lifeways.

The archaeological and historical evidence of these past cultural groups, interactions, and events—collectively called cultural resources—is extensive and varied across the Northern Rockies region. Cultural resources here include (1) ancient Indian camps and villages, rock art, tool stone quarries, and travel routes; (2) historic military forts and battlefields, mining and logging ruins, and homesteads; and (3) ranger stations, fire lookouts, and recreation sites built by the Civilian Conservation Corps. Currently, some 20,000 cultural resources have been documented, which represent probably only a small fraction of what exists in the Northern Rockies region.

Protection of cultural resources has been formally recognized since 1906, when the Antiquities Act was signed into law. This law requires Federal land management agencies to preserve historic, scientific, commemorative, and cultural values of archaeological and historic sites and structures of public lands for present and future generations (NPS 2015a), and gives the President of the United States authority to designate national monuments as a means to protect landmarks, structures, and objects of historical or scientific significance. The importance of cultural resources has been reaffirmed through the Historic Sites Act of 1935, the National Historic Preservation Act of 1966, the Archaeological Resources Protection Act of 1979, and the Native American Graves Protection and Repatriation Act of 1990. Although the focus of these laws differs, together they mandate the protection and management of cultural resources in Federal lands. The National Park Service has a particularly strong emphasis on protection of cultural resources (box 12.1).

Beyond physical sites, structures, and artifacts associated with past human use or events, protection of cultural resources involves the ongoing use of resources and associated activities relevant to the continuation of specified extant cultures. Many cultural resources are currently vulnerable to natural biophysical phenomena and human activities. Wildfire and biological processes degrade and destroy cultural resources, particularly those made of wood or located in erosion-prone environments. Vandalism, illegal artifact digging, arson, and other depreciative human behaviors also damage cultural resources. Agency land management actions can affect cultural sites and landscapes, and although Federal land managers protect and mitigate adverse effects to cultural resources, the enormity of this task often outstrips agency resources and capacity.

Broad-Scale Climate Change Effects on Cultural Resources

This assessment of the potential effects of climate change on cultural resources in the Northern Rockies region is fairly general because so little information has been generated on this topic, compared to the effects of climate change on natural resources. The broad diversity of cultural resources and locations where they are found makes it difficult to infer the spatial extent and timing of specific effects. Therefore, we have synthesized the relevant literature from diverse disciplines to cautiously project how an altered climate, both

Box 12.1—National Park Service Lands in the Northern Rockies Emphasize Preservation and Management of Cultural Resources

The National Park Service was created by Congress through the National Park Service Organic Act of 1916, whereby the Agency would allow "access to parks for the public enjoyment of cultural resources while ensuring their protection" (NPS 2011b). Specifically, a cultural resource is considered to be "an aspect of a cultural system that is valued by or significantly representative of a culture, or that contains significant information about a culture" (NPS 2015b). Cultural heritage and its preservation are emphasized in the agency's Cultural Resources, Partnerships and Science directorate, with goals to:

- Preserve cultural resources in cooperation with Indian tribes, Alaska Native villages and corporations, Native Hawaiian organizations, States, territories, local governments, nonprofit organizations, property owners, individuals, and other partners.
- Provide leadership in research and use of advanced technologies to improve the preservation of the nation's cultural heritage.
- Establish standards and guidance for managing cultural resources within the National Park System and communities nationwide.
- Enhance public understanding and appreciation for the Nation's cultural heritage.

Cultural Resources of National Parks in the Northern Rockies

Glacier National Park

Glacier National Park has six National Historic Landmarks and 350 structures listed in the National Register of Historic Places. Archaeological resources found in the park include prehistoric campsites, mining claims, and homesteads. Cultural landscapes in the park include the Going-to-the-Sun-Road, Chief Mountain, and Headquarters Historic District.

Grand Teton National Park

Historical sites in Grand Teton National Park predate creation of the park, and many structures are found in the National Register of Historic Places. Some of these structures are remnants of homesteads of ranchers and other people who settled in the Jackson Hole area. Several of these structures have been incorporated into the park and restored to their original condition. An example of an early structure preserved in the park is Mining Ditch, which carried water near Schwabacher's Landing. Cunningham Cabin, home to early settlers in the Jackson Hole area, has also been preserved. Menor's Ferry operated for decades until 1927, taking passengers across the Snake River, and is now part of a Historic District that was recently added to the National Register.

