

Chapter 10: Effects of Climate Change on Recreation in the Northern Rockies Region

Michael S. Hand and Megan Lawson

Introduction

Outdoor recreation is an important benefit provided by Federally managed and other public lands throughout the Rocky Mountains. National forests in the Forest Service, U.S. Department of Agriculture (USFS) Northern Region and Greater Yellowstone Area (a region hereafter called the Northern Rockies region) have an estimated 13.3 million visits per year; Yellowstone, Grand Teton, and Glacier National Parks account for another 8 million visits per year. National forests and national parks provide recreation opportunities at sites that offer a wide variety of characteristics. Recreation on public lands in the Northern Rockies region is inseparable from ecosystems and natural features. Whether visitors ski, hike, hunt, or camp, explore developed sites or the backcountry, or simply drive through a park or forest, natural and ecological conditions in large part determine their overall recreation experience.

Climatic conditions and environmental characteristics that depend on climate are key factors that determine the availability of and demand for different recreation opportunities (Shaw and Loomis 2008). Changing climatic conditions may alter the supply of and demand for recreation opportunities, resulting in changes in visitation patterns and the benefits derived from recreation in the future. Climate change is projected to increase outdoor recreation participation in general (Bowker et al. 2014). Benefits provided by recreation are expected to increase under climate change scenarios because anticipated increases in summer and warm-weather activities will outweigh losses in winter activities (Loomis and Crespi 2004; Mendelsohn and Markowski 2004).

Public lands managers will face a complex task of managing recreation opportunities under changing recreational preferences and ecological conditions. Investments in infrastructure, the provision and maintenance of facilities, and decisions about recreation development are important inputs that determine recreational setting and the type of recreational opportunities available to visitors. These inputs can be classified by using the Recreation Opportunity Spectrum, which has been used for decades by public lands managers for planning and allocation of recreation opportunities (Clark and Stankey 1979). Recreation visitation behavior and values can be mapped to the Recreation Opportunity Spectrum, providing managers with information about the tradeoffs associated with different types of investments and

development (Rosenthal and Walsh 1986; Swanson and Loomis 1996). A changing climate may alter types of recreation experiences desired and the opportunities that can be provided by public lands.

Although broad trends in recreation participation under climate change scenarios may be borne out at the regional scale, little is known about how recreation in the Northern Rockies region will change. This chapter describes the broad categories of recreation activities that may be sensitive to climate-related changes in the region, and assesses the likely effects of projected climate changes on recreation participation.

Relationships Between Climate Change and Recreation

The supply of and demand for recreation opportunities are sensitive to climate through (1) a direct effect of changes in temperature and precipitation on the availability and quality of recreation sites, and (2) an indirect effect of climate on the characteristics and ecological condition of recreation sites (Loomis and Crespi 2004; Mendelsohn and Markowski 2004; Shaw and Loomis 2008) (fig. 10.1).

Direct effects of changes in temperature and precipitation patterns are likely to affect most outdoor recreation activities in some way. Direct effects are important for skiing and other snow-based winter activities that depend on seasonal temperatures and the amount, timing, and phase of precipitation (Englin and Moeltner 2004; Irland et al. 2001; Stratus Consulting 2009). Warm-weather activities are also sensitive to direct effects of climate change. Increases in minimum temperatures have been associated with increased national park visits in Canada, particularly during nonpeak “shoulder” seasons (Scott et al. 2007). The number of projected warm weather days is positively associated with expected visitation for a national park in the United States, although visitation is expected to be lower under extreme-heat scenarios (Bowker et al. 2012; Richardson and Loomis 2004). Temperature and precipitation may also directly affect the comfort and enjoyment that participants derive from engaging in an activity on a given day (Mendelsohn and Markowski 2004).

Indirect climate effects tend to be important for recreation activities that depend on additional ecosystem inputs, such as wildlife, vegetation, and surface water.

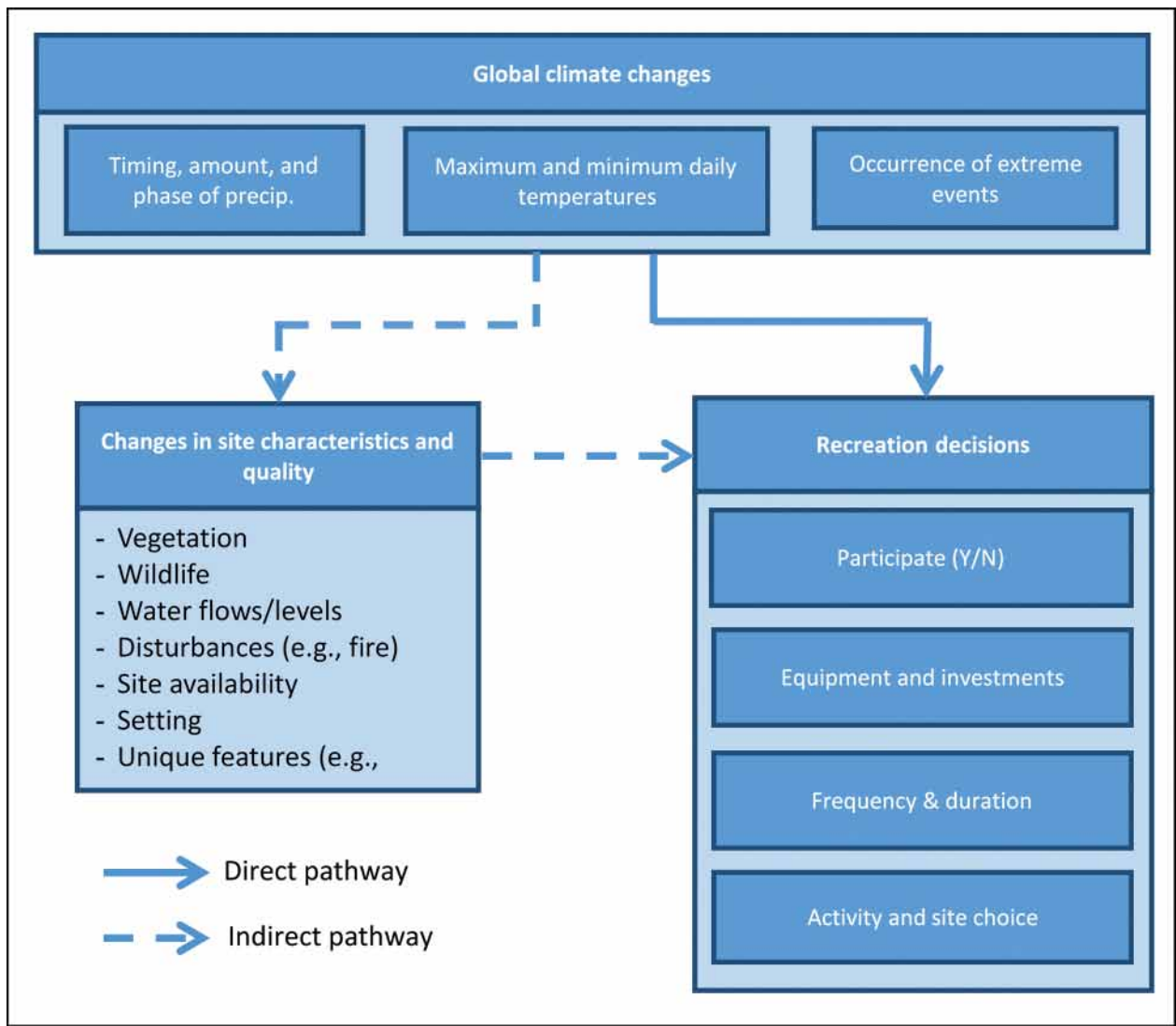


Figure 10.1—Direct and indirect effects of climate on recreation decisions.

Cold-water fishing is expected to decline in the future due to climate effects on temperature and streamflow that threaten cold-water fish species habitat (Jones et al. 2013) (see Chapter 5). Surface water area and streamflows are important for water-based recreation (e.g., boating), and forested area affects several outdoor activities (e.g., camping and hiking) (Loomis and Crespi 2004). Recreation visits to sites with highly valued natural characteristics, such as glaciers or popular wildlife species (see chapters 4 and 9) or scenic and aesthetic qualities, may be reduced in some future climate scenarios if the quality of those characteristics is threatened (Scott et al. 2007). The indirect climate effect on disturbances, and wildfire in particular (see Chapter 8), may also play a role in recreation behavior, although the effect may be diverse and vary over time (Englin et al. 2001).

Identifying Climate-Sensitive Outdoor Recreation Activities

People participate in a wide variety of outdoor recreation activities in the Northern Rockies region. The National Visitor Use Monitoring (NVUM) survey, conducted by the USFS to monitor recreation visitation and activity on national forests, identifies 27 different recreation activities in which visitors may participate. These include a wide variety of activities and ways that people enjoy and use national forests and other public lands.

The NVUM surveys roughly one-quarter of forest units in each region every year, and each unit is surveyed again every 5 years. For this analysis, we used the latest survey data available for each forest. Sample years for the units included in this analysis are as follows: 2008—Bridger-Teton, Custer, Helena; 2009—Gallatin, Idaho Panhandle, Shoshone; 2010—Beaverhead-Deerlodge, Caribou-Targhee, Flathead;

2011—Clearwater, Lolo, Nez Perce; 2012—Bitterroot, Kootenai, Lewis and Clark. Visitors are sampled by using a stratified random sampling technique designed for assessing use on national forests. Sampling sites are stratified according to type of recreation site and times of day and week. Visitors are asked about different categories of trip-related spending incurred within 50 miles of the site where they are interviewed. Interviewees are selected at random, and interviewers conduct as many surveys as possible (English et al. 2001).

All outdoor recreation activities depend to some degree, directly or indirectly, on climatic conditions or environmental conditions that are determined by climate. For example, skiing opportunities depend on the availability of areas with snow-covered terrain, which is determined by patterns of temperature and precipitation as snow. As climate change affects seasonal trends in temperature and precipitation, the availability of certain skiing sites may change in the future.

