

**MONITORING ECOLOGICAL RESPONSE TO CLIMATE CHANGE  
IN HIGH ELEVATION PARK UNITS OF THE  
GREAT NORTHERN LANDSCAPE CONSERVATION COOPERATIVE**

---



*An NPS Inventory and Monitoring workshop  
to explore ecological response to climate change,  
develop criteria and preliminary priorities for monitoring, and  
explore opportunities to expand monitoring partnerships  
within the Great Northern LCC.*

**May 4-5, 2010**

**Gallatin Gateway Inn**

**Bozeman, Montana**

## **Contents**

<b>Workshop Overview .....</b>	<b>3</b>
<b>Workshop Goal and Objectives .....</b>	<b>3</b>
Goal .....	3
Objectives .....	3
<b>Background.....</b>	<b>3</b>
Meeting Impetus.....	3
Connection to LCCs .....	3
National Park Service Strategy .....	4
Planned 2010 Efforts .....	4
<b>Expected Workshop Products.....</b>	<b>4</b>
<b>Workshop Agenda.....</b>	<b>5</b>
<b>Attendee List.....</b>	<b>8</b>
<b>Network Makeup.....</b>	<b>10</b>
Greater Yellowstone Network (GRYN).....	10
Rocky Mountain Network (ROMN) .....	10
Upper Columbia Basin Network (UCBN) .....	10
<b>Bozeman Area Restaurants.....</b>	<b>10</b>
<b>Craig MacKinnon (BLM) Presentation Materials.....</b>	<b>12</b>
<b>Useful Maps .....</b>	<b>16</b>
<b>Conceptual Diagrams .....</b>	<b>19</b>
<b>Workshop Evaluation .....</b>	<b>24</b>

## Workshop Overview

---

The National Park Service (NPS) Inventory & Monitoring (I&M) Programs of the Intermountain and Pacific West Regions, and the Sonoran Institute are co-hosting a two-day workshop on monitoring the impacts of climate change to high-elevation ecosystems. The workshop is intended to engage participants in producing critical input for developing strategies for long-term monitoring of ecological response to climate change relevant to park management and protection.

The general framework for organizing the workshop is the Great Northern Landscape Conservation Cooperative (GNLCC), recently funded by the Department of Interior. However, the primary focus of the workshop will be twelve high elevation park units within the Rocky Mountain, Greater Yellowstone, and Upper Columbia Basin Networks. Partner parks include: Big Hole National Battlefield; City of Rocks National Reserve; Craters of the Moon National Monument and Preserve; Nez Perce National Historical Park; Bighorn Canyon National Recreation Area; Grand Teton National Park; John D. Rockefeller, Jr. Memorial Parkway; Yellowstone National Park; Florissant Fossil Beds National Monument; Glacier National Park; Great Sand Dunes National Park and Preserve; and Rocky Mountain National Park.

Workshop participants include the National Park Service, U.S. Fish and Wildlife Service (Wildlife Refuge System and GNLCC-Ecological Services), US Geological Survey (USGS Northern Rockies Climate Response Center), Bureau of Land Management (BLM), National Ecological Observatory Network (NEON), and others.

## Workshop Goal and Objectives

---

### *Goal*

The goal of the workshops is to engage parks, Inventory and Monitoring networks, partner agencies and cooperators in gaining critical input for developing multi-year strategies for long-term monitoring of ecological response

to climate change relevant to park management and protection.

### *Objectives*

1. Enhance participant's understanding of projected changes in climate variables (e.g., temperature, precipitation, snowpack, growing season) and resultant effects on ecosystem components (e.g., communities, disturbance regimes, ecological processes, species).
2. Engage parks, networks, and other key staff in developing multi-year strategies and work plans for protocol development and implementing long-term monitoring of indicators of climate change.
3. Work collaboratively across parks, networks, and regions, and engage potential partners to discuss opportunities for collaboration on ongoing and new monitoring of climate change on federal lands.

## Background

---

### *Meeting Impetus*

Secretarial Order No. 3289 of September 14, 2009 established a climate change strategy to integrate the work of each Department of Interior (DOI) bureau to mitigate and adapt to the effects of climate change in the pursuit of their respective missions (senate hearing on climate change, October 28, 2009). Given the broad impacts of climate change, management responses to such impacts are expected to be coordinated on a landscape-level basis.

### *Connection to LCCs*

Agencies within DOI have proposed use of the U.S. Fish and Wildlife Service (USFWS) twenty-two geographic areas, referred to as Landscape Conservation Cooperatives (LCCs), as an organizing framework for cooperation on addressing impacts of climate change. The USFWS describes LCCs as "conservation-science partnerships between the USFWS, USGS, and other federal agencies, states, tribes, NGOs,

universities and stakeholders within a geographically defined area."

### ***National Park Service Strategy***

The NPS expects to fully participate with each of the DOI-proposed LCCs. In fiscal year 2010, the NPS anticipates receiving up to \$10M service-wide to address climate change impacts to park resources with an integrated strategy that includes planning, adaptation, and monitoring. The NPS strategy includes monitoring indicators of climate change impacts to park natural resources within four thematic areas: high-elevation, high-latitude, arid-lands, and coastal. In fiscal year 2010 the Washington Support Office (WASO) I&M program will receive initial funding to begin developing work plans for monitoring ecological impacts of climate change within a subset of NPS units across these four thematic areas. The USFWS Refuge System is receiving new funding 2010 to begin developing an inventory and monitoring program for refuge lands. The NPS and USFWS expect to collaborate closely on ecological monitoring.

### ***Planned 2010 Efforts***

During this fiscal year, the Intermountain (IMR) and Pacific West Regions (PWR) will cooperate on developing work plans for monitoring indicators of climate change within two LCCs: the Great Northern LCC and the Desert LCC. This year the IMR and PWR I&M programs will focus their planning on high-elevation park units (Great Northern LCC) and arid-lands park units (Desert LCC). Planning for monitoring in parks outside of these two LCCs is expected in subsequent years. Future funding for I&M monitoring of climate change indicators requires working closely with park managers to set monitoring priorities and produce collaborative, multi-year work plans to implement high priority monitoring in parks.

For this year's efforts, the Great Northern and Desert LCCs will establish the framework for these work plans that must be approved by WASO to secure the funding necessary to support our climate change

monitoring. Two one-week long workshops will (a) provide critical input from park managers needed for setting priorities, and (b) initiate collaboration among potential partners for developing and implementing climate change monitoring. The first workshop, in April, brought together park managers and partners from three I&M networks within the Desert LCC: Chihuahuan Desert, and Sonoran Desert (IMR), and the Mojave Desert (PWR). The current workshop brings together park managers and partners from three I&M networks within Great Northern LCC: Upper Columbia Basin (PWR), and Greater Yellowstone and Rocky Mountain (IMR).

