Chapter 11
Effects of Climate Change on Cultural Resources in the Northern Rockies

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Abstract Cultural resources in the Northern Rockies are currently vulnerable to various natural and human agencies, including wildfire and biological processes, vandalism and other depreciative human behaviors, and changing population demographics and recreational use. Climate change has the potential to accelerate some of these ongoing effects to cultural resources. Increasing wildfires will have a direct effect on cultural resources, because they are broadly distributed throughout forest and grassland ecosystems. Melting ice caused by climate change poses a risk to previously ice-encased and well-preserved cultural resources. Seasonal aridity and prolonged drought will accelerate soil deflation and erosion, and expose archaeological sites once buried in prairie or mountain soils. At the same time, a projected increase in winter precipitation, coupled with earlier and more intense spring runoff, poses another threat to cultural resources. Climate-induced changes in terrestrial and aquatic habitats also affect abundance of culturally-valued plants, animals and fish, affecting the ability of Native American tribes to exercise their treaty rights.

Damage to cultural and historic sites is irreversible, making protection a key management focus. To some extent, wildfire effects can be mitigated through active prevention measures (for example, thinning trees around historic structures) and fire suppression and recovery tactics. Hydrological events are unpredictable, and protection measures such as stabilization and armoring are expensive. 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 is ongoing, although intermittent, in the Northern Rockies. It will be possible to locate and monitor cultural resources only if these efforts are significantly expanded.

Keywords American Indians • Artifacts • Cultural landscapes • Cultural resources • Historic buildings • National Historic Preservation Act • Traditional cultural uses

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11.1 Background and Cultural Context

People have inhabited the Northern Rocky Mountains and Great Plains of the United States since the end of the last Pleistocene glacial period (Fagan 1990; Meltzer 2009), and evidence of this distant and more recent human occupation is found throughout the assessment area. The Northern Rockies and Plains are the ancestral homeland, aboriginal territory, and hunting ground of the Assiniboine, Blackfeet, Chippewa-Cree, Crow, Hidatsa, Kiowa, Kutenai, Nez Perce, Northern Cheyenne, Salish, Shoshone, Sioux and other Plains, Intermountain, and Columbia Plateau American Indian tribes (Walker 1988; Schleiser 1994; DeMallie 2001). Beginning in the eighteenth century, the region was explored and then settled by people of many different European ancestries (White 1993). The region has always contained a diversity of cultural backgrounds and lifeways.

Archaeological and historical evidence of past cultural groups, interactions, and events are termed "cultural resources," and 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 (NPS 2015b). The U.S. Forest Service (USFS) Northern Region alone has documented approximately 20,000 cultural resources, representing a small fraction of what likely exists across the entire assessment area.

Protection of cultural resources has been formally recognized since 1906 when the Antiquities Act was signed into law, and has been reaffirmed by 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. Federal land management agencies are required to identify, evaluate and preserve historic, scientific, commemorative, and cultural values of archaeological and historic sites and structures on public lands for present and future generations (NPS 2015a; USFS 2008). The President of the United States has authority to designate national monuments in order to protect landmarks, structures, and objects of historical or scientific significance. In 1966, Congress declared it to the our national policy that the Federal government will "administer federally owned, administered, or controlled prehistoric and historic resources in a spirit of stewardship for the inspiration and benefit of present and future generations." Thus, a core mission of the National Park Service is the preservation, enhancement and interpretation of cultural resources. The USFS and other federal land management agencies protect and manage cultural resources as part of their multiple use missions.

Protection of cultural resources also includes ongoing use of resources and associated activities relevant to the continuation of extant American Indian and other cultures (NPS 2011). Many cultural resources are currently vulnerable to natural biophysical phenomena and human activities. Wildfire and decomposition degrade and destroy cultural resources, particularly those made of wood or located in erosion-prone environments. Vandalism, illegal artifact collecting, arson, and

other human behaviors also damage cultural resources. Land management actions can affect cultural sites, although federal land managers attempt to protect and mitigate adverse effects wherever possible.