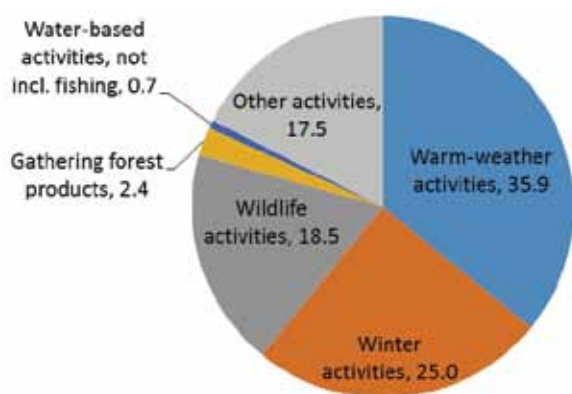
To assess how recreation patterns may change in the Northern Rockies region, categories of outdoor recreation activities that may be sensitive to climate changes were identified (fig. 10.2). For this assessment, a recreation activity was considered sensitive to climate change if changes in climate or environmental conditions that depend on climate would be an important factor affecting the demand for or supply of that recreation activity within the study area. However, there is no hard rule by which activities satisfy this requirement, and other types of activities not explicitly covered in this chapter may be affected by climate changes.

The 27 recreation activities identified in the NVUM survey were grouped into 5 climate-sensitive categories of activities, plus an “Other” category of activities that are less sensitive to climate changes. Each category includes activities likely to be affected by changes in climate and environmental conditions in similar ways. Table 10.1 lists the activities in the climate-sensitive categories and summarizes their sensitivity to climate changes. The categories were developed to capture the most common types of recreation that people engage in on public lands in the Northern Rockies region that would be affected by

climate changes. Seventeen activities were identified as sensitive to climate changes.

These 17 activities account for the primary recreation activities for 83 percent of visits to national forests in the study area. Activities in the “Other” category were judged to be less sensitive to climate changes and tend to be less frequently listed as a primary recreation activity in the Northern Rockies region. Although participation in many of these activities may be linked to climate in some way, other factors are likely to be more important determinants of participation (for example, maintenance of infrastructure for visiting interpretive sites). Warm-weather activities are the most popular, and include hiking/walking, viewing natural features, developed and primitive camping, bicycling, backpacking, horseback riding, picnicking, and other nonmotorized uses. These were the main activity for 35.9 percent of national forest visitors (4.8 million visitors per year) (table 10.1). Of these, hiking/walking was the most popular, and is the primary reason for a visit for 16.9 percent of visitors (2.2 million people). Snow-based winter activities are also a large draw, and include downhill skiing, snowmobiling, and cross-country skiing. They were the primary activity for 25.0 percent of all visitors (3.3 million people). Wildlife-related activities, including hunting, fishing, and viewing wildlife, were the primary activity for 18.5 percent of visitors (2.5 million people). Of these, hunting was the most popular with 11 percent of visitors (1.5 million people). Gathering forest products such as berries and mushrooms was the primary activity for 2.4 percent of visitors (300,000 people). Motorized and nonmotorized water activities (other than fishing) attracted 0.7 percent of visitors (97,000 people) (table 10.1).

Non-local visitors—those who report a home ZIP code that is more than 30 miles from the forest boundary—spend \$601 million (in 2014 dollars) per year within 50 miles of the forest boundaries. Note that some nonlocal respondents may have second homes near the forest boundary that would qualify as local had they reported the ZIP code associated with the second home (Stynes and White 2005). Table 10.2 summarizes expenditures by visitors to national forests in the Northern Rockies region. We focus on spending by nonlocal visitors because their expenditures in local communities would not have occurred otherwise. Lodging expenses account for nearly 31 percent of total expenditures, followed by restaurants (18 percent), gas and oil (17 percent), and groceries (12 percent). The remaining expenditure categories of other transportation, activities, admissions and fees, and souvenirs represent 21 percent of all spending.



Source: USDA FS (n.d.)

Figure 10.2—Percent of total national forest visits by climate-sensitive primary activity.

Climate Change Vulnerability Assessment

The overall effect of climate change on recreation activity is likely to be an increase in participation and increase in the benefits derived from recreation. This is due primarily to warmer temperatures and increased season length appropriate

Table 10.1—Participation in different recreational activities in national forests in the Northern Region and Greater Yellowstone Area.

Activity	Relationship to climate and environmental conditions	National Forest visitors who participated in this activity as their main activity ^a	
		Percent of total NF visits	Number
Warm-weather activities	Participation typically occurs during warm weather; dependent on the availability of snow- and ice-free sites, dry weather with moderate daytime temperatures, and the availability of sites where air quality is not impaired by smoke from wildfires.	35.9	4,770,616
Hiking/walking		16.9	2,248,171
Viewing natural features		8.6	1,136,245
Developed camping		2.8	375,174
Bicycling		2.2	286,707
Other non-motorized		2.0	265,476
Horseback riding		1.3	168,175
Picnicking		1.2	164,638
Primitive camping		0.6	74,876
Backpacking		0.4	51,154
Winter activities	Participation depends on the timing and amount of precipitation as snow and cold temperatures to support consistent snow coverage. Inherently sensitive to climate variability and inter-annual weather patterns.	25.0	3,318,426
Downhill skiing		12.8	1,695,621
Snowmobiling		6.4	843,778
Cross-country skiing		5.9	779,027
Wildlife activities	Wildlife availability is a significant input for these activities. Temperature and precipitation are related to habitat suitability through effects on vegetation, productivity of food sources, species interactions, and water quantity and temperature (for aquatic species). Disturbances (wildland fire, invasive species, insect and disease outbreaks) may affect amount, distribution, and spatial heterogeneity of suitable habitat.	18.5	2,452,053
Hunting		11.3	1,503,520
Fishing		5.3	708,589
Viewing wildlife		1.8	240,944
Gathering forest products	Depends on availability and abundance of target species (e.g., berries, mushrooms), which are related to patterns of temperature, precipitation, and snowpack. Disturbances may alter availability and productivity of target species in current locations and affect opportunities for species dispersal.	2.4	313,475
Water-based activities, not including fishing	Participation requires sufficient water flows (in streams and rivers) or levels (in lakes and reservoirs). Typically considered a warm-weather activity, and depends on moderate temperatures and snow- and ice-free sites. Some participants may seek water-based activities as a heat refuge during periods of extreme heat.	0.7	96,643

^a Source: USDA FS (n.d.). Total estimated National Forest visits is 13,273,685. Percentage calculations are based on the percent of total visits accounted for by each activity and category.

for warm-weather activities, outweighing decreased winter activities that depend on snow and consistently cold temperatures (Mendelsohn and Markowski 2004). However, these general findings mask potential variation in the effects of climate on recreation between types of activities and geographic locations (boxes 10.1, 10.2).

This section assesses the likely effects of climate on major climate-sensitive recreation activities in the region (table 10.3). Two sources of information are used to develop assessments

for each category of recreation activity. First, reviews of existing studies of climate change effects on recreation and studies of how recreation behavior responds to climate-sensitive ecological characteristics are used to draw inferences about likely changes for each activity category. Second, projections of ecological changes specific to the Northern Rockies region, as detailed in the other chapters of this volume, are paired with the recreation literature to link expected responses of recreation behavior to specific expected climate effects.

Table 10.2—Total annual expenditures by non-local and local visitors to Northern Rockies and Greater Yellowstone Area national forests, by spending category.

Spending category	Non-local spending ^{a,b}		Local spending	
	Total annual expenditures	Spending for each category	Total annual expenditures	Spending for each category
	<i>Thousands of \$ (2014)</i>	<i>%</i>	<i>Thousands of \$ (2014)</i>	<i>%</i>
Lodging	185,355	31	14,743	6
Restaurant	109,743	18	29,618	13
Groceries	74,003	12	44,886	19
Gasoline, oil	104,319	17	78,880	34
Other transportation	3,013	1	1,059	0
Activities	36,376	6	14,195	6
Admissions, fees	39,482	7	19,103	8
Souvenirs	48,839	8	28,075	12
Total	601,128		230,562	

^a Non-local refers to trips that required traveling more than 50 miles.

^b Source: USDA FS (n.d.).

Current Conditions and Existing Stressors

Public lands in the Northern Rockies region provide an abundance and variety of recreational options, offering opportunities for people of all interests and abilities. Opportunities range from high-use developed sites near urban areas and popular tourist destinations, to vast areas of remote wilderness and seldom used sites off the beaten path. The facilities and services available also exhibit a wide range of conditions and characteristics. Some sites are developed with modern amenities and staffed by agency employees or volunteers. Others may exhibit scant evidence of human influence other than a trailhead.

Current conditions reflect wide variation in intra-annual and interannual (within and between years) weather and ecological conditions. Temperature, precipitation, water flows and levels, wildlife distributions, vegetative conditions, and wildfire activity may vary widely. Recreationists are most likely already accustomed to some degree to making decisions with a significant degree of uncertainty about conditions at the time of participation.

Several existing challenges and stressors affect recreation in the Northern Rockies region. Increased population, particularly in proximity to public lands, can strain visitor services and facilities due to increased use; projected population increases in the future may exacerbate these effects (Bowker et al. 2012). Increased use due to population growth can also reduce site quality because of congestion at the most popular sites (Yen and Adamowicz 1994). Changes in land use may alter access to public lands, fragmentation of landscapes and habitat, and disturbance regimes that relate to recreation activities.

The physical condition of recreation sites and natural resources is constantly changing due to human and natural

forces. Recreation sites and physical assets need maintenance, and deferred or neglected maintenance may increase congestion at other sites that are less affected or increase hazards for visitors who continue to use degraded sites. Unmanaged recreation can create hazards and contribute to natural resource degradation (USDA FS 2010). This stressor may interact with others, such as population growth and maintenance needs, if degraded site quality or congestion encourages users to engage in recreation that is not supported or appropriate at certain sites or at certain times of the year. Natural hazards and disturbances may create challenges for the provision of recreation opportunities. For example, wildfire affects recreation demand (due to site quality and characteristics), but may also damage physical assets or exacerbate other natural hazards such as erosion (see chapters 4 and 12).