### **Expected Workshop Products**

We expect five products to result from this workshop

1. An improved understanding of climate change on high elevation park units through presentations associated with a newly completed climate change synthesis covering these parks.
2. Increased knowledge of partnership opportunities through partner presentations and input at workout groups.
3. Updated conceptual diagrams for climate change impacts to key high elevation systems.
4. A set of criteria for prioritizing climate response monitoring variables.
5. A preliminary prioritization of long-term monitoring projects for climate change response.

The prioritized list referred to in item 5 will be used as input for a planning meeting immediately following the workshop that will be attended only by subset of workshop attendees. This group will strive to establish priorities for a long term strategy for monitoring ecological response to climate change in high elevations park units.

## Workshop Agenda

---

### TUESDAY, MAY 4

***Purpose:** (1) Creating a shared knowledge of ecological response to climate change and related monitoring needs; and (2) Identifying opportunities for enhancing existing and planned climate change response monitoring efforts between NPS and partner agencies within the GNLCC.*

- |              |  |
|--------------|--|
| 8:30a        | Call to order— <b>Tom Olliff</b> , NPS GRYN Program Manager  |
| 8:30-8:45a   | Welcome and opening remarks— <b>Chas Cartwright</b> , Superintendent Glacier National Park   |
| 8:45-9:00a   | Overview and purpose of the workshop— <b>Bruce Bingham</b> , NPS Intermountain Region I&M Program Manager  |
| 9:00-9:30a   | State of the knowledge of climate change with respect to past impacts and paleo/historic record for the Great Northern Landscape Conservation Cooperative— <b>Steve Gray</b> , Wyoming State Climatologist; presentation and discussion. |
| 9:30-10:00a  | State of the knowledge of projected climate changes in the Great Northern Landscape Conservation Cooperative— <b>Dave McWethy</b> , MSU adjunct professor; presentation and discussion.  |
| 10:00-10:30a | State of the knowledge of ecological response to climate change in the Great Northern Landscape Conservation Cooperative— <b>Mike Britten</b> , NPS ROMN Program Manager; presentation and discussion.                                   |
| 10:30-10:45a | BREAK  |

10:45-12:00p	<p>Panel presentations and discussions: Great Northern Landscape Conservation Cooperative and the role of inter-agency cooperation. Each presenter provides 20-25 minute presentation addressing:</p> <p>(1) What is going on within each agency with respect to monitoring climate change and what does each agency see missing?</p> <p>(2) What are the opportunities for monitoring partnerships or other types of collaboration and cooperation with regards to climate change monitoring?</p> <ul style="list-style-type: none"> <li>○ Landscape Conservation Cooperative concept with focus on the Great Northern Landscape Conservation Cooperative; LCCs as a framework for partnerships—<b>Yvette Converse</b>, USFWS Interim Coordinator GNLCC</li> <li>○ National Park Service vision for role of NPS inventory and monitoring networks with respect to climate change response in the Great Northern Landscape Conservation Cooperative—<b>Steve Fancy</b>, NPS National I&amp;M Program Leader</li> <li>○ US Fish and Wildlife Service National Wildlife Refuge System I&amp;M Vision—<b>Mark Chase</b>, Chief, USFWS Natural Resource Program Center (Steve Fancy will present)</li> <li>○ US Geological Survey's role in research and decision support related to global change in the Great Northern Landscape Conservation Cooperative—<b>Rick Sojda</b>, USGS Climate Change Specialist, USGS Northern Rockies Science Center</li> <li>○ Role of Bureau of Land Management efforts with respect to climate change issues within the Great Northern Landscape Conservation Cooperative—<b>Craig MacKinnon</b>, BLM Assessment, Inventory &amp; Monitoring Project Manager Washington Office</li> </ul>
12:00p	LUNCH
1:00-3:00p	<p>Panel presentations and discussion (continued)—open discussion with panelists and audience Q&amp;A.</p> <p>(1) What is going on within each agency with respect to monitoring climate change and what does each agency see missing?</p> <p>(2) What are the opportunities for monitoring partnerships or other types of collaboration and cooperation with regards to climate change monitoring?</p>
3:00-3:15p	BREAK
3:15-4:00p	Data sharing and integration across landscapes— <b>Margaret Beer</b> , NPS National I&M Data Manager; presentation and discussion
4:00-4:30p	Greater Yellowstone Science Learning Center— <b>Tami Blackford</b> , NPS Greater Yellowstone Science Learning Center and Editor, <i>Yellowstone Science</i> ; presentation and discussion
4:30-4:45p	Wrap up of the day— <b>Tom Olliff and Scott Bischke</b>
5:00-6:30p	No host bar, Gallatin Gateway Inn fireside room
6:30p	Dinner for workshop participants, Gallatin Gateway Inn dining room

## WEDNESDAY, MAY 5

***Purpose:** Establish NPS Inventory and Monitoring program priorities for monitoring ecological response to climate change.*

- 8:00-8:15a Opening remarks, focus on the purpose of the day; recap of day 1—**Scott Bischke**
- 8:15-8:45a Overview of NPS climate change strategy: mitigation, adaptation, communication, and science—**Tom Olliff**
- 8:45-9:15a First principles and criteria for multi-network monitoring strategy—**Bruce Bingham**
- 9:15-10:45a Presentations and Panel Discussion: Conceptual diagram and framework for monitoring climate change impacts in the High Elevation Parks. Presentations and discussion with audience Q&A.
1. Riparian/aquatic—**Billy Schweiger**, NPS ROMN Ecologist
  2. Sagebrush steppe/grasslands—**Tom Rodhouse**, NPS UCBN Ecologist  
Forest/woodland—**Donna Shorrock**, NPS ROMN Ecologist
  3. Alpine/subalpine—**Stacey Ostermann-Kelm**, NPS GRYN Ecologist
- 10:45-11:00a Strategies, options, and charge to work groups—**Scott Bischke**
- 11:00-12:00p **Work group breakouts.** Self-organize into seven work groups, largely paralleling the conceptual model discussions—Riparian Communities, Aquatic, Sage Steppe Grasslands, Forest/Woodland, Alpine, Physical Resources, and a Partnership group. The goal of these breakout groups is to create a first pass, coarse filter prioritized list of recommendations associated with monitoring ecological response to climate change. The first six work groups will address the following topics:
- Inventory of existing monitoring via review of monitoring table to be presented.
  - Identify any gaps to address monitoring for climate change (or identify any adjustments that can be made to existing monitoring).
  - Identify potential for collaboration in monitoring across the landscape—both inter-agency and inter-I&M network
  - Prioritize the resulting monitoring recommendations (via ranking exercise) needed to accomplish monitoring needs to address climate change.
- The LCC Partnership work group will discuss pursuing a coordinated monitoring approach for the Great Northern LCC.
- 12:00p LUNCH
- 1:00-2:45p Work Groups (continued)
- 2:45-3:00p BREAK
- 3:00-4:15p Groups report back—Synthesis of ideas
- 4:15-4:30p Wrap up, next steps—**Penny Latham**, NPS Pacific West Region I&M Program Manager
- 4:30p Closure, thanks—**Bruce Bingham**

## Attendee List

An alphabetized list of registered workshop attendees follows.