11.2 Climate Change Effects on Cultural Resources

11.2.1 Primary Effects and Stressors

This evaluation of the potential effects of climate change on cultural resources in the Northern Rockies is quite general, because so little information has been generated on this topic compared to the effects of climate change on natural resources, and because it is difficult to infer the spatial extent and timing of specific effects. Inferences in this chapter are based on a synthesis of relevant literature from different disciplines to project how an altered climate, both directly and indirectly (through increased disturbance), will create conditions that modify the condition of and access to cultural resource sites.

Climate change has the potential to exacerbate and accelerate existing effects on cultural resources (Rockman 2015; Morgan et al. 2016) (Table 11.1). A warmer climate will alter the scale of wildfires across western North America (McKenzie et al. 2004; Schoennagel et al. 2004; Chap. 7), thus having at least three general effects on cultural resources. First, wildfires burn cultural resources made of wood and

Table 11.1 Summary of climate change stressors and potential effects on cultural resources in the Northern Rockies

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

For additional detail, see UNESCO (2007), Rockman (2015), and Morgan et al. (2016)

Fig. 11.1 Aboriginal stone cairn exposed by wildfire in Custer-Gallatin National Forest (Photo by Halcyon LaPoint, U.S. Forest Service)

combustible materials, including ancient wood shelters and game drives, and historic homesteads, mining ruins, and early USFS backcountry cabins, lookouts and administrative structures. Second, wildfire suppression and post-fire recovery operations (e.g., heavy equipment use, erosion abatement) affect standing structures and archaeological sites buried in forest soils. Third, flooding and debris flows can damage (e.g., erode away, disturb, bury) cultural resources exposed in the post-fire environment. However, fire can be beneficial if it exposes cultural sites that were not previously visible and archaeologists have the opportunity to record them and develop protection measures where they are now threatened by natural or human disturbances (Fig. 11.1).

Federal agencies implement various actions to reduce the effects of wildfire on cultural resources, such as encasing historic structures in fireproof wrap, reducing suppression activities near cultural sites, and physical armoring of cultural resources vulnerable to post-fire flooding. Because it is difficult and expensive to implement these actions across large landscapes, damage is expected to continue as climate change amplifies area burned.

Seasonal aridity and prolonged drought accelerate soil deflation and erosion, exposing archaeological sites buried in the soil. Wind and water erosion can remove ground cover, revealing artifacts and features such as cooking hearths and tool-making areas. Newly exposed artifacts make them vulnerable to illegal collecting, which can be intensified in areas where livestock grazing, recreation, and mining have already caused impacts. For example, livestock often converge around streams and natural springs where archaeological sites of ancient hunter-gatherers are common.

Fig. 11.2 Post-wildfire debris flow that obliterated or covered cultural resources in Meriwether Canyon, Helena National Forest (Photo by Carl Davis, U.S. Forest Service)

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 of drainages and stream beds (Meltzer 1990; Ruddiman 2007). Warmer temperatures in the future (Mayewski and White 2002; IPCC 2007; Chap. 2) will create additional potential for cultural resource loss through drought and erosion, particularly in drier areas such as southeastern Montana.

If winter precipitation increases (Chap. 2) and reduced snowpack leads to higher winter streamflows (Chap. 3), archaeological and historic sites will be increasingly vulnerable to flooding, debris flows, down cutting, and mass wasting of underlying landforms. This already occurs in the aftermath of large wildfires, especially in the dry mountain ranges of central and eastern Montana (Fig. 11.2), and an increase in extreme events (Chap. 7) will almost certainly increase hydrological impacts on cultural resources (National Research Council 2002).

Persistent high-elevation snowfields contain artifacts remaining from hunting and gathering forays by Native Americans in mountain environments hundreds to thousands of years ago (Lee 2012) (Fig. 11.3). Melting ice caused by a warmer climate poses a risk to previously ice-encased cultural resources that are well preserved. For example, ancient bone, wood, and fiber artifacts have been revealed by melting ice patches in the Beartooth Mountains (south-central Montana). Melting ice provides opportunities for archaeologists and Native Americans to locate, document, and archive artifacts, but it also makes artifacts susceptible to decay or theft.