Current Management

Recreation is an important component of public land management in the Northern Rockies region. For lands managed by the USFS, sustainable recreation serves as a guiding principle for planning and management purposes (USDA FS 2010, 2012b). Recreation is included with other major multiple uses of national forests, such as timber products and livestock grazing. Sustainable recreation seeks to sustain and expand the benefits to the United States that quality recreation opportunities provide (USDA FS 2010). At the heart of this principle is the desire to manage recreational resources to increasingly connect people with natural resources and cultural heritage, and adapt to changing social needs and environmental conditions. Recreation managers aim to provide diverse recreation opportunities that span the recreation

Box 10.1—Subregional Assessment of Climate Change Effects on Recreation

The broad links between climate, ecological changes, and recreation behavior that form the basis of the activity category assessments are designed to be generally applicable to all locations in the Northern Rockies region. However, in a region that encompasses parts of five States and stretches hundreds of miles from east to west, significant subregional heterogeneity in climate effects may exist. The five Northern Rockies Adaptation Partnership (NRAP) subregions (Western Rockies, Central Rockies, Eastern Rockies, Greater Yellowstone Area [GYA], Grassland) represent a wide variety of geographic and ecological features, and each has distinctive recreation opportunities that may be sensitive to climate changes. Assessing differences between the subregions can yield more geographically specific information about the effects of climate on recreation.

Table 10.B1 summarizes national forest visits by primary activity category for each subregion. Warm-weather activities are the most common category for all subregions, but there are significant differences in the relative importance of each activity category. Snow-based recreation is relatively more important in the Central Rockies, Eastern Rockies, and GYA subregions, where there are multiple sites with consistently viable snow seasons and developed ski areas. In contrast, much less snow-based recreation (as a share of total visits) occurs in the Western Rockies and Grassland subregions. Wildlife recreation activities (hunting, fishing, wildlife viewing) are most important in the Western Rockies and Grassland, although the Central Rockies, Eastern Rockies, and GYA see a significant minority of visitors engaging in these activities. Forest product gathering and water-based (not fishing) activities represent a small share of visits in all subregions, but the Grassland subregion sees almost no visitation for these activities.

The differences in activity participation also suggest that climate will have different effects on recreation in each subregion. The largest differences in activity participation are for snow-based activities; these activities are also the most likely to have negative impacts due to warming temperatures and decreased precipitation as snow. The Grassland subregion and to a lesser extent the Western Rockies have relatively low exposure to this effect because snow-based recreation is less prominent. The Central Rockies, Eastern Rockies, and GYA have higher participation in snow-based activities that could be exposed to climate change, although it is unclear to what extent snow-based sites will experience changes that degrade conditions for snow-based activities.

Other differences between subregions are likely to depend on differences in climate effects between subregions. For example, one subregion could experience warming that increases the incidence of extreme heat days, which has a negative impact on warm-weather recreation, whereas another subregion might experience warming that extends the warm-weather season without a significant increase in the incidence of extreme heat days.

Table 10.B1—National Forest visits by NRAP subregion and activity category.

Activity category	Subregion ^a				
	Western Rockies	Central Rockies	Eastern Rockies	Grassland	Greater Yellowstone Area
<i>Percent of annual visitors reporting main activity</i>					
Warm-weather activities ^{b,c}	36.7	36.9	33.3	60.8	36.2
Snow-based winter activities	7.4	26.0	27.2	1.6	31.3
Wildlife activities	23.3	19.6	18.8	30.5	15.1
Forest product gathering	6.5	1.9	2.1	0.0	1.1
Water-based activities, not including fishing	0.5	0.8	1.6	0.2	0.1

^a To estimate activity participation, subregions are defined by groups of national forests: Western Rockies (Idaho Panhandle, Kootenai, Nez Perce-Clearwater), Central Rockies (Bitterroot, Flathead, Lolo), Eastern Rockies (Beaverhead-Deerlodge, Custer, Gallatin, Helena, Lewis and Clark), Grassland (Dakota Prairie Grasslands), Greater Yellowstone Area (Bridger-Teton, Caribou-Targhee, Shoshone). Geospatial definitions of the subregions include parts of several forests divided between two subregions—for example, parts of Custer, Beaverhead-Deerlodge, and Gallatin National Forests are divided between the Eastern Rockies and Greater Yellowstone Area subregions, but tabulated as part of the Eastern Rockies subregion; these forests are also summarized in table 10.B2 separately from the other Greater Yellowstone Area forests.

^b Source: USDA FS (n.d.).

^c Percentages do not sum to 100 because not all visitors report activities, and not all activities are included in climate-sensitive categories (e.g., nature center activities, visiting historic sites).

Box 10.2—Climate Change in the Greater Yellowstone Area and Glacier National Park

The Greater Yellowstone Area (GYA) provides a wide range of recreation opportunities. The GYA is composed of two national parks (Yellowstone, Grand Teton), parts of six national forests (Beaverhead-Deerlodge, Bridger-Teton, Caribou-Targhee, Custer, Gallatin, Shoshone), and other Federally administered protected areas (John D. Rockefeller Memorial Parkway, National Elk Refuge, Red Rock Lakes National Wildlife Reserve). These areas offer the full spectrum of recreation opportunities, from developed and urban settings to wilderness and primitive sites. Glacier National Park, which straddles the Western and Eastern Rockies subregions in northwestern Montana, also provides a broad range of recreation opportunities comparable to those in the GYA.

Recreation visitation to Federal units within the GYA and Glacier National Park is summarized in table 10.B2. Yellowstone National Park and Grand Teton National Park receive an annual average of 3.4 million and 2.6 million visitors, respectively. For both parks, two of the most common activities were viewing wildlife and viewing scenery and natural features. Most Yellowstone visitors also indicated that they engaged in developed camping, walking or hiking, and visiting museums and visitor centers. Grand Teton visitors indicated pleasure driving and walking or hiking as common activities (NPS 2006). Wildlife viewing is also an important activity for visitors to the Red Rock Lakes National Wildlife Refuge and the National Elk Refuge, although these sites receive only a fraction of the visitors compared with the national parks (NPS 2006). Sightseeing is the dominant activity for the 2.1 million annual visitors in Glacier National Park.

Table 10.B2—Recreation visits to Greater Yellowstone Area units and Glacier National Park.

Unit	Total annual visits	Most frequent activity	Year
Yellowstone National Park ^{a,b}	3,390,000	Viewing wildlife (93% of visitors)	2010–2014 annual average
Grand Teton National Park ^{a,b}	2,650,000	Viewing scenery (88% of visitors)	2010–2014 annual average
Red Rock Lakes National Wildlife Reserve ^c	12,000	Viewing wildlife (45% of visitors)	2014
National Elk Refuge ^{a,d}	900,000	Viewing wildlife (53% of visitors)	2008, 2004
Gallatin National Forest ^e	2,010,000	Hiking/walking (29% of visitors)	2009
Beaverhead-Deerlodge National Forest ^e	583,000	Hunting (32% of visitors)	2010
Caribou-Targhee National Forest ^e	1,850,000	Hiking/walking (18% of visitors)	2010
Shoshone National Forest ^e	646,000	Viewing natural features (25% of visitors)	2009
Bridger-Teton National Forest ^e	2,180,000	Downhill skiing (31% of visitors)	2008
Custer National Forest ^e	314,000	Downhill skiing (26% of visitors)	2008
Glacier National Park ^{b,f}	2,149,000	Sightseeing (97% of visitors)	2010–2014 annual average 1990 (visitor activities)

^a Source: NPS (2006).

^b Source: NPS (2014).

^c Source: USDI (2014).

^d Source: Sexton et al. (2012).

^e Source: USDA FS (n.d.); most frequent activity is the reported main activity (visitors may engage in other secondary or tertiary activities).

^f Source: Littlejohn (1991).

Note: Visitor data are not available for John D. Rockefeller Parkway.

Box 10.2—Continued.

National forests in the GYA receive a combined 7.6 million visitors annually. The most popular activity for visitors varies across forests. In the Gallatin and Caribou-Targhee National Forests, hiking and walking are the most popular activities, whereas downhill skiing is the most popular activity in Bridger-Teton and Custer National Forests. In Beaverhead-Deerlodge National Forest, hunting is the most popular activity (32 percent of visitors) and in Shoshone National Forest, viewing natural features is the most popular activity (25 percent of visitors).

Most of the general assessment of climate change effects on recreation in the Northern Rockies applies to the GYA and Glacier National Park, although the different activity profile means that exposure to the effects of climate change differs in this subregion. Visitation is dominated by warm-weather visits; 80 percent of visits to Yellowstone and Grand Teton National Parks are during the June–September period. An additional 11 percent of visits occur during the “shoulder” season months of May and October. Warmer temperatures are expected to increase warm-weather recreation; earlier- and later-season periods of snow- and ice-free sites in the parks may encourage additional off-peak visitation. Some visitors may also substitute early- or late-season visits to avoid extreme summer heat. However, seasonal shifts in visitation may be constrained by summer vacation months determined by academic calendars.

Changes in the distribution and abundance of wildlife may affect recreation visitation and enjoyment for the large number of Yellowstone and Grand Teton visitors who engage in wildlife viewing. However, many climate-related changes in target wildlife species are ambiguous because of complex interactions between species, vegetation and forage opportunities, and disturbances (see Chapter 9).

Other popular activities, such as driving for pleasure on roads and viewing scenery and special features (e.g., geysers and thermal features in Yellowstone, driving the Going-to-the-Sun Road in Glacier National Park), may be more or less sensitive to climate changes. In some cases the qualities, characteristics, and features that draw visitors to these activities have a limited connection to climate changes. However, features such as glaciers and snow-capped mountains are a particular draw for some visitors, and visitation tied to such features is likely to be affected. Longer warm-weather seasons will probably increase access to roads and sites inaccessible when snow and ice are present; greater accessibility would have a positive effect on visitation. In addition, wildfire and other disturbances can affect site access and the desirability of visiting fire-affected sites. For example, wildfires in Yellowstone National Park are associated with decreased visitation in the subsequent month, but there does not appear to be a lasting negative effect on visitation or wildfire occurrence (Duffield et al. 2013).

opportunity spectrum, from modern and developed to primitive and undeveloped (Clark and Stankey 1979).

Warm-Weather Activities

Warm-weather activities as a category are the most common recreation activities in national forests and national parks in the Northern Rockies region. Slightly more than one-third of all visits involve one of these activities as the primary activity of visitors. Warm-weather recreation is sensitive to the length of appropriate season, depending on the availability of snow- and ice-free trails and sites, and the timing and number of days with temperatures within the range of comfortable temperatures (which may vary with activity type and site). The number of warm-weather days has been shown to be a significant predictor of visitation behavior (Richardson and Loomis 2004), and studies of national park visitation show that minimum temperature is a strong predictor of monthly visitation patterns (Scott et al. 2007).