First Name	Last Name	Affiliation	Email
John	Apel	NPS CRMO Resource Manager	John_Apel@nps.gov
Isabel	Ashton	NPS ROMN Ecologist	Isabel_Ashton@nps.gov
Vaughn	Baker	NPS ROMO Supt.	Vaughn_Baker@nps.gov
Margaret	Beer	NPS National I&M Data Manager	Margaret_Beer@nps.gov
Steven	Bekedam	NPS CRMO Vegetation Ecologist	Steven_Bekedam@nps.gov
Allison	Berry	Sonoran Institute	aberry@sonoraninstitute.org
Bruce	Bingham	NPS Intermountain Region I&M Program Manager	Bruce_Bingham@nps.gov
Scott	Bischke	MountainWorks	scott@emountainworks.com
Tami	Blackford	NPS GRYN Science Learning Center	Tami_Blackford@nps.gov
Ben	Bobowski	NPS ROMN Tech. Comm. & ROMO Chief of Research & Resources Management	Ben_Bobowski@nps.gov
Mike	Britten	NPS ROMN Program Manager	Mike_Britten@nps.gov
Cassity	Bromley	NPS BICA Resources	Cassity_Bromley@nps.gov
Fred	Bunch	NPS ROMN Tech. Comm. & GRSA Chief of Research & Resources Management	Fred_Bunch@nps.gov
Stephanie	Burkhart	NPS Deputy Associate Regional Director of Natural Resources, Intermountain Region	stephanie_burkhart@nps.gov
Colin	Campell	NPS Deputy Superintendent Yellowstone National Park	colin_campbell@nps.gov
Suzanna	Carrithers	USGS Outreach Specialist	
Tara	Carolyn	NPS ROMN Tech. Comm. & Director of the Crown of the Continent Research Learning Center	Tara_Carolin@nps.gov
Chas	Cartwright	NPS Superintendent Glacier National Park	Chas_Cartwright@nps.gov
Nina	Chambers	Sonoran Institute	nchambers@sonoraninstitute.org
Alice	Chung-MacCoubrey	NPS SIEN I&M Program Manager	Alice_Chung-MacCoubrey@nps.gov
Dave	Clow	USGS Research Hydrologist, USGS Colorado Water Science Center	dwclow@usgs.gov
Sue	Consolo-Murphy	NPS Chief, Science & Resource Management, Grand Teton National Park	Sue_Consolo-Murphy@nps.gov
Yvette	Converse	USFWS Interim Coordinator Great Northern LCC	Yvette_Converse@fws.gov
David	Cooper	CSU	davidc@picea.cnr.colostate.edu
Robert	Crabtree	Chief Scientist, Yellowstone Ecological Research Center	crabtree@yellowstoneresearch.org
Rob	Daley	NPS GRYN Data Manager	Rob_Daley@nps.gov
Laurie	Domler	NPS IMR Planning/NEPA Specialist	laurie_domler@nps.gov
Stephanie	Dubois	NPS Deputy Superintendent Glacier National Park	Stephanie_Dubois@nps.gov
Steve	Fancy	NPS National I&M Program Leader	Steve_Fancy@nps.gov
Kirsten	Gallo	NPS CHDN Program Manager	Kirsten_Gallo@nps.gov
Lisa	Garrett	NPS UCBN Program Manager	Lisa_Garrett@nps.gov
Sophie	Glass	Sonoran Institute	sglass@sonoraninstitute.com