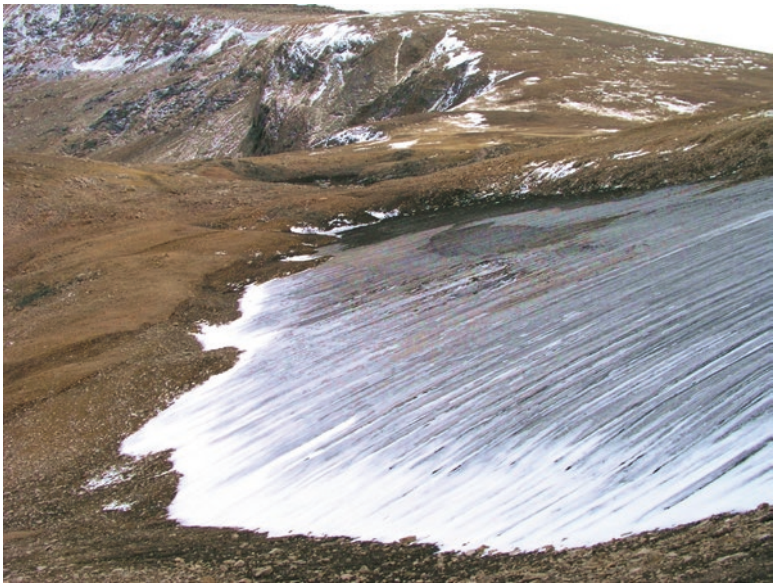

Fig. 11.3 Melting perennial ice patches expose prehistoric artifacts in Custer-Gallatin National Forest (Photo by Craig Lee, Montana State University)

Climate change can affect cultural landscapes whose integrity is derived from both cultural resources and environmental context (NPS 1994; Rockman 2015), including ancient American Indian travel routes, battlefields (e.g., Big Hole Battlefield) and historic mining districts. Altered distribution and abundance of dominant vegetation could potentially affect the physical and visual integrity of such landscapes (Melnick 2009). For example, whitebark pine (*Pinus albicaulis*) is an important historical component of the Alice Creek-Lewis and Clark Pass (Road to the Buffalo Trail) cultural landscape on the Continental Divide near Helena, Montana (Fig. 11.4). Whitebark pine is currently in decline, because warmer temperatures have facilitated extensive outbreaks of mountain pine beetle (*Dendroctonus ponderosae*) in addition to several decades of mortality and damage from white pine blister rust (*Cronartium ribicola*), a nonnative fungal pathogen (Tomback and Kendall 2001) (Chap. 7).

Cultural sites and landscapes are also recognized for their traditional importance to descendant communities, particularly Native American tribes, who value traditional-use areas for foods, medicinal and sacred plants, paints, and ceremonial and spiritual places. Significant climate-induced effects in these landscapes, particularly shifts in native vegetation, may reduce and even sever the continuous cultural connectivity of these areas by indigenous peoples and local communities.

Extreme events related to climate change (e.g., wildfire, flooding, debris flows) may affect historic buildings and structures. In addition to these direct effects, period furniture, interpretive media, and artifact collections inside historic (and

Fig. 11.4 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)

non-historic) buildings can be affected by extreme events. Additional stressors include increased heat, moisture, humidity, freeze-thaw events, insect infestation, and fungi, all of which can accelerate weathering, deterioration, corrosion, and decay of structures and ruins (UNESCO 2007).

Climate change may also diminish the appeal of cultural sites and cultural landscapes for members of the public who visit these sites and interpretive exhibits. 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). Dead and dying forests also present hazards to hikers, sightseers, and other visitors (Chap. 9). Altered ecological conditions surrounding cultural sites and within cultural landscapes may reduce their attractiveness and value for tourism, recreation and other purposes, with potential impact on local communities and economies (Chaps. 9 and 10).

11.2.2 Spatial and Temporal Risk Assessment

Climate change effects on cultural resources will be highly variable across the assessment area, with some effects occurring within the next few decades and others by the end of the twenty-first century. Wildfire will be the biggest and most pervasive risk for cultural resources on federal lands in the region, creating a mosaic of

burned areas of different sizes and severities over time. For example, large, high-severity wildfires since 2000 have burned hundreds of thousands of hectares on national forests in Idaho and Montana, from the Bitterroot National Forest in western Montana to the Custer Gallatin National Forest in southeastern Montana (Fig. 11.1). Hundreds of cultural resources have been affected. Glacier and Yellowstone National Parks, Bureau of Land Management units, and other public lands have also experienced large fires since the 1990s, with the same consequences to cultural resources. This is likely to continue into the foreseeable future.