Participants are also sensitive to site quality and characteristics, such as the presence and abundance of wildflowers, condition of trails, and vegetation and cover (e.g., cover for shade, wildfire effects). The condition of unique features that are sensitive to climate changes, such as glaciers, may affect the desirability of certain sites (Scott et al. 2007). Forested area is positively associated with warm-weather activities, such as camping, backpacking, hiking, and

picnicking (Loomis and Crespi 2004), and is sensitive to future climate changes (USDA FS 2012a).

Wildfire can also affect participation in warm-weather activities through changes to site quality and characteristics (fig. 10.3). Wildfires have a diverse and temporally nonlinear effect on recreation (Englin et al. 2001). The presence of recent wildfires has differential effects on the value of hiking trips (positive) and mountain biking (negative), although recent wildfire activity tends to decrease the number of visits (Hesseln et al. 2003, 2004; Loomis et al. 2001). The severity of fire may also matter; high-severity fires have been associated with decreased recreation visitation, whereas low-intensity fires are associated with slight increases in visitation (Starbuck et al. 2006). Recent fires are associated with initial losses of benefits for camping (Rausch et al. 2010) and backcountry recreation activities (Englin et al. 1996); these effects are attenuated over time. Visitation in Yellowstone National Park tends to be lower following months with high wildfire activity, although there is no discernable effect of previous-year fires (Duffield et al. 2013).

Overall demand for warm-weather activities is expected to increase due to a direct effect of climate change on season length. Temperatures are expected to increase 5 to 12 °F across the region by 2100 (see Chapter 3), which is expected to result in earlier availability of snow- and ice-free sites and an increase in the number of warm-weather days in spring and fall. For example, higher minimum temperatures



Figure 10.3—Expectations for extent and severity of wildfires in a warmer climate will create forest conditions that may be less desirable for hiking and other recreational activities (photo courtesy of Dave Pahlas, <http://IdahoAlpineZone.com>).

are associated with increased number of hiking days (Bowker et al. 2012). More extreme summer temperatures can dampen participation during the hottest weeks of the year, and extreme heat scenarios for climate change are expected to reduce visitation (Richardson and Loomis 2004); higher maximum summer temperatures are associated with reduced participation in warm-weather activities (Bowker et al. 2012). The temperature that is considered “extreme” may vary between individuals and chosen activities. In Bowker et al. (2012), a linear effect of maximum summer temperature in the visitor’s home county was included in participation models. Extreme heat may shift demand to cooler weeks at the beginning or end of the warm-weather season, or shift demand to alternative sites that are less exposed to extreme temperatures (e.g., at higher elevations).

Indirect effects of climate change on forested area may have a negative effect on warm-weather recreation if site availability and quality (e.g., scenic and aesthetic attributes) are compromised. However, the effect on warm-weather recreation in the Northern Rockies region and its various subregions will depend on local effects of climate on forest resources.

Potential increases in the likelihood of extreme wildfire activity may reduce demand for warm-weather activities in certain years because of degraded site desirability, impaired air quality from smoke, and limited site access due to fire management activities. The Northern Rockies region is expected to experience increases in area burned by wildfire, average fire size, and fire severity (see Chapter 8), which tend to have a negative impact on recreation visitation and benefits derived from recreation.

Adaptive capacity among recreationists is high because of the large number of potential alternative sites, ability to alter the timing of visits, and ability to alter capital investments (e.g., appropriate gear). However, benefits derived from recreation may decrease even if substitute activities or sites are available (Loomis and Crespi 2004). For example, some alternative sites may involve higher costs of access (because of remoteness or difficulty of terrain) or congestion costs if demand is concentrated among fewer desirable sites. In addition, visitors’ ability to alter seasonality of visits may be limited because of the timing of scheduled academic breaks. Although recreationists’ ability to substitute sites and activities is well established, there is less understanding of how people substitute across time periods or between large geographic regions (e.g., choosing a site in the Northern Rockies instead of the Southwest) (Shaw and Loomis 2008). In some cases, unique features or strong individual attachment to particular places may limit substitutability.

Projected climate scenarios are expected to result in a moderate increase in warm-weather recreation activity and benefits derived from these activities. Longer warm-weather seasons are likely to increase the number of days when warm-weather activities are viable and to increase the number of sites available during shoulder seasons. The effects of a longer season may be offset somewhat by negative effects on warm-weather activities during extreme heat and increased wildfire activity. The likelihood of effects on warm-weather recreation is high; the primary driver of climate-related changes to warm-weather recreation is through direct effects of temperature changes on the demand for warm-weather recreation. Climate scenarios outlined in Chapter 3 differ in the projected magnitude of warming, but overall project warmer temperatures. Indirect effects on recreation, primarily through wildfire effects, may be harder to project with certainty and precision (particularly at a fine-grained geospatial scale).

Cold-Weather Activities

The Northern Rockies region boasts many winter recreation sites that in total exhibit a wide range of site characteristics and attract local, national, and international visitors. Several sites support developed downhill skiing and snowboarding operated by special-use permit on lands administered by the USFS. Sites for cross-country skiing, snowshoeing, and snowmobiling tend to be maintained directly by the USFS, although national parks also provide access for these activities.

Snow-based recreation is highly sensitive to variations in temperature and the amount and timing of precipitation as snow. Seasonal patterns of temperature and snowfall determine the likelihood of a given site having a viable season and the length of viable seasons (Scott et al. 2008). Lower temperatures and the presence of new snow are associated with increased demand for skiing and snowboarding (Englin and Moeltner 2004). Indirect effects of climate, such as changes in scenery and unique features (e.g., glaciers) may also affect winter recreation, although these effects are expected to be small relative to the effect of changes in amount and timing of snowfall.

Climate change is expected to have a generally negative effect on snow-based winter activities, although a wide range of effects at local scales is possible because of variations across the region in site location and elevation. Warmer projected winter temperatures for the region are expected to reduce the proportion of precipitation as snow, even if the total amount of precipitation does not deviate significantly from historical norms (see Chapter 4). The rain-snow transition zone (i.e., where precipitation is more likely to be snow rather than rain for a given time of year) is expected to move to higher elevations, particularly in late fall and early spring (Klos et al. 2014). This effect places lower elevation sites at risk of shorter or nonexistent winter recreation seasons (fig. 10.4). However, the highest elevation areas in the region remain snow dominated for a longer portion of the season in future climate scenarios.

Studies of the ski industry in North America uniformly project negative effects of climate change (Scott and McBoyle 2007). Overall warming is expected to reduce expected season length and the likelihood of reliable winter recreation seasons (Wobus et al. 2017). Climatic projections for the Northern Rockies region (see Chapter 3) are consistent with studies of the vulnerability of ski areas to climate change in other regions, where projected effects of climate change on skiing, snowboarding, and other snow-based recreation activities are negative (Dawson et al. 2009; Scott et al. 2008; Stratus Consulting 2009).

Snow-based recreationists have moderate capacity to adapt to changing conditions given the relatively large number of winter recreation sites in the region. For undeveloped or minimally developed site activities (for example, cross-country skiing, backcountry skiing, snowmobiling, snowshoeing), recreationists may seek higher elevation sites with higher likelihoods of viable seasons. Although developed downhill skiing sites are fixed improvements, potential adaptations include snowmaking, development at higher elevations, and development of new runs (Scott and McBoyle 2007). However, the ability of winter tourism sector businesses to adapt probably varies considerably. Warmer temperatures and increased precipitation as rain may increase availability of water for snowmaking in the near term during winter, but warmer temperatures may also reduce the number of days per season when snowmaking is viable.



Figure 10.4—Cross-country skiing at lower elevation locations (shown here in the Beaverhead-Deerlodge National Forest) may be vulnerable as snowpack decreases in future decades (photo courtesy of U.S. Forest Service).

Changes in Northern Rockies sites relative to other regions may also be important. If other regions experience relatively large effects of climate on snow-based recreation, recreationists may view Northern Rockies sites as a substitute for sites in other regions (e.g., the Southwest), although interregional substitution patterns for recreation activities are poorly understood (Shaw and Loomis 2008). Further, increased interregional substitution combined with shorter seasons may result in concentrated demand at fewer sites on fewer days, creating potential congestion effects.

The magnitude of climate effects on snow-based winter activities is expected to be high. Warmer temperatures are likely to shorten winter recreation seasons and reduce the likelihood of viable seasons at lower elevation sites. Developed sites may have limited ability to adapt to these changes unless additional adjacent area is available and feasible for expanded development. In comparison to other regions, Northern Rockies winter recreation sites may see fewer effects from climate change; interregional substitution could mitigate losses in some years if participants from other regions are more likely to visit Northern Rockies

sites. The likelihood of effects is expected to be high for snow-based recreation, although variation across sites is possible because of differences in location and elevation. Climate models generally project warming temperatures and a higher-elevation rain-snow transition zone, which would mean that additional sites would be left exposed to the risk of shorter seasons.

Wildlife Activities

Wildlife recreation activities involve terrestrial or aquatic animals as a primary component of the recreation experience. Wildlife recreation can involve consumptive (e.g., hunting) or nonconsumptive (e.g., wildlife viewing, birding, catch-and-release fishing) activities. Distinct from other types of recreation, wildlife activities depend on the distribution, abundance, and population health of desired target species. These factors influence activity “catch rates,” that is, the likelihood of catching or seeing an individual of the target species. Sites with higher catch rates can reduce the costs associated with a wildlife activity (e.g., time and effort tracking targets) and enhance overall enjoyment of a recreation day for that activity (e.g., greater number of views of highly valued species).

Participation in wildlife activities is sensitive primarily to climate-related changes that affect expected catch rates. Catch rates are important determinants of site selection and trip frequency for hunting (Loomis 1995; Miller and Hay 1981), substitution among hunting sites (Yen and Adamowicz 1994), participation and site selection for fishing (Morey et al. 2002), and participation in nonconsumptive wildlife recreation (Hay and McConnell 1979). Changes to habitat, food sources, or streamflows and water temperature (for aquatic species) may alter wildlife abundance and distribution, which in turn influence expected catch rates and wildlife recreation behavior.