<b>Steve</b>	<b>Gray</b>	Wyoming State Climatologist	sgray8@uwyo.edu
<b>John</b>	<b>Gross</b>	NPS I&M Climate Change Ecologist	john_gross@nps.gov
<b>Andy</b>	<b>Hansen</b>	MSU--NEON	hansen@montana.edu
<b>Steve</b>	<b>Hostetler</b>	USGS Climate Modeler	swhostet@usgs.gov
<b>Andy</b>	<b>Hubbard</b>	NPS SODN Program Manager	Andy_Hubbard@nps.gov
<b>Mark</b>	<b>Huff</b>	NPS NCCN I&M Program Manager	Mark_Huff@nps.gov
<b>Art</b>	<b>Hutchison</b>	NPS ROMN Chair BoD & GRSA Supt.	Art_Hutchinson@nps.gov
<b>Kathi</b>	<b>Irvine</b>	Assistant Professor of Statistics, MSU	irvine@math.montana.edu
<b>Cathie</b>	<b>Jean</b>	NPS GRYN Project Manager	cathie_jean@nps.gov
<b>Jannis</b>	<b>Jocius</b>	NPS Natural Resource Specialist, NEPE	Jannis_Jocius@nps.gov
<b>Jeff</b>	<b>Kershner</b>	USGS Northern Rockies Science Center	jkershner@usgs.gov
<b>Penny</b>	<b>Latham</b>	NPS Pacific West Region I&M Program Manager	Penny_Latham@nps.gov
<b>Jason</b>	<b>Lyon</b>	NPS Integrated Resource Manager NEPE	Jason_Lyon@nps.gov
<b>Maggie</b>	<b>MackCluskie</b>	NPS Program Manager Central Alaska Network	
<b>Craig</b>	<b>MacKinnon</b>	BLM Assessment, Inventory & Monitoring Project Manager Washington Office	craig_mackinnon@blm.gov
<b>Linda</b>	<b>Mazzou</b>	NPS Acting Chief, Yellowstone Center for Resources, Yellowstone National Park	Linda_Mazzu@nps.gov
<b>Kelly</b>	<b>McCloskey</b>	NPS Ecologist, Grant Teton National Park	kelly_mccloskey@nps.gov
<b>Cheryl</b>	<b>McIntyre</b>	Sonoran Institute	cmcintyre@sonoraninstitute.org
<b>Shawn</b>	<b>McKinney</b>	NPS Sierra Nevada Network Ecologist	shawn_mckinney@nps.gov
<b>Dave</b>	<b>Mcwethy</b>	Postdoctoral Fellow in Paleoecology, Montana State University	dmcwethy@montana.edu
<b>Doug</b>	<b>Neighbor</b>	NPS CRMO Superintendent	Doug_Neighbor@nps.gov
<b>Tom</b>	<b>Olliff</b>	NPS GRYN Program Manager	Tom_Olliff@nps.gov
<b>Susan</b>	<b>O'Ney</b>	NPS GRYN Water Specialist	Susan_O'Ney@nps.gov
<b>Stacey</b>	<b>Ostermann-Kelm</b>	NPS GRYN Ecologist	Stacey_Ostermann-Kelm@nps.gov
<b>Keith</b>	<b>Payne</b>	NPS ROMN BoD & FLFO Supt.	Keith_Payne@nps.gov
<b>Greg</b>	<b>Pederson</b>	USGS Climatologist	gpederson@usgs.gov
<b>Dustin</b>	<b>Perkins</b>	NPS NCPN Program Manager	dustin_w_perkins@nps.gov
<b>Tom</b>	<b>Philippi</b>	NPS Quantitative Ecologist, National I&M Program	tom_philippi@nps.gov
<b>Glenn</b>	<b>Plumb</b>	NPS YELL Center for Resources	Glenn_Plumb@nps.gov
<b>Jack</b>	<b>Potter</b>	NPS ROMN Tech. Comm. & GLAC Chief of Science & Resources Management	Jack_Potter@nps.gov
<b>Tom</b>	<b>Rodhouse</b>	NPS UCBN Ecologist	Tom_Rodhouse@nps.gov
<b>Ann</b>	<b>Rodman</b>	NPS GRYN Technical Committee	ann_rodman@nps.gov
<b>Billy</b>	<b>Schweiger</b>	NPS ROMN Ecologist	billy_schweiger@nps.gov
<b>Donna</b>	<b>Shorrock</b>	NPS ROMN Ecologist	Donna_Shorrock@nps.gov
<b>Rick</b>	<b>Sojda</b>	USGS Northern Rockies Science Center	sojda@usgs.gov
<b>Lisa</b>	<b>Thomas</b>	NPS SCPN Program Manager	Lisa_Thomas@nps.gov
<b>Kathy</b>	<b>Tonnessen</b>	NPS ROMN Technical Committee & NPS RM-CESU Research Coordinator	Kathy_Tonnessen@nps.gov
<b>Judy</b>	<b>Visty</b>	NPS ROMN Technical Committee, & Director of the Continental Divide Research Learning Center	Judy_Visty@nps
<b>Jeff</b>	<b>Warren</b>	USFWS Biologist, Red Rock Lakes National Wildlife Refuge	jeffrey_warren@nps.gov
<b>Mandi</b>	<b>Wick</b>	NPS Lead Ranger BIHO	Mandi_Wick@nps.gov
<b>Rick</b>	<b>Wilson</b>	NPS ROMN Tech. Comm. & FLFO Chief Ranger	Rick_Wilson@nps.gov
<b>Janet</b>	<b>Wise</b>	NPS IMR Climate Change Coordinator	Janet_Wise@nps.gov

## Network Makeup

---

Parks making up each network are shown below. The GRYN and ROMN are in the NPS I&M Program's Intermountain Region; the UCBN is in the Pacific West Region.

### *Greater Yellowstone Network (GRYN)*

- Bighorn Canyon National Recreation Area
- Grand Teton National Park
- John D. Rockefeller, Jr. Memorial Parkway
- Yellowstone National Park

### *Rocky Mountain Network (ROMN)*

- Big Hole National Battlefield
- City of Rocks National Reserve
- Craters of the Moon National Monument and Preserve
- Nez Perce National Historical Park

### *Upper Columbia Basin Network (UCBN)*

- Glacier National Park
- Great Sand Dunes National Park and Preserve
- Rocky Mountain National Park
- Florissant Fossil Beds National Monument

## Bozeman Area Restaurants

---

The map and information and map that follow provide addresses from some uniquely Bozeman restaurants. Note that the Gallatin Gateway Inn includes in house as the Porter House Restaurant.

Dave's Sushi-Off Main  
115 North Bozeman Avenue  
Bozeman, MT 59715-3657  
(406) 556-1351  
davessushi.com

Starky's Authentic Americana  
24 N Tracy Ave  
Bozeman, Mt 59715  
(406) 556-1111  
starkyonline.com

Cateye Cafe  
23 N Tracy Ave  
Bozeman, Mt 59715  
(406) 587-8844  
cateyecafe.com

Ted's Montana Grill  
105 W Main Street  
587-6000

Over the Tapas  
19 South Wilson  
556-8282

18 Miles To the Border  
131 West Main Street  
Bozeman, MT 59715-4644  
(406) 556-1818

Emerson Grill  
207 West Olive Street  
Bozeman, MT 59715  
(406) 586-5247  
emersongrill.com  
Mac Kenzie River Pizza Co  
232 East Main Street  
Bozeman, MT 59715-4748  
(406) 587-0055  
mackenzieriverpizza.com

Nova Cafe The  
312 East Main Street  
Bozeman, Mt 59715  
(406) 587-3973  
thenovacafe.com

Montana Ale Works  
611 East Main Street  
Bozeman, MT 59715-3778  
(406) 587-7700  
montanaaleworks.com

Garage the Soup Shack  
451 East Main Street  
Bozeman, MT 59715-6235  
(406) 585-8558  
Santa Fe Reds  
1235 North 7th Avenue  
Bozeman, MT 59715-2509  
(406) 587-5838

Community Food Co-Op  
908 West Main Street  
Bozeman, MT 59715  
(406) 587-4039  
bozo.coop

Blackbird  
140 East Main Street  
Bozeman, MT 59715-4701  
(406) 586-0010

Bacchus Pub Inc  
103 West Main Street  
Bozeman, MT 59715  
(406) 522-0079  
Bagelworks