Yellowstone National Park

Yellowstone National Park has been preserved not only for biodiversity but also for information about past human activities and significant archaeological and cultural resources contained within the park. Some historic structures and sites are Obsidian Cliff, where obsidian was first used for making tools more than 11,000 years B.P.; Yellowstone Lake, which has intact cultural deposits from more than 9,000 years B.P.; Mammoth Hot Springs, which includes the Mammoth Post Office and Roosevelt Arch from the late 1800s; and the town site of Cinnabar, Montana, which was established in 1883 as the last stop on the Northern Pacific Railroad line to Yellowstone Park. The potential effects of climate change on cultural resources have been described for Big Hole National Battlefield, Montana (NPS 2011a). A warmer climate will complicate the goal of management to restore and maintain the battlefield in a biological condition representative of 1877. Scientific understanding of climate change effects provides a foundation for reconciling biological effects with management goals based on historical conditions.

directly and indirectly (through increased disturbance), will create conditions that modify the condition of and access to cultural resource sites and their contents.

Climate change has the potential to exacerbate and accelerate existing effects to cultural resources (table 12.1). A warmer climate will alter the scale of wildfires across western North America (Schoennagel et al. 2004; Westerling et al. 2006) (see Chapter 8), thus having at least three general effects on cultural resources. First, wildfires readily burn cultural resources made of wood and other combustible materials, such as ancient aboriginal wood shelters and game drives, or historic homesteads, mining ruins, and buildings. Second, emergency wildfire suppression tactics, including fireline construction using heavy equipment, affect both standing structures and archaeological sites buried in forest soils. Third, post-wildfire flooding and debris flows threaten cultural resources exposed atop fire-charred landforms and soils. Alternatively, fire can expose cultural sites that might not have been otherwise visible (fig. 12.1).

Currently, Federal agencies implement various actions to reduce the effects of wildfire on cultural resources, such as encasing historic structures in fireproof wrap, routing of fireline away from sites, and armoring cultural resources vulnerable to postfire flooding events. However, these actions are often not commensurate with the scale of large wildfires or the ensuing cultural resource loss. Thus, damage

Table 12.1—Summary of climate change stressors and potential effects on cultural resources in the Northern Rockies (see also Rockman 2014, UNESCO 2007). Human activities can exacerbate some of the expected effects of climate change (see text).

Climate change stressor	Biophysical effects	Effects on cultural sites and landscapes
Temperature increase	• Wildfire	• Combustion, damage, destruction
	• Drought, erosion	• Exposed artifacts and cultural features
	• Vegetation changes	• Altered physical appearance, integrity
	• Spread of invasive species	• Altered physical appearance, integrity
	• Ice patch melt	• Artifact decay and theft
	• Altered freeze-thaw cycles	• Saturation, desiccation, warping, biochemical changes
Altered precipitation	• Earlier seasonal runoff, flooding	• Removal, damage, degradation
	• Debris flows, slumping	• Burial, removal, degradation
	• Down-cutting, mass wasting	• Removal, damage, degradation
	• Increased moisture and humidity	• Decay, oxidation, exfoliation, corrosion, biochemical changes
	• Extreme precipitation events	• Removal, damage, degradation, collapse, exposure

Figure 12.1—Prehistoric stone cairn exposed by wildfire in Custer National Forest. Intense wildfires, suppression, and rehabilitation activities annually affect hundreds of cultural resources in the Northern Rockies (photo: Halcyon LaPoint, Custer-Gallatin National Forest).

is expected to continue as climate change amplifies amount of area burned, if not severity, across the Northern Rockies region.

Seasonal aridity and prolonged drought accelerate soil deflation and erosion, and thus expose archaeological sites once buried in plains and mountain soils. Wind and water roil across archaeological sites, blowing or washing away ground cover, revealing ancient artifacts and features such as cooking hearths and tool-making areas (fig. 12.2). Newly exposed ground leaves artifacts vulnerable to artifact collecting and illegal digging, effects that are intensified in areas where livestock grazing, recreation, and mining occur and the ground is already impacted. For example, livestock in grazing allotments typically converge around creeks and natural springs where ancient hunter-gatherer archaeological sites are commonly located.

Periods of dry climate and drought have occurred throughout the Holocene in the Intermountain West, with corresponding episodes of soil deflation, erosion, and down cutting (Meltzer 1990; Ruddiman 2007). However, increasing temperatures outside of the Holocene norm (Intergovernmental Panel on Climate Change 2007; Mayewski and White 2002; see also Chapter 3) will create additional potential for cultural resource loss through drought and erosion, particularly in drier areas such as southeastern Montana.