Wildlife activities may also be sensitive to other direct and indirect effects of climate change. The availability of highly valued targets affects benefits derived from wildlife activities (e.g., cutthroat trout [*Oncorhynchus clarkii*] for cold-water anglers) (Pitts et al. 2012), as does species diversity for hunting (Milon and Clemmons 1991) and nonconsumptive activities (Hay and McConnell 1979). Temperature and precipitation are related to general trends in participation for multiple wildlife activities (Bowker et al. 2012; Mendelsohn and Markowski 2004), although the precise relationship may be specific to the activity or species. Some activities such as big game hunting may be enhanced by cold temperatures and snowfall at particular times to aid in field dressing, packing out harvested animals, and tracking. Other activities may be sensitive to direct climate effects similar to warm-weather activities, in which moderate temperatures and snow- and ice-free sites are desirable.

Warming temperatures projected for the Northern Rockies region are expected to increase participation in terrestrial wildlife activities because of an increased number

of days that are desirable for outdoor recreation. In general, warmer temperatures are associated with greater participation in and number of days spent hunting, bird watching, and viewing wildlife (Bowker et al. 2012). However, hunting that occurs during discrete seasons (e.g., elk and deer hunting season dates managed by States) may depend on weather conditions during a short period of time. The desirability of hunting during established seasons may decline as warmer weather persists later into the fall and early winter and the likelihood of snow cover decreases, reducing harvest rates.

The effects of changes in habitat for target species are likely to be ambiguous because of complex relationships among species dynamics, vegetation, climate, and disturbances (primarily wildfire and invasive species) (see chapter 9), and are likely to be heterogeneous across species and habitat types. Overall vegetative productivity may decrease in the future, although this is likely to have a neutral effect on game species populations, depending on the size, composition, and spatial heterogeneity of forage opportunities in the future (see Chapter 9). Similarly, the effects of disturbances on target species harvest rates are ambiguous because it is unknown exactly how habitat composition will change in the future.

Higher temperatures are likely to decrease populations of native cold-water fish species as climate refugia retreat to higher elevations (see Chapter 5). This change favors populations of fish species that can tolerate warmer temperatures. However, it is unclear whether shifting populations of species (e.g., substituting rainbow trout [*O. mykiss*] for cutthroat trout) will affect catch rates because relative abundance of fish may not necessarily change.

Total precipitation is not projected to change under future climate scenarios (see Chapter 3), but increased interannual variability in precipitation, the possibility of extreme drought, and reduced snowpack could result in higher peakflows in winter and lower low flows in summer, creating stress for fish populations during different portions of their life histories. The largest patches of habitat for cold-water species will be at higher risk to shrink and fragment. Increased incidence and severity of wildfire may increase the likelihood of secondary erosion events that degrade waterways and game species habitat. These effects could degrade the quality of individual sites in a given year or decrease the desirability of angling as a recreation activity relative to other activities.

The magnitude of climate effects on activities involving terrestrial wildlife is expected to be low overall for terrestrial wildlife activities and moderate for fishing. Ambiguous effects of vegetative change on terrestrial wildlife populations and distribution suggest that conditions may improve in some areas and decline in others. Overall warming tends to increase participation, but may create timing conflicts for activities with defined regulated seasons (e.g., big game hunting) unless the timing of seasons is changed. Anglers may experience moderate negative effects of climate change on benefits derived from fishing.

Opportunities for cold-water species fishing are likely to be reduced as cold-water refugia retreat to higher elevations or are eliminated in some areas. Cold-water species tend to be the highest value targets, indicating that this habitat change will decrease benefits enjoyed by anglers. Warm-water tolerant species may increasingly provide targets for anglers, mitigating reduced benefits from fewer cold-water species. Warmer temperatures and longer seasons encourage additional participation, but indirect effects of climate on streamflows and reservoir levels could reduce opportunities in certain years. The likelihood of climate-related effects on wildlife activities is expected to be moderate for both terrestrial and aquatic wildlife activities. Uncertainties exist about the magnitude and direction of indirect effects of climate on terrestrial habitat and the degree to which changes in available target species affect participation.

Gathering Forest Products

Forest product gathering for recreational purposes accounts for a relatively small portion of primary activities during visits in the Northern Rockies region, although it is relatively more common as a secondary activity. Forest products are also important for cultural and spiritual uses, which are discussed in Chapters 11 and 12. A small but avid population of enthusiasts for certain types of products supports a small but steady demand for gathering as a recreational activity. Small-scale commercial gathering probably competes with recreationists for popular and high-value products such as huckleberries (*Vaccinium* spp.), although resource constraints may not be binding at current participation levels.

Forest product gathering is sensitive primarily to climatic and vegetative conditions that support the distribution and abundance of target species. Participation in forest product gathering is akin to warm-weather recreation activities because it also depends on moderate temperatures and the accessibility of sites where products are typically found. Vegetative change due to warming temperatures and increased interannual variation in precipitation may alter the geographic distribution and productivity of target species (see chapters 6 and 7). Increased incidence and severity of wildland fires may eliminate sources of forest products in some locations (e.g., for berries), but in some cases fires may enhance short- or medium-term productivity for other products (e.g., mushrooms). Long-term changes in vegetation that reduces forest cover may reduce viability of forest product gathering in areas that have a high probability of vegetative transition to less productive vegetation types.

Recreationists engaged in forest product gathering may have the ability to select different gathering sites as the distribution and abundance of target species change, although these sites may increase the costs of gathering. Those who engage in gathering as a secondary or tertiary activity may choose alternate activities to complement primary activities. Commercial products serve as an

imperfect substitute for some forest products such as Christmas trees.

The magnitude of climate effects on forest product gathering is expected to be low. This activity is among the less-common primary recreation activities in the region, although it may be more often engaged in as a secondary or tertiary activity. Longer warm-weather seasons may expand opportunities for gathering in some locations, although these seasonal changes may not correspond with greater availability of target species. The likelihood of effects is expected to be moderate, although significant uncertainty exists regarding direct and indirect effects on forest product gathering. Vegetative changes caused by climate changes and disturbances may alter abundance and distribution of target species, although the magnitude and direction of these effects are unclear.

Water-Based Activities, not Including Fishing

Separate from angling, water-based activities are a small portion of primary recreation activity participation on Federal lands. Upper reaches of streams and rivers are generally not desirable for boating and floating. Lakes and reservoirs provide opportunities for both motorized and nonmotorized boating and swimming, although boating may commonly be paired with fishing. Existing stressors include the occurrence of drought conditions that reduce water levels and site desirability in some years, and disturbances that can alter water quality (e.g., erosion events following wildland fires).

Even if total precipitation does not change significantly under future climate scenarios (see Chapter 3), the availability of suitable sites for non-angling, water-based recreation is sensitive to reductions in water levels caused by warming temperatures, increased variability in precipitation (including the possibility of severe droughts), and decreased precipitation as snow. Reduced water levels may also have an indirect effect on the aesthetic qualities of some water-based recreation sites (e.g., exposure of “bathtub rings” at reservoirs with low water levels). Reductions in surface-water area are associated with decreases in participation in boating and swimming activities (Bowker et al. 2012; Loomis and Crespi 2004; Mendelsohn and Markowski 2004), and streamflow is positively associated with number of days spent rafting, canoeing, and kayaking (Loomis and Crespi 2004). Demand for water-based recreation is also sensitive to temperature. Warmer temperatures are generally associated with higher participation in water-based activities (Loomis and Crespi 2004; Mendelsohn and Markowski 2004), although extreme heat may dampen participation for some activities (Bowker et al. 2012).

Increasing temperatures, reduced storage of water as snowpack, and increased variability of precipitation are expected to increase the likelihood of reduced water levels and greater variation in water levels in lakes and reservoirs on Federal lands (see Chapter 4), which are associated with



Figure 10.5—Algal blooms, shown here in Hayden Lake, Idaho, may become more common in a warmer climate. These conditions are undesirable for water-based recreation and some fish species (photo courtesy of Panhandle Health District).

reduced site quality and suitability for certain activities (fig. 10.5). Increased demand for surface water by downstream users may exacerbate water levels in drought years. Warmer temperatures are expected to increase the demand for water-based recreation as the viable season lengthens. Extreme heat encourages some people to seek water-based activities as a climate refuge, although extreme heat also discourages participation in outdoor recreation in general (Bowker et al. 2012). Overall, projections of water-based activities in response to climate change tend to be small compared to broad population and economic shifts (Bowker et al. 2012).

Climate change is expected to have a moderate effect on water-based activities. Increasing temperatures and longer warm-weather seasons are likely to increase demand, although the incidence of extreme temperatures may dampen this effect in certain years. A higher likelihood of lower streamflows and reservoir levels and potential reductions to site aesthetic quality may also offset increased demand to some extent. Climate change effects are expected to occur with moderate likelihood. Climate model projections tend to agree on a range of warming temperatures and longer seasons, although changes in precipitation are uncertain. Changes in the timing of snowmelt may increase the likelihood of negative effects to water-based activities (through lower summer flows and reservoir levels) that offset increases due to warmer temperatures.

Summary

Several recreation activities are considered highly sensitive to changes in climate and ecosystem characteristics. However, recreation in the Northern Rockies region is diverse, and the effects of climate are likely to vary widely between different categories of activities and across geographic areas within the region. Overall, participation in climate-sensitive recreation activities

is expected to increase in the region, primarily because longer warm-weather seasons will make more recreation sites available for longer periods of time.

Increased participation in warm-weather activities is likely to be offset somewhat by decreased snow-based winter activities. Receding snow-dominated areas and shorter seasons in the future are likely to reduce the opportunities (in terms of available days and sites) for winter recreation.

Beyond these general conclusions, the details of changes in recreation patterns in response to climate changes are complex. Recreation demand is governed by several economic decisions with multiple interacting dependencies on climate. For example, decisions about whether to engage in winter recreation, activity type (e.g., downhill or cross-country skiing), location, frequency of participation, and duration of stay per trip depend somewhat on climate and ecological characteristics. On the supply side, site availability and quality depend on climate, but the effect may differ greatly from one location to another. Thus, climate effects on recreation depend on spatial and temporal relationships between sites, climate and ecological characteristics, and human decisions.

Uncertainty derives from unknown effects of climate on site quality and characteristics that are important for some recreation decisions (e.g., indirect effects of climate on vegetation, wildlife habitat, and species abundance and distribution). The precise effect of climate on target species or other quality characteristics may be difficult to predict or diverse across the region, yet these characteristics play a large role in recreation decisions for some activities. Another source of uncertainty is how people will adapt to changes when making recreation decisions. Interregional and intertemporal substitution behavior is not yet well understood (Shaw and Loomis 2008). This may be important for the Northern Rockies region if in the future some sites exhibit relatively little

effect from climate change compared with sites in other regions. For example, winter recreation sites in the Northern Rockies may experience shorter or lower quality seasons in the future but see increased demand if the quality of sites in other regions becomes relatively worse in the future.