708 West Main Street  
Bozeman, MT 59715-3357  
(406) 585-1727  
bozemanbagelworks.com

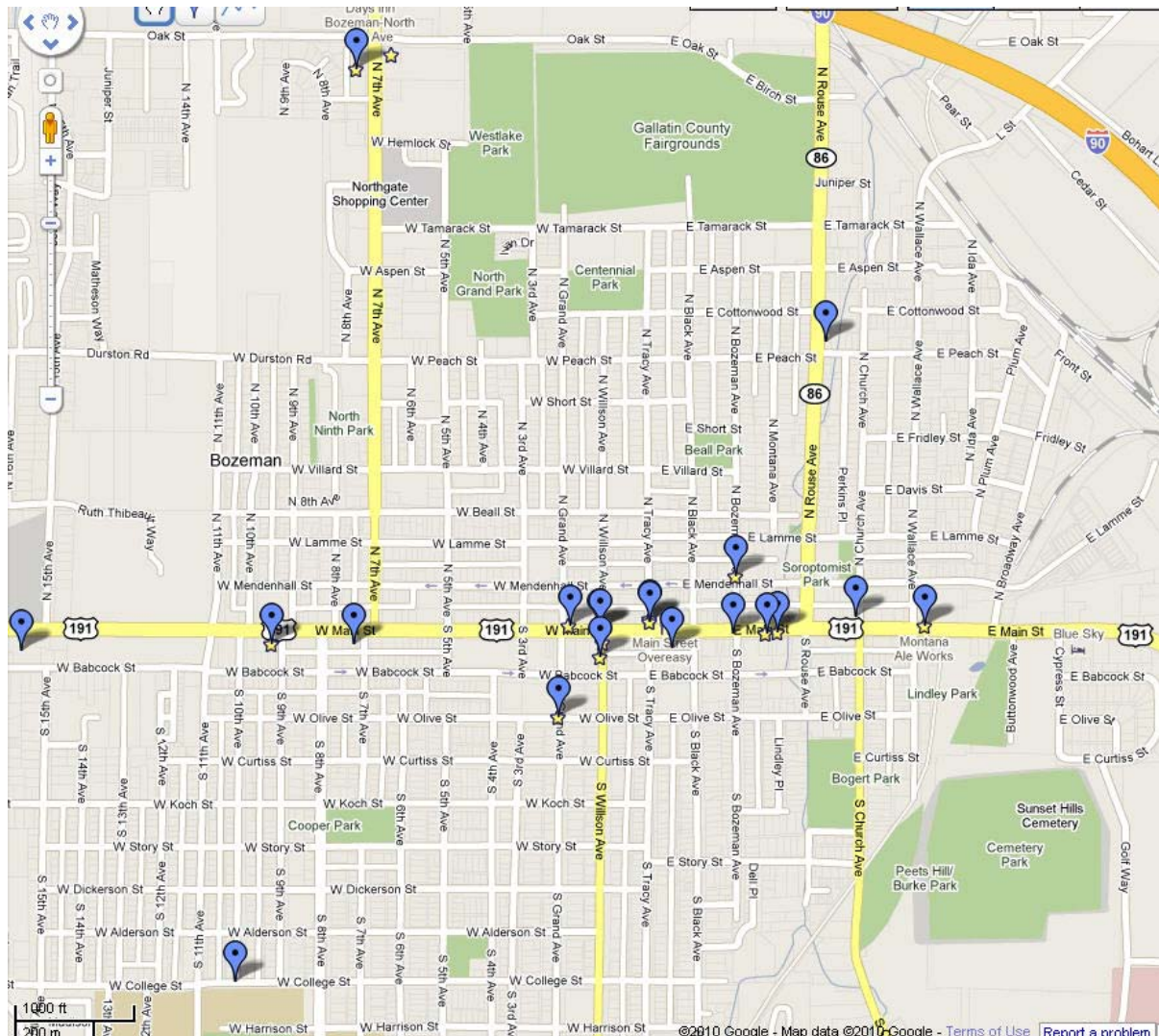
Cafe Zydeco  
1520 West Main Street  
Bozeman, MT 59715-4010  
(406) 994-0188  
cafezydeco.com

Colombo's Pizza & Pasta  
1003 West College Street

Bozeman, MT 59715-5064  
(406) 587-5544

Audrey's Pizza Oven  
401 East Peach Street  
Bozeman, MT 59715  
(406) 582-4449  
audreypizza.com

Wild Joe's Coffee  
18 West Main Street  
Bozeman, MT 59715-4643  
(406) 586-1212  
wildjoescoffee.com



## Craig MacKinnon (BLM) Presentation Materials

Landscape Scale Management Questions and Associated Data for Inventory, Monitoring, and Predictive Models					
NOTE: MANY DATA SETS WILL REQUIRE MULTIPLE SCALES, E.G. NATIONAL, LCC, ECOREGION, PLANNING UNIT, SITE					
	Ecosystem Component		Activity (including Lead Agency)		
	<i>Ecological Components</i>	<i>Management Questions</i>	<i>Inventory</i>	<i>Monitoring</i>	<i>Predictive</i>
1	Biotic Capacity (Integrity)	Where are native plant species of management concern and species of greatest conservation need?	Vegetation map (composition)	Core indicators/ Data Standards/ Methods/ Sample framework	
2		Where are native animal species of management concern and species of greatest conservation need?			
3		Where are native and unfragmented plant communities for grassland/shrubland/savanna, riparian, and forest cover types?			
4		Where are ecologically unique endemic species/communities of management concern including culturally significant communities?			
5		Where are areas where species composition represents a native, intact community and/or high species diversity?			
6		Where are areas described explicitly for aquatic or terrestrial wildlife habitat connectivity?			
7		Where are areas or watersheds of significance for native species of economic and recreational importance?			
8	Hydrologic Capacity (Function)	Where are watersheds that support perennial water/aquatic systems?	NHD	Flow Regime	
9		Where are riparian/aquatic areas that represent unique environments and support diversity and connectivity?			

10	Restoration Capacity (Stability)	Where are areas with the biophysical setting necessary for reestablishment of community(s) of concern?	Biophysical setting	Climate	Climate model
11		Where are areas with high potential to restore or reconnect endemic species populations?	Ecological Site Description		

	<b><i>Change Agents</i></b>	<b><i>Management Questions</i></b>	<b><i>Inventory</i></b>	<b><i>Monitoring</i></b>	<b><i>Predictive</i></b>
1	Climate Change	Where are climatic zones located today?			
2		Where are species most vulnerable to changing climatic conditions?			
3		Where are areas with the greatest potential for thermal and hydrologic regime change?			
4	Wildland Fire	Where have fires occurred?			
5		Where are areas with fuel loads and/or fuel continuity with high fire risk?			
6		Where are areas with high fire risk and/or high resource value and/or high likelihood of irreversible damage if fire occurred?			
7	Invasive Species	Where are exotic species located?			
8		Where is the range/extent of exotic species most likely to expand?			
9		Where are native species, i.e. Conifer, bark beetle expanding their range?			
10	Industrial Development	Where is existing energy development (e.g., oil and gas, coal, wind, geothermal, solar and energy transport)?			
11		Where are existing commitments to future energy development (e.g., oil and gas, coal, wind, geothermal, solar and energy transport)?			
12		Where is there potential for future energy development (e.g., oil and gas, coal, wind, geothermal and solar)?			
13		Where are existing water diversions, dams, and other barriers that limit aquatic migration or restoration potential?			