In addition, if winter precipitation increases (see Chapter 3) and reduced snowpack leads to higher winter streamflows (see Chapter 4), archaeological and historic sites will be increasingly vulnerable to flooding, debris flows, down cutting, and mass wasting of underlying landforms. This scenario is now common in the aftermath of large-scale wildfires, especially in the dry mountain ranges of central

Figure 12.2—Prehistoric artifacts exposed in soil-deflated surface caused by drought conditions. Exposed artifacts are vulnerable to illegal collecting and livestock trampling (photo: Carl Davis, U.S. Forest Service).

and eastern Montana (fig. 12.3). These severe events are likely to accelerate hydrologic impacts to cultural resources (National Research Council 2002).

Perennial high-elevation snowfields contain ancient artifacts, the result of hunting and gathering excursions to mountain environments (Lee 2012) (fig. 12.4). Melting ice caused by a warmer climate poses a risk to previously ice-encased and well-preserved cultural resources. For example, melting ice patches in the Beartooth Mountains of south-central Montana have yielded ancient bone, wood,

Figure 12.3—Post-wildfire debris flow that obliterated or covered cultural resources in Meriwether Canyon, Helena National Forest. Early, intense spring runoff events may become more common in the future (photo: Carl Davis, U.S. Forest Service).

Figure 12.4—Melting perennial ice patches expose prehistoric artifacts in Custer-Gallatin National Forest. These high-elevation locations document activities by Native American groups in the recent and distant past (photo: Craig Lee, Montana State University).

and fiber artifacts. Although melting ice patches provide research opportunities, the rapid rate of melting ice may preclude timely inspection by archaeologists, and newly exposed artifacts may decay or be stolen without adequate archaeological documentation.

Climate change also affects larger cultural landscapes whose integrity is derived from both cultural resources and environmental context (NPS 1994). Historic sites from the 1800s (e.g., Euro-American settlements, battlefields) are also valued historical resources, especially in some NPS units. Major shifts in dominant vegetation could potentially affect the physical and visual integrity of these landscapes (Melnick 2009). For example, whitebark pine (*Pinus albicaulis*) is an important historical component of the Alice Creek-Lewis and Clark Pass cultural landscape on the Continental Divide near Helena, Montana (fig. 12.5). Whitebark pine is currently in decline because warmer winter temperatures have accelerated the rate of mountain pine beetle (*Dendroctonus ponderosae*) outbreaks in addition to the effects of white pine blister rust (*Cronartium ribicola*), a nonnative fungal pathogen (Tomback and Kendall 2001; see also Chapter 8).

Cultural sites and landscapes are also recognized for their traditional importance to descendant communities, particularly American Indian tribes in the Intermountain West. Some traditional use areas provide foods, medicinal and sacred plants, pigments, and other resources, as well as ceremonial-religious places. Significant climate-induced effects in these landscapes, particularly altered distribution and abundance of vegetation, may curtail and even sever the continuous cultural connectivity and traditional use of these areas by indigenous peoples and local communities.

Figure 12.5—Whitebark pine mortality may affect the integrity and status of cultural sites, such as the Lewis and Clark Pass cultural landscape and National Register District shown here. Significant landscape change may also affect indigenous peoples and local communities who use the area and its resources (photo by Sara Scott, Montana Department of Fish, Wildlife and Parks).

Climate change also poses risks to historic buildings and structures though increases in wildfire, flooding, debris flow, and extreme weather events (fig. 12.6). In addition to these direct threats, period furniture, interpretive media, and artifact collections inside historic (and nonhistoric) buildings may likewise be affected by those events. More nuanced stressors include increased heat, moisture, humidity, freeze-thaw events, insect infestation, and micro-organisms (mold), all of which accelerate weathering, deterioration, corrosion, and decay of buildings, structures, and ruins made of wood, stone, and other organic materials (UNESCO 2007).

Finally, climate change may diminish the appeal of cultural sites and landscapes for public visitation and interpretation. Extensive outbreaks of mountain pine beetle and other insects, which have been facilitated by higher temperature, have turned some historic landscapes in southwestern Montana from green to brown to gray (e.g., Logan and Powell 2001). In addition to visual impacts, dead and dying forests present hazards to hikers, sightseers, and other forest users (see Chapter 10). Over time, altered ecological conditions in cultural landscapes of the Northern Rockies region may reduce their attractiveness and value for tourism, recreation, and other purposes, thus affecting local communities and economies (see chapters 10, 11).

Risk Assessment

Climate change effects on cultural resources are likely to be highly variable across the Northern Rockies region by the end of the 21st century, depending on the particular stressor and geographic location. Wildfire is expected to create the highest risk for cultural resources and is expected to broadly,

Figure 12.6—Installing emergency roof supports in the main lodge, OTO Dude Ranch, Custer-Gallatin National Forest. Routine and emergency projects to stabilize, protect, and maintain historic buildings are likely to increase in a warmer climate (photo by Marcia Pablo, Custer-Gallatin National Forest).

though unevenly, affect cultural resources on all national forests, national grasslands, and national parks, including locations that have already burned since the 1990s.