Substitution is likely to be an important adaptation mechanism for recreationists. Many recreation activities that are popular in the region may have several alternate sites, or timing of visits can be altered to respond to climate changes. However, substitution may represent a loss in benefits derived from recreation even if it appears that participation changes little (Loomis and Crespi 2004); the new substitute site may be slightly more costly to access, or slightly lower quality than the preferred visit prior to climate change. This represents a decrease in benefits to the person engaging in recreation.

Adapting Recreation to the Effects of Climate Change

Adapting recreation management to climate change in the Northern Rockies region will be critical to ensure that recreation opportunities exist in the future.

Adaptation by Recreation Participants

Increasing temperatures with changing climate will have significant negative effects on snow-based recreation. Length of the snow-based recreation season is likely to decrease, and the quality of the snow during the season may also decrease (be wetter).

Water-based recreationists may adapt to climate change by choosing different sites that are less susceptible to changes in water levels (e.g., by seeking higher-elevation natural lakes) and changing the type of water-based recreation activity they engage in (e.g., from motorized boating on reservoirs to nonmotorized boating on natural lakes).

Hunters may need to adapt by altering the timing and location of hunts. However, State rules on hunting season dates impose a constraint on this behavior unless States change hunting seasons based on expected climate changes. Hunters may also target different species if the abundance or distribution of preferred species changes in the future.

Like hunters, wildlife viewers may change the timing and location of viewing experiences and target different species. Viewing is not typically governed by State-regulated seasons, so wildlife viewers may have more flexibility to shift timing to coincide with appropriate weather conditions or the movement of species into accessible areas. However, adaptation options may be more limited if the abundance or distribution of highly valued species significantly decreases the likelihood of viewing, and limited high-quality substitute species are available.

Anglers may adapt by choosing different species to target (for example, shifting from cold-water to warm-water tolerant species) and choosing sites that are relatively less affected by climate change (e.g., higher elevation secondary-stem reaches of streams). The former is less costly than the latter, although some anglers may place a high value on certain target species and have a lower willingness to target warm-water species that may thrive in place of cold-water species.

Adaptation by Public Land Managers

Managers may need to reconsider how infrastructure investments and the provision and maintenance of facilities align with changing ecological conditions and demands for recreation settings. The Recreation Opportunity Spectrum can be used to match changing conditions and preferences to the allocation of available recreation opportunities. Adaptation by managers may take the form of responding to changing recreation patterns, but also may involve helping to shape the settings and experiences that are available to recreation users on public lands in the future.

For winter recreation, a general adaptation strategy may be a transition to recreation management that addresses shorter winter recreation seasons and changing recreation use patterns (table 10.4). Specifically, opportunities may exist to expand facilities where concentrated use increases, and options for snow-based recreation can be diversified to include more snowmaking, additional ski lifts, and runs at higher elevations. In some cases, however, adaptations related to the supply and quality of winter recreation opportunities could result in tradeoffs with other activities, such as warm-weather access to undeveloped higher elevation sites or effects of snowmaking on streamflow in winter versus summer.

With higher temperatures and earlier snowmelt, warm-weather activity seasons are likely to lengthen. Recreation managers have options for responding to changing patterns in warm-season recreation demand in order to provide sustainable recreation opportunities. A first step will be to conduct assessments to understand the changing patterns of use (table 10.4). Then, adjustments can be made to increase the capacity of recreation sites that are showing increased use (e.g., campgrounds can be enlarged, and more fences, signs, and gates can be installed where necessary). The potential for congestion and damage to resources due to increases in use for some sites may, in part, drive such adjustments. However, there may be some limits to increasing the capacity of recreation sites (e.g., restrictions for developed recreation sites under the U.S. Fish and Wildlife Service [USFWS] Northern Continental Divide Ecosystem Grizzly Bear Conservation Strategy; USFWS 2013). The timing of actions such as trail closures, food storage orders, and special-use permits may also need to

Table 10.4—Adaptation options that address climate change effects on recreation in the Northern Rockies.

Sensitivity to climatic variability and change: Ice- and snow-based recreation is highly sensitive to variations in temperature and the amount and timing of precipitation as snow.			
Adaptation strategy/approach: Transition to address shorter average winter recreation seasons and changing use patterns.			
Tactic	Specific tactic – A Maintain current infrastructure and expand facilities in areas where concentrated use increases.	Specific tactic – B Develop options for diversifying snow-based recreation, such as cat-skiing, helicopter skiing, additional ski lifts, additional higher elevation runs, toboggan runs, snow making, and back country yurts.	Specific tactic – C Conduct safety education to make the public aware of increased risk of avalanche and thin ice.
Where can tactics be applied?	Snow recreation areas and major lakes	In and around existing permitted areas; within driving distance of population centers	Snow recreation areas and major lakes
Sensitivity to climatic variability and change: The warm weather recreation season will increase in length with increasing temperatures and earlier snowmelt.			
Adaptation strategy/approach: Provide sustainable recreation opportunities in response to changing demand.			
Tactic	Specific tactic – A Assess to understand changes in use patterns and identify demand shifts.	Specific tactic – B Adjust capacity of recreation sites (e.g., enlarge campgrounds, collect additional fees, and install infrastructure such as fences, signs and gates). Where demand increases on Federal lands, as appropriate	Specific tactic – C Adjust timing of actions such as road and trail closures, food storage orders, and special-use permits. Federal lands
Where can tactics be applied?	At multiple levels (national, regional, forest-level, and local)		
Sensitivity to climatic variability and change: The seasonality of whitewater rafting will shift with increasing temperatures and shifts in the timing of peak streamflows.			
Adaptation strategy/approach: Increase management flexibility and facilitate transitions to meet user demand and expectation.			
Tactic	Specific tactic – A Vary permit season to adapt to changes in peakflow and duration.	Specific tactic – B Educate the public about changing river conditions.	Specific tactic – C n/a
Where can tactics be applied?	Permitted rivers	Permitted rivers	n/a
Sensitivity to climatic variability and change: Increases in flooding, fire, and other natural disturbances will cause damage to infrastructure.			
Adaptation strategy/approach: Manage recreation sites to mitigate risks to public safety and infrastructure and to continue to provide recreation opportunities.			
Tactic	Specific tactic – A Assess to determine which recreation sites and infrastructure are at risk from increased flooding and other natural hazards.	Specific tactic – B Prioritize post-disturbance treatments, including relocation, arming, and other mitigation measures.	Specific tactic – C Invest strategically in developed recreation facilities, prioritizing those that will be viable in the future and accommodate changing use patterns.
Where can tactics be applied?	Federal lands	Federal lands	Federal lands

be adjusted within the context of providing sustainable recreation. For example, the season for whitewater rafting permits may need to be modified to adjust to shifts in timing of peakflows (table 10.4).

Increased frequency of disturbances, such as fire and flooding, is likely to cause increased damage to infrastructure associated with multiple types of recreation activities. Recreation sites can be managed to decrease risks to public safety and infrastructure (table 10.4). Assessments can be used to determine which sites and infrastructure are most at risk from disturbance, and strategic investments can be made in those facilities that are expected to be viable in the future and accommodate changing use patterns.

More-specific details on adaptation strategies and tactics that address climate change effects on recreation in each Northern Rockies Adaptation Partnership subregion are in Appendix 10A.

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Appendix 10A—Adaptation Options for Recreation in the Northern Rockies.

The following tables describe climate change sensitivities and adaptation strategies and tactics for recreation, developed in a series of workshops as a part of the Northern Rockies Adaptation Partnership. Tables are organized by subregion within the Northern Rockies. See Chapter 10 for summary tables and discussion of adaptation options for recreation.

Table 10A.1—Adaptation options that address climate change effects on recreation in the Central Rockies subregion.

Sensitivity to climatic variability and change: Risk to infrastructure with changes in the frequency and severity of natural hazards and disturbances.			
Adaptation strategy/approach: Manage recreation sites to mitigate natural hazards.			
Strategy objective: Increase the resiliency of recreation sites by reducing threats and encouraging coordination with partners.			
Tactic	Specific tactic – A	Specific tactic – B	Specific tactic – C
	Maintain safety by assessing risk factors.	Identify flood plains and risks to campgrounds (developed sites) and dispersed recreation sites.	Identify effects after disturbance to recreation sites and prioritize treatments or conversions (e.g., relocate, arming, and/or mitigation measures).
Tactic effectiveness (risks)	Moderate–high	Moderate–high	High
Implementation urgency	Near term	Near term	Near term
Where can tactics be applied? (geographic)	Forest lands or adjacent lands; high risk disturbance areas	Forest wide	National Forest System lands
Opportunities for implementation	Work with other agencies, such as the Federal Emergency Management Agency; use existing data for tree mortality and add species and overlay of use areas	Model risk of storm events, such as rain-on-snow events and flood events (including post-fire floods)	Rapid assessment teams; learn from other agencies, such as the National Park Service
Cost	Moderately expensive	Moderately expensive	Moderately expensive
Barriers to implementation	Some: organizational will; leadership commitment; internal resistance, priority setting; integration and interpretation of data and models	Some: external partner support and coordination	Some: forest capacity (resources and funding); public resistance to relocations and closures

Table 10A.2—Adaptation options that address climate change effects on recreation in the Central Rockies subregion.

Sensitivity to climatic variability and change: Changes in demand for warm-weather recreation.			
Adaptation strategy/approach: Transition to address extended seasons or changing use patterns.			
Strategy objective: Provide sustainable recreation opportunities in response to changing demand.			
	Specific tactic – A	Specific tactic – B	Specific tactic – C
Tactic	Assess use patterns to understand demand shifts and address recreation niches identified for the area.	Identify natural resource impacts and increase coordination with partners and concessionaires.	Adjust capacity issues such as enlarging campgrounds and fee opportunities.
Tactic effectiveness (risks)	Moderate	Moderate-high	High
Implementation urgency	Near term	Mid term	Mid term
Where can tactics be applied? (geographic)	National, regional, forest and local levels	Forest level	Local level
Opportunities for implementation	Coordinate with states, local communities; enhance National Visitor Use and Monitoring processes with sub-surveys	Annual operation meetings, meetings with target user groups, special interest groups meetings	Limited opportunities
Cost	Moderately expensive	Moderately expensive	Moderate – expensive
Barriers to implementation	Ability to acquire or predict patterns of use is difficult because demand is difficult to determine; lack of leadership support to engage in studies; low priority in program of work regionally and nationally; declining budgets and staffing	Shifting demographics	Political and environmental justice fees

Table 10A.3—Adaptation options that address climate change effects on winter recreation in the Central Rockies subregion.