14		Where are proposed water diversions, dams, and other barriers that may limit aquatic migration or restoration potential?			
		Where are impaired waters, fish advisories, NPDES permits, and/or toxic release points?			
15	Urban Growth	Where is existing urban growth, including transportation infrastructure and other anthropogenic barriers that limit species migration or restoration potential?			

	<b><i>Change Agents (Continued)</i></b>	<b><i>Management Questions</i></b>	<b><i>Inventory</i></b>	<b><i>Monitoring</i></b>	<b><i>Predictive</i></b>
16		Where is projected urban growth, including transportation infrastructure?			

	<b><i>Treatment Information</i></b>	<b><i>Management Questions</i></b>	<b><i>Inventory</i></b>	<b><i>Monitoring</i></b>	<b><i>Predictive</i></b>
1		Where are fuels and weed treatments?			
2		Where are reforestation, reclamation and re-vegetation projects?			

	<b><i>Base Information</i></b>	<b><i>Management Questions</i></b>	<b><i>Inventory</i></b>	<b><i>Monitoring</i></b>
1	Land Ownership	Who owns the surface (e.g., federal, Tribal, state, private)?		
2		Who owns the subsurface? (e.g., federal, non-federal)?		
3	Administrative Boundaries	Who has administrative jurisdiction (e.g., state, county, congressional districts)?		
4		Where are agency administrative boundaries?		
5		Where are BLM administrative units?		
6	Protected Areas	Where are existing protected areas (e.g., federal, state, NGO)?		
7		Where are priority areas identified in other assessments?		
8		Where are outdoor recreation priority and highly managed recreational areas?		

	<b><i>Geospatial Synthesis</i></b>	<b><i>Management Questions</i></b>	<b><i>Modeled Data</i></b>
1	Conservation Areas	Where are areas with highest conservation potential for wide ranging species?	Model-For example: Areas with biotic integrity, hydrologic function and soil site stability AND sufficient size AND ability to persist AND low threat from change agents
2		Where are areas with high conservation values and high risk potential?	Model-For example: Relatively intact endemic species/communities of management concern AND ability to persist AND high threat from change agents
3		Where are conservation areas for unique, significant and endemic populations with limited adaptation ability?	Model
4	Restoration Areas	Where are areas with highest restoration potential?	Model-For Example: Biophysical setting (soils, elevation, landform, climate) requirements for selected community of interest AND likelihood of success (legacy treatment) AND low risk from change agents
5	Development Areas	Where are areas with high development potential?	Model-For example: Areas low in conservation potential AND low in restoration potential AND areas with greatest potential to be impacted by change agents

Source documents:

Michael J. Wisdom, Rowland, M., and Suring, H., 2005, Habitat Threats in the Sagebrush Ecosystem: Methods of Regional Assessment and Applications in the Great Basin, Alliance Communications Group

Jeffrey D. Parrish, Braun, D., and Unnasch, R., 2003, 53:9, Are We Conserving What We Say We Are? Measuring Ecological Integrity within Protected Areas, BioScience

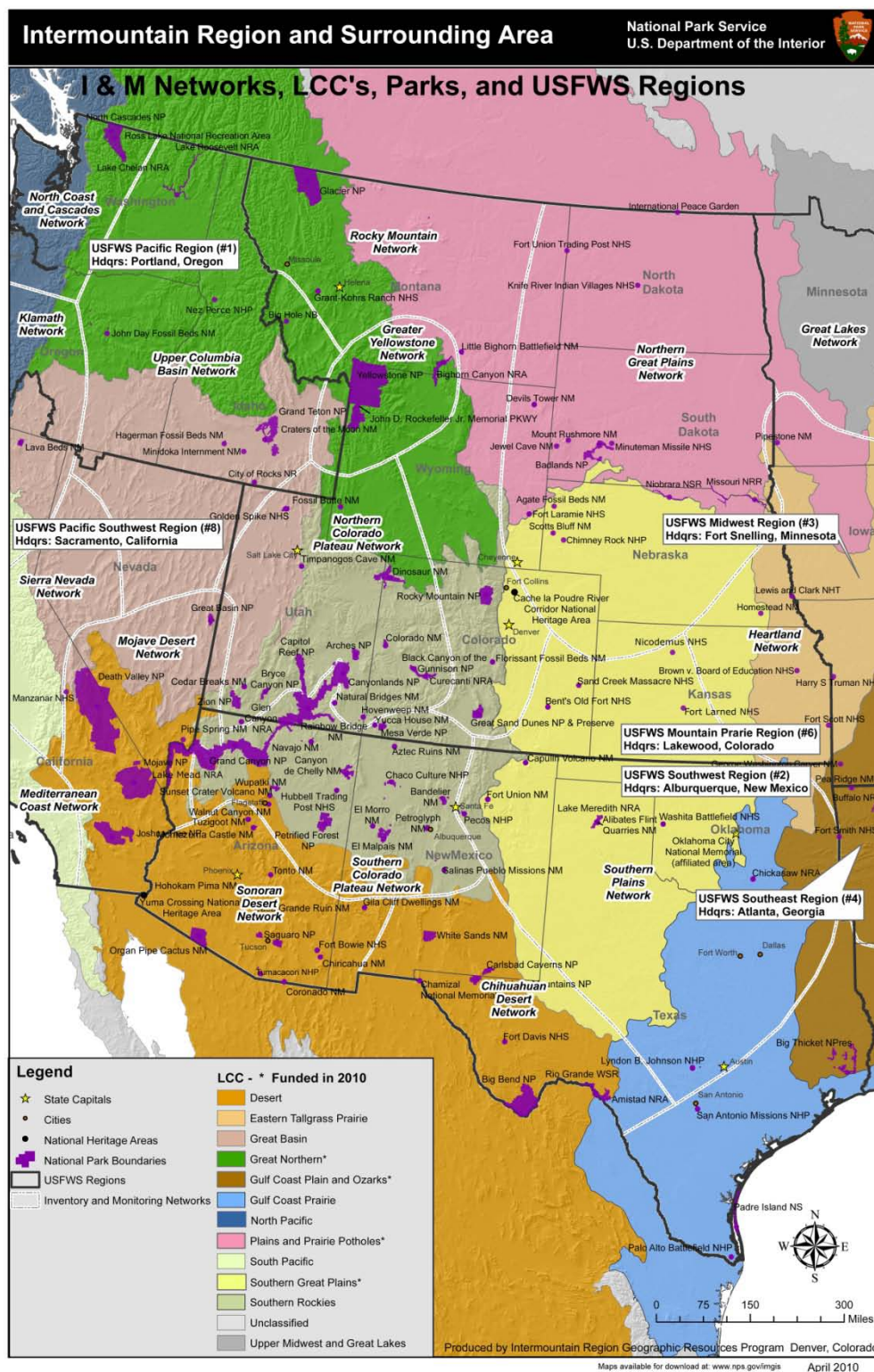
Rangeland Health, New Methods to Classify, Inventory, and Monitor Rangelands, 1994, National Research Council, National Academy Press