The prospect of prolonged aridity and drought caused by projected temperature increase may be partially offset if winter precipitation increases in the future (see Chapter 3). Thus, it is difficult to quantify the long-term effects of drought, floods, and extreme weather events on cultural resources. In general, these natural processes, exacerbated by climate change, are likely to pose a significant risk to cultural resources. Resource loss will be greatest in those areas prone to major hydrologic events, such as at canyon mouths and in river bottoms where cultural sites are often concentrated. Cultural sites located here are difficult to armor and protect in the face of significant flooding and debris flows. Furthermore, artifact collectors may eventually target these areas because newly exposed cultural materials are often strewn over a wide area in the aftermath of a flood or debris flow; protection of these materials depends on active law enforcement.

Other potential climate change-related effects on cultural resources will be more subtle and moderate. Shifting distribution and abundance of vegetation are likely to affect the visual integrity of some cultural landscapes. Climate change effects to historic buildings or structures will be both gradual and cumulative (i.e., decay and degradation) and sudden and direct (i.e., structural collapse caused by moisture and snow loading). Certain natural resources associated with traditional cultural landscapes that tribal peoples continue to use today, may be diminished or entirely disappear. However, increased wildfire may increase the abundance of some culturally valuable species, such as huckleberry (*Vaccinium* spp.), common camas (*Camassia quamash*), and nodding onion (*Allium cernuum*).

Agency proposals and efforts to control, abate, or mitigate the projected effects of climate change may also affect cultural resources. For example, in anticipation of significant flooding events in the future, historic culverts and bridge abutments made of stone may be replaced with larger metal ones. Although project design and mitigation measures would reduce many adverse effects to cultural resources, landscape restoration projects designed to increase resilience to climate stressors could diminish the cultural resource base in some locations.

The effects of climate change on cultural resource tourism are difficult to estimate because this is contingent on social and economic factors. Visiting historic sites is popular throughout the Northern Rockies (Nickerson 2014), and tourism is an important economic contributor to many local communities (see Chapter 10). Hot, dry summer weather could reduce public interest in visiting cultural resources, cultural landscapes, and interpretive sites located on Federal lands, particularly in areas recently affected by severe wildfires or floods. This potential impact on forest tourism could, in turn, affect local communities to some extent.

Adapting to the Effects of Climate Change

Federal agencies in the Northern Rockies region have the capacity to address some of the projected effects of climate change on cultural resources. Fuels reduction around significant cultural resources is already in place in some locations to reduce the intensity and severity of future wildfires. USFS heritage personnel are engaged in all aspects of wildfire suppression and recovery, which facilitates protection of cultural resources threatened by wildfires. However, fire vulnerability assessment and abatement programs for cultural resources may need further emphasis to address a potential for more wildfires in the future.

Less progress has been made in completing vulnerability assessments or implementing protection strategies for cultural resources located in areas prone to large-scale hydrologic events, and the full scope of this risk is unknown in the Northern Rockies region. Hydrologic events are unpredictable, and protection measures such as stabilization and armoring are expensive. Viable protection measures often require hydrologic, engineering, and other resource expertise. Nonetheless, Federal agencies have a strong mandate to implement measures to protect cultural sites threatened by such natural processes and emergency events.

Survey and evaluation in areas where cultural resources are concentrated or likely are ongoing, although intermittent, in the Northern Rockies region. It will be possible to locate and monitor cultural resources potentially at risk only if these efforts are significantly expanded. High-elevation melting ice patches are a particular priority, but surveys are critical in other locations where cultural resources are likely to be affected by flooding and debris flows in mountain canyon and foothills areas. Correlating areas where cultural resources are common with areas where ice melt and flooding are expected will help to focus attention on landscapes at greatest risk.

Some climate-induced vegetation shifts in designated cultural landscapes could be partially mitigated through silvicultural treatments and prescribed burning, although the effectiveness of proposed treatments relative to the scope and scale of the cultural landscape is difficult to evaluate. Careful monitoring and tracking of vegetation stability and change in cultural landscapes will become increasingly important in future decades.

To date, the potential effects of climate change on the historic built environment in the Northern Rockies region has received relatively little attention. However, a variety of actions may eventually be necessary to abate or mitigate the projected effects of climate change on historic buildings and structures. Vulnerability assessments by qualified experts are necessary precursors to initiating any remediation work such as stabilization, armoring, and other interventions. In this context, historic preservation teams, volunteers, and partners will be important contributors to climate-related preservation work in the future.

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