Increased aridity and drought may be partly offset if winter precipitation increases in the future (Chap. 2), making it difficult to quantify the long-term effects of extreme weather and hydrologic events. Resource damage will be greatest in areas prone to hydrologic disturbance, such as canyon mouths and river bottoms where cultural sites are often concentrated. It will be difficult to armor and protect sites in these locations, and artifact collectors may target these areas where cultural materials are exposed in newly disturbed landforms or are deposited there by water and debris.

Other effects on cultural resources will be more subtle or slow to appear. Shifting vegetation distribution and abundance will occur gradually over many decades, typically requiring one or more large disturbances to promote regeneration. Climate change effects to historic buildings and structures will be gradual and cumulative (deterioration, decay) in some cases, and sudden and direct (e.g., structural collapse caused by snow loading and excessive moisture) in others (Morgan et al. 2016). Some natural resources associated with traditional cultural landscapes, still used by Native Americans today, may deteriorate or 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*).

The effects of climate change on cultural resource tourism are difficult to estimate because tourism is strongly affected by many social and economic factors, but it is unlikely that most popular cultural sites will completely deteriorate in the next several decades. Visiting historical sites is popular throughout the intermountain West (Nickerson 2014), and tourism is an important economic contributor to many local communities (Chap. 9). The direct effects of hot weather could reduce public interest in visiting cultural landscapes and interpretive sites, particularly in areas recently affected by dying and dead vegetation, severe wildfires, or floods, with secondary economic effects on local communities.

11.3 Adapting Cultural Resources and Management to Climate Change

Federal agencies 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, thus reducing the intensity and

Fig. 11.5 The Bar Gulch Cabin (Helena National Forest) survived a wildfire in 2000, because it was protected by fire retardant wrap and a water sprinkler system. Historic structures will be vulnerable if fire frequency increases in the future (Photo by Carl Davis, U.S. Forest Service)

severity of future wildfires. Heritage personnel in national forests and national parks are engaged in all aspects of wildfire management, helping to protect cultural resources that could be damaged by wildfires, fire suppression and fire recovery (Fig. 11.5). Fire vulnerability assessment and abatement programs for cultural resources deserves additional emphasis in anticipation of more wildfires in the future.

Less progress has been made in implementing protection strategies for cultural resources in areas prone to large-scale hydrologic events, partly because the scope of this risk has not been documented. Flooding and geomorphic disturbance are unpredictable in space and time. Protection measures (e.g., stabilization, armoring) are often prohibitively expensive, typically requiring expertise in hydrology, engineering, and other disciplines to develop effective solutions.

Survey, inventory, and evaluation in areas where cultural resources are concentrated or likely to exist are ongoing, albeit at a low level of activity. Identification and monitoring of at-risk resources will be possible only if these efforts are greatly expanded. High-elevation melting ice patches are currently a priority, but surveys are also needed in locations where artifacts may be damaged by water and earth movement (e.g., canyon and foothills areas). Areas with cultural resources can be correlated with areas where flooding and ice melt are expected will help identify landscapes at greatest risk.

Potential climate-induced vegetation shifts in cultural landscapes could be partly 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.

The potential effects of climate change on the historic built environment in the Northern Rockies has received little attention. However, some actions may eventually be necessary to reduce the potentially negative effects of climate change on historic buildings and structures. These actions could include hazardous fuels reduction, flood and erosion control, insect abatement, building weatherization, and structural stabilization. Conducting vulnerability assessments is the first step to planning any remediation work. Collaborative efforts that include agency managers, heritage specialists, historic building preservation teams, partners, and volunteers are needed to develop priorities and initiate this work on public lands.

References

DeMallie, R. J. (Ed.). (2001). *Handbook of North American Indians: Plains, volume 13*. Washington, DC: Smithsonian Institution.

Fagan, B. M. (1990). *The journey from Eden: The peopling of our world*. London: Thames & Hudson.