Michael Pellant, Shaver, P., Pyke, D., Herrick, J., 2005, Interpreting Indicators of Rangeland Health, version 4, Bureau of Land Management, National Science and Technology Center

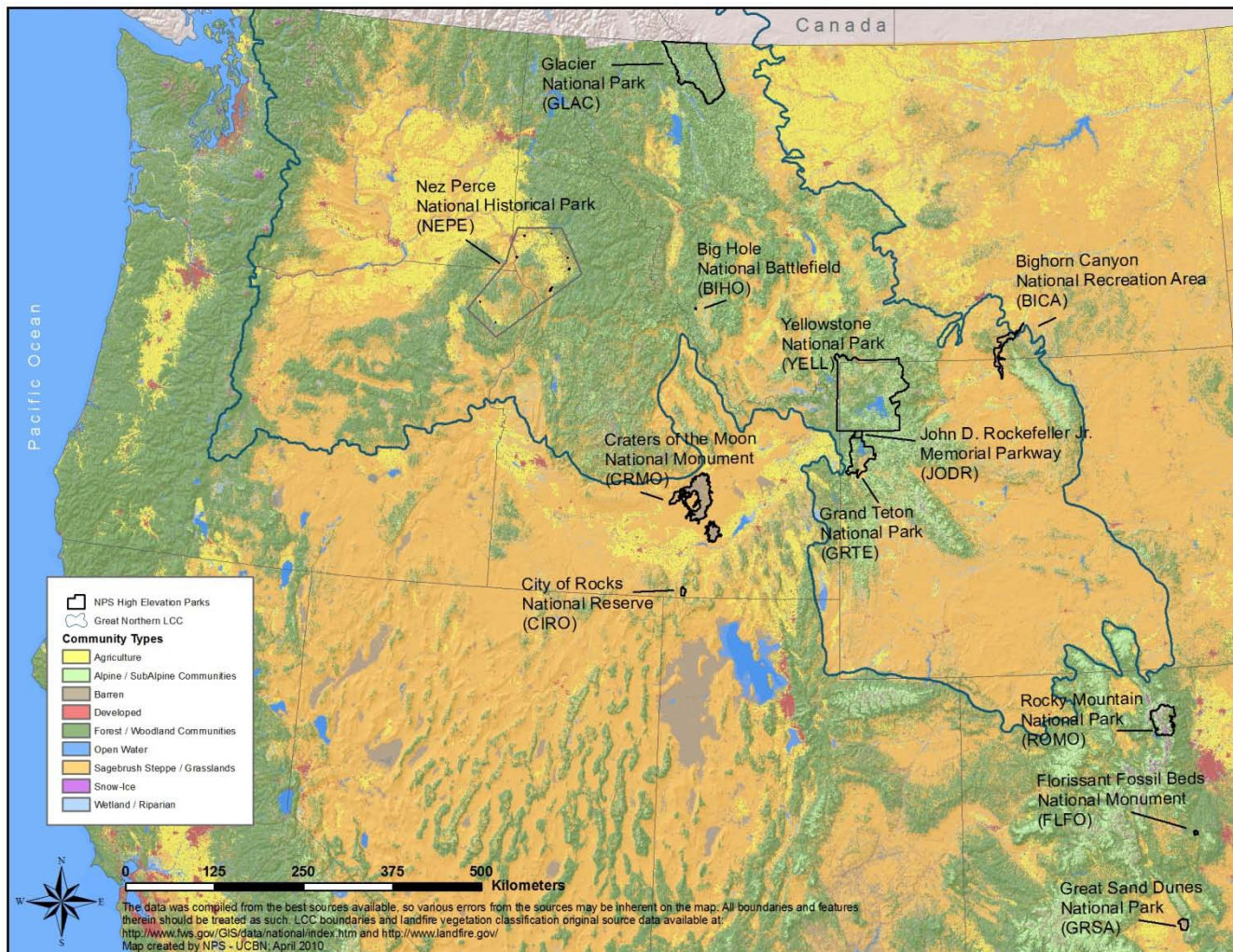
Integrated Vegetation Handbook, 2008, Bureau of Land Management, National Science and Technology Center