Sensitivity to climatic variability and change: Threats to winter recreation			
Adaptation strategy/approach: Transition to address shorter average season and changing use patterns.			
Strategy objective: Provide sustainable recreation in response to changing demand.			
	Specific tactic – A	Specific tactic – B	Specific tactic – C
Tactic	Shift winter use, address safety concerns, and engage partners to implement changes needed in use.	Create management areas and direction addressing concentrated winter use areas through forest planning; communicate with partners, cooperators and other agencies and maintain recreation internet sites with access information.	Relocate sites as necessary and add signs to guide the public.
Tactic effectiveness (risks)	Moderate	Moderate-high	Moderate
Implementation urgency	Mid term	Near term	Mid term
Where can tactics be applied? (geographic)	Winter recreation sites	Designated management areas	Winter recreation sites
Opportunities for implementation	Forest plan revision; project planning; avalanche centers; state agreements	Forest Planning – Revision Efforts Project planning Avalanche Centers State Agreements	Integrate projects to include recreation; large landscape efforts; adjusted stewardship law to include recreation
Cost	Moderately expensive	Moderately expensive	Expensive
Barriers to implementation	Our ability to respond	Timing, unclear direction for those not in revision; lacks leadership support to engage	Environmental resources; cultural and political

Table 10A.4—Adaptation options that address climate change effects on recreation in the Eastern Rockies subregion.

Sensitivity to climatic variability and change: Recreation access needs may change with climate change, including change to location, season of use, type of use, and duration of use.			
Adaptation strategy/approach: Ensure that access is adequate for projected recreation use and demand and compatible with resource and climate change conditions.			
Strategy objective: Facilitate transition of recreation access to ensure relevancy and resiliency by season of use and changing use patterns.			
	Specific tactic – A	Specific tactic – B	Specific tactic – C
Tactic	Evaluate and prioritize existing access by season (e.g., trailheads and trails) to ensure consistency with changing recreation opportunity spectrum settings with climate change.	Identify new access needs and potential changes to existing access by season.	Strategically invest in new and potential changes to existing access by season.
Tactic effectiveness (risks)	High	High	High/moderate
Implementation urgency	Near term	Mid term	Mid term
Where can tactics be applied? (geographic)	Federal lands	Federal lands	Federal lands
Opportunities for implementation	Partners	Partners	Partners
Cost	Moderate	Moderate	Moderate
Barriers to implementation	Some (funding/capacity)	Some (funding/capacity)	Some (funding)

Table 10A.5—Adaptation options that address climate change effects on recreation in the Eastern Rockies subregion.

Sensitivity to climatic variability and change: Recreation settings (Recreation Opportunity Spectrum and scenery), both motorized and non-motorized, during all seasons will be affected by the expected changes in climate.			
Adaptation strategy/approach: Align our recreation settings with changing landscape conditions and demand.			
Strategy objective: Facilitate transition of recreation settings to achieve flexibility, relevancy and resiliency; maintain those recreation settings that complement our niches.			
	Specific tactic – A	Specific tactic – B	Specific tactic – C
Tactic	Assess existing recreation opportunity spectrum settings and scenic character to determine which are most vulnerable to climate change effects.	Develop management strategies to shift or maintain existing recreation opportunity spectrum settings and scenic character in response to climatic change.	Develop a sub-regional niche.
Tactic effectiveness (risks)	High	High	Moderate/low
Implementation urgency	Mid term	Mid term	Near term
Where can tactics be applied? (geographic)	Federal lands	Federal lands	Federal lands
Opportunities for implementation	None	None	None
Cost	Moderately expensive	Moderately expensive	Inexpensive
Barriers to implementation	Some barriers	Some barriers	None

Table 10A.6—Adaptation options that address climate change effects on recreation in the Eastern Rockies subregion.

Sensitivity to climatic variability and change: Cultural and heritage resources may be affected by changes in climate, technology, demographics, and culture.			
Adaptation strategy/approach: Protect cultural and heritage sites and the sacred uses of traditional cultural landscapes.			
Strategy objective: Acknowledge the importance of cultural and heritage sites and protect valuable sites.			
	Specific tactic – A	Specific tactic – B	
Tactic	Inventory and identify those areas at most risk to climate change and changes in use patterns, and mitigate the effects	Develop interpretation and education opportunities to educate the public in areas or resources most at risk.	
Tactic effectiveness (risks)	Moderate	Moderate	
Implementation urgency	Near term	Near term	
Where can tactics be applied? (geographic)	Greater Yellowstone Area	Greater Yellowstone Area	
Opportunities for implementation	Tribes; Tribal Historic Preservation Office; universities, State Historic Preservation Officer; Passport in Time volunteers	Tribes; Tribal Historic Preservation Office; universities, State Historic Preservation Officer; Passport in Time volunteers	
Cost	Expensive	Moderately expensive	
Barriers to implementation	Some: Forest Service capacity and funding	Some: Forest Service capacity and funding	

Table 10A.7—Adaptation options that address climate change effects on recreation in the Eastern Rockies subregion.

Sensitivity to climatic variability and change: Recreation user demand and the shift in recreation activity, amount of use, and patterns of use will be driven by climate change, technology, demographics, and culture.			
Adaptation strategy/approach: Align our recreation opportunities with future demand to commercial (permitted) and non-commercial recreation users.			
Strategy objective: Facilitate transition of recreation opportunities to achieve flexibility, relevancy and resiliency.			
	Specific tactic – A	Specific tactic – B	Specific tactic – C
Tactic	Understand the changes in demand, demographics, and economic trends, both regionally and nationally.	Conduct research to clearly identify localized impacts of climate change.	Conduct research to understand the latest and upcoming technology that impacts recreation.
Tactic effectiveness (risks)	High	High	High
Implementation urgency	Near term	Near term	Near term
Where can tactics be applied? (geographic)			
Opportunities for implementation	Partners, research, university, non-governmental organizations	Partners, research, university, non-governmental organizations	Partners, research, university, non-governmental organizations
Cost	Moderate	Moderate	Moderate
Barriers to implementation	Some: expertise, agency culture	Some: expertise, agency culture	Some: expertise, agency culture

Table 10A.8—Adaptation options that address climate change effects on recreation in the Eastern Rockies subregion.

Sensitivity to climatic variability and change: The future viability of recreation facilities will be affected by changes in climate.			
Adaptation strategy/approach: Provide recreation facilities that accommodate future demand, and reduce user and natural resource conflicts.			
Strategy objective: Facilitate transition of recreation opportunities to achieve flexibility, relevancy and resiliency.			
	Specific tactic – A	Specific tactic – B	Specific tactic – C
Tactic	Prioritize existing recreation facilities, by season, for viability, investment, and change in services.	Invest strategically in developed recreation facilities.	Design facilities for flexibility in use.
Tactic effectiveness (risks)	Moderate	Moderate-high	Moderate
Implementation urgency	Near term	Mid term	Mid term
Where can tactics be applied? (geographic)			
Opportunities for implementation	Partners, including permittees, public and non-governmental organizations	None	None
Cost	Moderate	Expensive	Moderate
Barriers to implementation	Some: funding, internal agency	Some: funding	Some: funding and capacity

Table 10A.9—Adaptation options that address climate change effects on recreation in the Greater Yellowstone Area subregion.

Sensitivity to climatic variability and change: Archeological sites are susceptible to damage and destruction with increase in wildland fires, erosion and floods, vandalism due to increased recreation activities and longer summer season, and rot from loss of protective snow cover hiding archeological sites.				
Adaptation strategy/approach: Get cultural resources more involved in the climate change discussion.				
Strategy objective: Increase education and reduce stressors.				
	Specific tactic – A	Specific tactic – B	Specific tactic – C	Specific tactic – D
Tactic	Increase pro-active surveys and site recording.	Increase post-fire inventories.	Prioritize site sensitivities and management allocation.	Mitigate adverse effects.
Tactic effectiveness (risks)	High	High	Medium	Medium-high
Implementation urgency	Near term	Near term	Near term	Near term
Where can tactics be applied? (geographic)	High elevation – determine locations by predictive modeling	In burned areas	Unit wide	Site specific
Opportunities for implementation	Section 110 of National Historic Preservation Act; engage with university partners; historical societies; Passport in Time projects	Burned area emergency response; engage with university partners	Forest Service manual	Section 110 of National Historic Preservation Act (when not related to specific undertaking)
Cost	Moderately expensive	Moderately expensive	Inexpensive	Expensive
Barriers to implementation	Forest leadership team may not see benefit, would rather concentrate on support to other functions	Limitation of use of burned area emergency response funds	None	Major costs

Table 10A.10—Adaptation options that address climate change effects on recreation in the Greater Yellowstone Area subregion.