Intergovernmental Panel on Climate Change (IPCC). (2007). The physical science basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. S. Solomon, D. Qin, M. Manning, et al. (Eds.) Cambridge, UK: Cambridge University Press.

Lee, C. M. (2012). Withering snow and ice in the mid-latitudes: A new archaeological and paleobiological record for the Rocky Mountain region. *Arctic, 65*, 165–177.

Logan, J., & Powell, J. (2001). Ghost forests, global warming, and the mountain pine beetle (Coleoptera: Scolytidae). *American Entomologist, 47*(3), 160–173.

Mayewski, P. A., & White, F. (2002). *The ice chronicles: The quest to understand global climate change*. Hanover, NH: University of New Hampshire Press.

McKenzie, D., Gedalof, Z., Peterson, D. L., & Mote, P. (2004). Climatic change, wildfire, and conservation. *Conservation Biology, 18*(4), 890–902.

Melnick, R. Z. (2009). Climate change and landscape preservation: A twenty-first century conundrum. *APT Bulletin: Journal of Preservation Technology, 40*(3-4), 34–43.

Meltzer, D. J. (1990). Human responses to middle Holocene (Altithermal) climates on the North American Great Plains. *Quaternary Research, 52*, 404–416.

Meltzer, D. J. (2009). *First peoples in a new world: Colonizing ice age America*. Berkeley: University of California Press.

Morgan, M., Rockman, M., Smith, C., & Meadow, A. (2016). *Climate change impacts on cultural resources* (Cultural resources partnerships and science). Washington, DC: National Park Service.

National Park Service (NPS). (1994). *Protecting cultural landscapes: Planning, treatment and management of historic landscapes* (Preservation Brief 36). Washington, DC: National Park Service.

National Park Service (NPS). (2011). Cultural resources, partnerships and science directorate. http://www.nps.gov/history/tribes/aboutus.htm. 30 Jan 2017.

National Park Service (NPS). (2015a). Archaeology program–Antiquities Act 1906–2006. http://www.nps.gov/archeology/sites/antiquities/about. 30 Jan 2017.

National Park Service (NPS). (2015b.) Glacier National Park: What are cultural resources? http://gnpculturalresourceguide.info/files/resources/What%20Are%20Cultural%20ResourcesFinal.pdf. 30 Jan 2017.

National Research Council. (2002). *Abrupt climate change: Inevitable surprises*. Washington, DC: National Academy Press.

Nickerson, N. P. (2014). *Travel and recreation in Montana: 2013 review and 2014 outlook*. Missoula: University of Montana, College of Forestry and Conservation.

Rockman, M. (2015). An NPS framework for addressing climate change with cultural resources. *The George Wright Forum, 32*(1), 37–50.

Ruddiman, W. F. (2007). *Earth's climate: Past and future*. New York: W. H. Freeman.

Schleiser, K. H. (1994). *Plains Indians, A.D. 500-1500: The archaeological past of historic groups*. Norman: University of Oklahoma Press.

Schoennagel, T., Verblen, T. T., & Romme, W. H. (2004). The interaction of fire, fuels, and climate across Rocky Mountain forests. *Bioscience, 54*(7), 661–676.

Tomback, D. F., & Kendall, K. C. (2001). Biodiversity losses: The downward spiral. In D. F. Tomback, S. F. Arno, & R. E. Keane (Eds.), *Whitebark pine communities: Ecology and restoration* (pp. 243–262). Washington, DC: Island Press.

U.S. Forest Service (USFS). (2008). *Forest service manual, FSM-recreation, wilderness, and related resource management, chapter 2360-heritage program management*. Washington, DC: National Headquarters.

United Nations Educational, Scientific, and Cultural Organization (UNESCO). (2007). *Climate change and world heritage: Report on predicting and managing the impacts of climate change on world heritage and strategy to assist states parties to implement appropriate management responses* (World Heritage Report 22). Paris: UNESCO, World Heritage Centre.

Walker, D. E. (Ed.). (1988). *Handbook of North American Indians: Plains, volume 12*. Washington, DC: Smithsonian Institution.

White, R. (1993). *It's your misfortune and none of my own: A new history of the American West*. Norman: University of Oklahoma Press.