Sensitivity to climatic variability and change: Infrastructure location, sizing, safety, and resource protection. Will our infrastructure be able to accommodate the projected future use in a safe manner, considering shorter winters with less snow, increased and earlier runoff, increased erosion, increased hazard trees from insects, disease and windthrow mortality, population shifts to higher elevation, and rapidly growing outdoor recreation locations?		
Adaptation strategy/approach: Proactively determine sites where projected climate change impacts may cause safety, resource or recreation-quality issues.		
Strategy objective: Assess infrastructure and set priorities while considering limited funding and capacity.		
	Specific tactic – A	Specific tactic – B
Tactic	Install appropriately sized culverts; relocate infrastructure; or eliminate infrastructure.	Develop additional restrictions in the permitting process, seasonal closures or allowable uses.
Tactic effectiveness (risks)	Very high	Medium
Implementation urgency	Near to mid term, unless major infrastructure, then 50 years	Near term
Where can tactics be applied? (geographic)	After catastrophic events using burned area emergency response funds; first priorities from climate analysis	Where needed – site specific
Opportunities for implementation	Department of Transportation, Emergency Relief for Federally Owned Roads	Existing user groups
Cost	Expensive, except when incorporated in already funded projects.	Moderately expensive – staff time
Barriers to implementation	None to major: funding; political and social barriers to road closures	Some barriers: social and political

Table 10A.10 (cont.)—Adaptation options that address climate change effects on recreation in the GYA Subregion

Sensitivity to climatic variability and change: Infrastructure location, sizing, safety, and resource protection. Will our infrastructure be able to accommodate the projected future use in a safe manner, considering shorter winters with less snow, increased and earlier runoff, increased erosion, increased hazard trees from insects, disease and windthrow mortality, population shifts to higher elevation, and rapidly growing outdoor recreation locations?		
Adaptation Strategy / Approach: Proactively determine sites where projected climate change impacts may cause safety, resource or recreation-quality issues.		
Strategy Objective: Assess infrastructure and set priorities while considering limited funding and capacity.		
	Specific Tactic – C	Specific Tactic – D
Tactic	Develop new opportunities or new recreation sites; be proactive in encouraging use in locations where the use will be sustainable and resources can support the use.	Monitor closure and restriction dates and set trigger points to determine changes.
Tactic effectiveness (risks)	Very high	Moderate
Implementation urgency	Near – mid term	Near term
Where can tactics be applied? (geographic)	Urban interface	Site specific
Opportunities for implementation	Any rec site planning process	Unit level; user groups
Cost	Expensive	Moderately expensive – staff time
Barriers to implementation	Some	Some: lack of staff time; lack of priority

Table 10A.11—Adaptation options that address climate change effects on recreation in the Greater Yellowstone Area subregion.

Sensitivity to climatic variability and change: Lower snow amounts, earlier snowmelt and a longer summer season.				
Adaptation strategy/approach: Focus on regulation, education, enforcement, and infrastructural changes.				
Strategy objective: Increase education and reduce stressors.				
	Specific tactic – A	Specific tactic – B	Specific tactic – C	Specific tactic – D
Tactic	Adjust dates of orders, as needed, such as extended dates of food storage, travel management, closures and trail shares.	Implement social media technology to disperse use, direct users, educate, and promote etiquette.	Engage Chambers of Commerce and Development organizations to help deal with the increased pressures on forest and park resources.	Install infrastructure as needed (e.g., fences, signs, gates).
Tactic effectiveness (risks)	Medium–high	Medium–high	Low–medium	Moderate
Implementation urgency	Near term	Near term	Mid to long term	Near term
Where can tactics be applied? (geographic)	Anywhere appropriate, but especially in areas with high occurrence of resource-user conflicts	Everywhere – messages can be general or site specific	Starting with the larger urban centers (i.e. Jackson, Bozeman, Cody, Idaho Falls and Billings)	Anywhere appropriate
Opportunities for implementation	Laws; revised travel management	The “GYA app”; National Geographic Magazine	Chambers of Commerce; state departments of tourism; state development councils; regional-scale employers; influential people who settle in the GYA	User groups; businesses
Cost	Inexpensive	Inexpensive to medium	Medium	Inexpensive (with partners)
Barriers to implementation	Small to large, depending on social/cultural opposition from users and communities	Medium to small: lack of coverage in remote areas and seniors not using social media; cost barrier	Medium to high: internal cultural barriers and political differences and external barriers	Low to implement; high to avoid vandalism

Table 10A.12—Adaptation options that address climate change effects on recreation in the Greater Yellowstone Area subregion.

Sensitivity to climatic variability and change: Shorter winters with less snow, and wetter or icier snow.				
Adaptation strategy/approach: Consider diversifying permitted activities, assess infrastructure and recreation sites, and develop prioritization process and criteria.				
Strategy objective: Increase knowledge, assess options, and engage industry and community partners.				
Tactic	Specific tactic – A	Specific tactic – B	Specific tactic – C	Specific tactic – D
	Develop options for diversifying snow-based recreation.	Use master development plan to determine if we can add uses and extend seasons (or modify the plan).	Examine viability of agency snow-based recreation sites, permitted downhill resorts and all permitted winter operations.	Monitor snow dates, snow event dates, and snowpack depth.
Tactic effectiveness (risks)	High in the short-term; must consider cost exclusivity and resource impacts	Low–medium	Low	Moderate
Implementation urgency	Mid term	Mid term	Mid–long term	Near term
Where can tactics be applied? (geographic)	For permitted areas, in and around the existing permitted area, within driving distance of population centers	Within and around permitted area	In and around recreation area	Existing snow telemetry (SNOTEL) sites
Opportunities for implementation				Unit
Cost				Inexpensive (especially with partners)
Barriers to implementation				Low to implement; high to avoid vandalism

Table 10A.13—Adaptation options that address climate change effects on recreation in the Western Rockies subregion.

Sensitivity to climatic variability and change: Increased human exposure to contaminated sediment due to dropping lake levels in the Coeur d'Alene basin and/or increased desire for water-based recreation in higher temperatures in the contaminated areas.			
Adaptation strategy/approach: Avoidance of contaminated areas.			
Strategy objective: Reduce stressors/threat and increase knowledge.			
	Specific tactic – A	Specific tactic – B	Specific tactic – C
Tactic	Cap or harden contaminated areas.	Establish vegetation barriers.	Concentrate use in areas that have been hardened.
Tactic effectiveness (risks)	High in the short-term (requires maintenance)	High	Moderate to low.
Implementation urgency	Near term (but ongoing in long term)	Near term (but ongoing in long term)	Near term (but ongoing in long term)
Where can tactics be applied? (geographic)	Throughout the basin, but focus on priority areas identified in the Coeur d'Alene Basin Restoration Plan Environmental Impact Statement	Throughout the basin, but focus on priority areas identified in the Coeur d'Alene Basin Restoration Plan Environmental Impact Statement	Throughout the basin, but focus on priority areas identified in the Coeur d'Alene Basin Restoration Plan Environmental Impact Statement
Opportunities for implementation	Federal, State, tribal, non-governmental organization partners	Federal, State, tribal, non-governmental organization partners	Federal, State, tribal, non-governmental organization partners
Cost	Moderately expensive	Moderately expensive	Moderately expensive
Barriers to implementation	Issues with sensitive species or other resource concerns	Minimal to none	Social

Table 10A.14—Adaptation options that address climate change effects on recreation in the Western Rockies subregion.

Sensitivity to climatic variability and change: Increased desire for water-based recreation with higher temperatures will lead to increased dispersed recreation sites in riparian areas.		
Adaptation strategy/approach: Limit expansion of sites and pioneering of new sites.		
Strategy objective: Coordinate (e.g., with other agencies and the public); reduce stressors/threat.		
	Specific tactic – A	Specific tactic – B
Tactic	Educate the public and post signs to prevent expansion of dispersed recreation sites in riparian areas.	Design measures for resource protection, such as blocking access to riparian areas, and revegetating impacted areas.
Tactic effectiveness (risks)	Moderate	Moderate
Implementation urgency	Near term (ongoing to long term)	Near term (ongoing to long term)
Where can tactics be applied? (geographic)	Riparian areas on Federal lands	Riparian areas on Federal lands
Opportunities for implementation	Federal, State, tribal, and private partnerships	Federal, State, tribal, and private partnerships
Cost	Moderately expensive	Moderately expensive
Barriers to implementation	Social	Social; recognizing treaty rights to maintain access to traditional family use areas

Table 10A.15—Adaptation options that address climate change effects on recreation in the Western Rockies subregion.

Sensitivity to climatic variability and change: Cultural/heritage recreation and tourism (e.g., Nimiipuu Trail and Lewis and Clark Trail) and associated scenic driving recreation will likely be affected by increased wildland fire with changing climate.		
Adaptation strategy/approach: Manage vegetation to limit wildfire impacts on recreation and tourism.		
Strategy objective: Promote resiliency.		
	Specific tactic – A	Specific tactic – B
Tactic	Reduce stand density, and vary age class and species composition through vegetation management and/or prescribed fire.	Re-establish native vegetation (e.g., forbs, grasses, and conifers such as whitebark pine); slow spread and reduce populations of invasive species.
Tactic effectiveness (risks)	High to moderate	Moderate to low
Implementation urgency	Near term	Near term
Where can tactics be applied? (geographic)	Within scenic corridors	Within scenic corridors
Opportunities for implementation	Tribal partnerships and collaborative partnerships	Cross-regional genetics improvement programs; Federal, tribal, State, and private partnerships
Cost	Moderately expensive	Expensive
Barriers to implementation	Some (opponents to vegetation management as a tool)	Some (difficulty with implementation success)

Table 10A.16—Adaptation options that address climate change effects on recreation in the Western Rockies subregion.

Sensitivity to climatic variability and change: Seasonality of whitewater rafting will likely shift with changing climate and timing of peak flows.		
Adaptation strategy/approach: Increase management (primarily permitting) flexibility.		
Strategy objective: Promote resiliency.		
	Specific tactic – A	Specific tactic – B
Tactic	Vary permit season to adapt to changes in peak flow and duration.	Educate the public about changes in peak flows and permitting.
Tactic effectiveness (risks)	Moderate	High to moderate
Implementation urgency	Mid term	Mid term
Where can tactics be applied? (geographic)	Permitted rivers	Permitted rivers
Opportunities for implementation	Agency partnerships	Agency partnerships
Cost	Low	Low
Barriers to implementation	Social	Social

Table 10A.17—Adaptation options that address climate change effects on recreation in the Western Rockies subregion.

Sensitivity to climatic variability and change: Winter recreation (ice fishing, cross-country skiing, snowmobiling) will be at risk with increased temperatures.		
Adaptation strategy/approach: Increase management (primarily permitting) flexibility.		
Strategy objective: Promote resiliency.		
	Specific tactic – A	Specific tactic – B
Tactic	Maintain current infrastructure and expand facilities in areas where concentrated use increases (anticipate additional use as lower elevation areas [Missoula] have reduced snowpacks).	Conduct safety education for increased risk (avalanche potential and thinning ice sheets).
Tactic effectiveness (risks)	Moderate	Moderate
Implementation urgency	Near term	Near term
Where can tactics be applied? (geographic)	Snow play areas and major lakes	Snow play areas and major lakes
Opportunities for implementation	Fees	Partnerships
Cost	Moderately expensive	Low
Barriers to implementation	Social; expense	Social (people do not always listen)