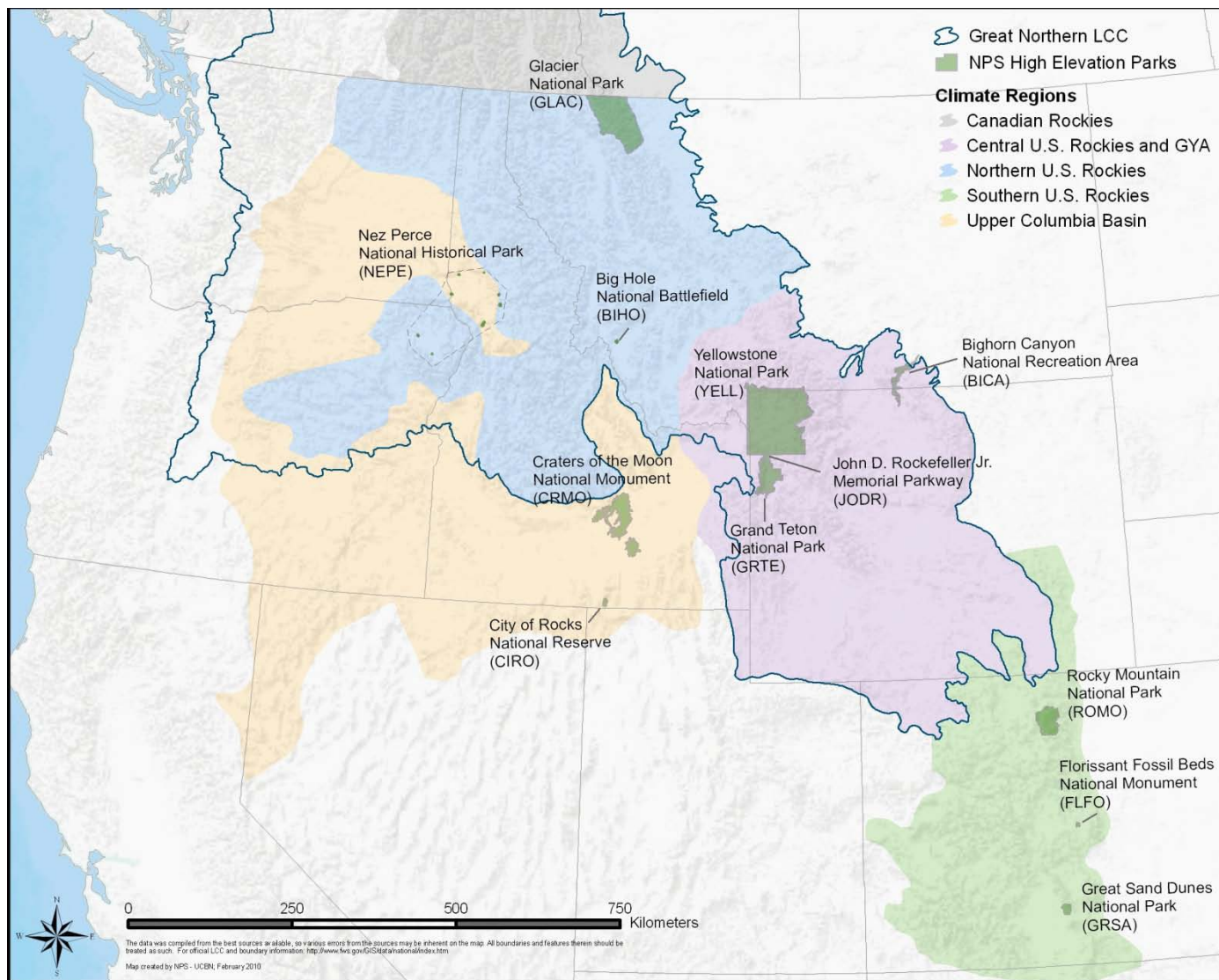
## Useful Maps







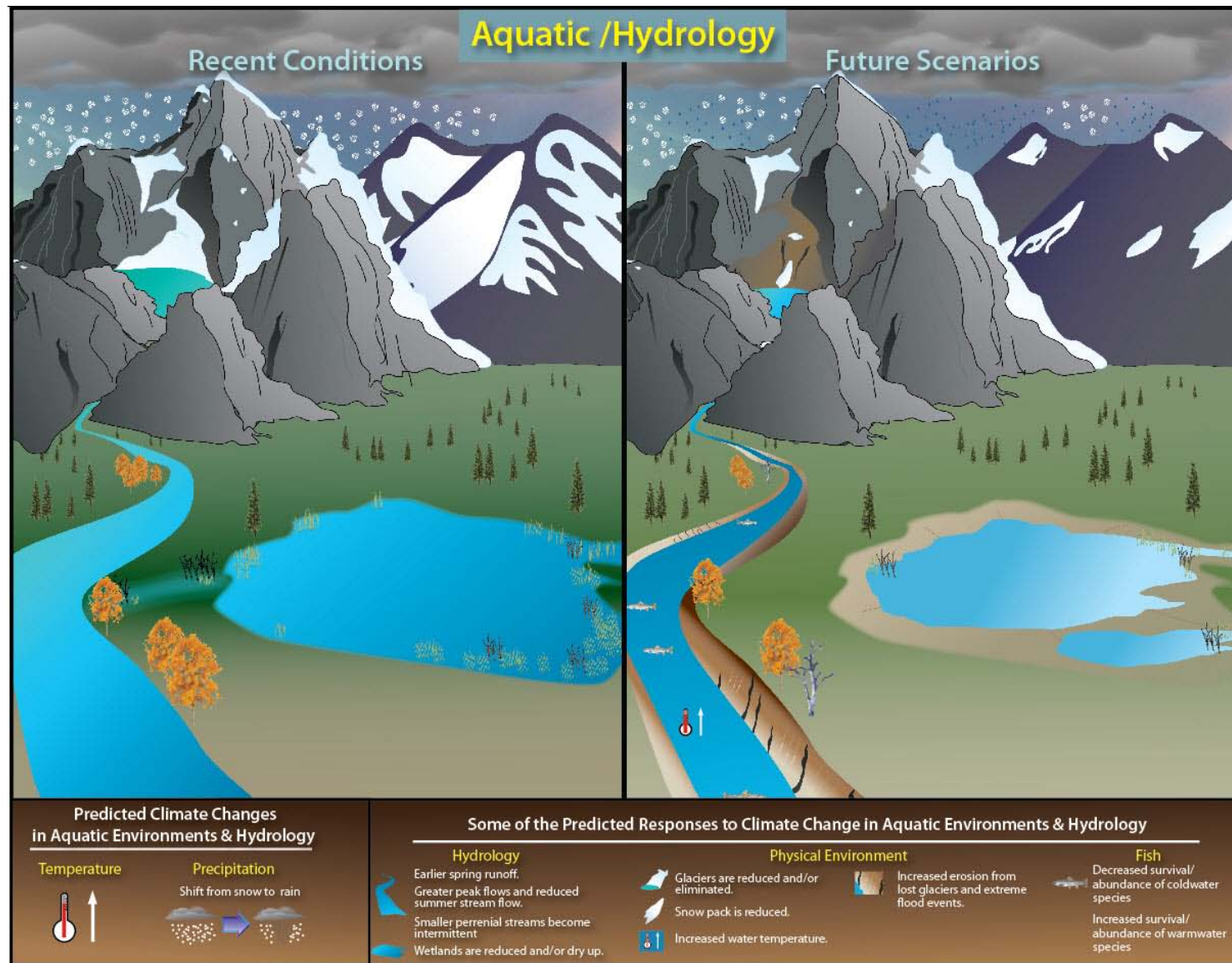
## High Elevations Parks and Landcover types

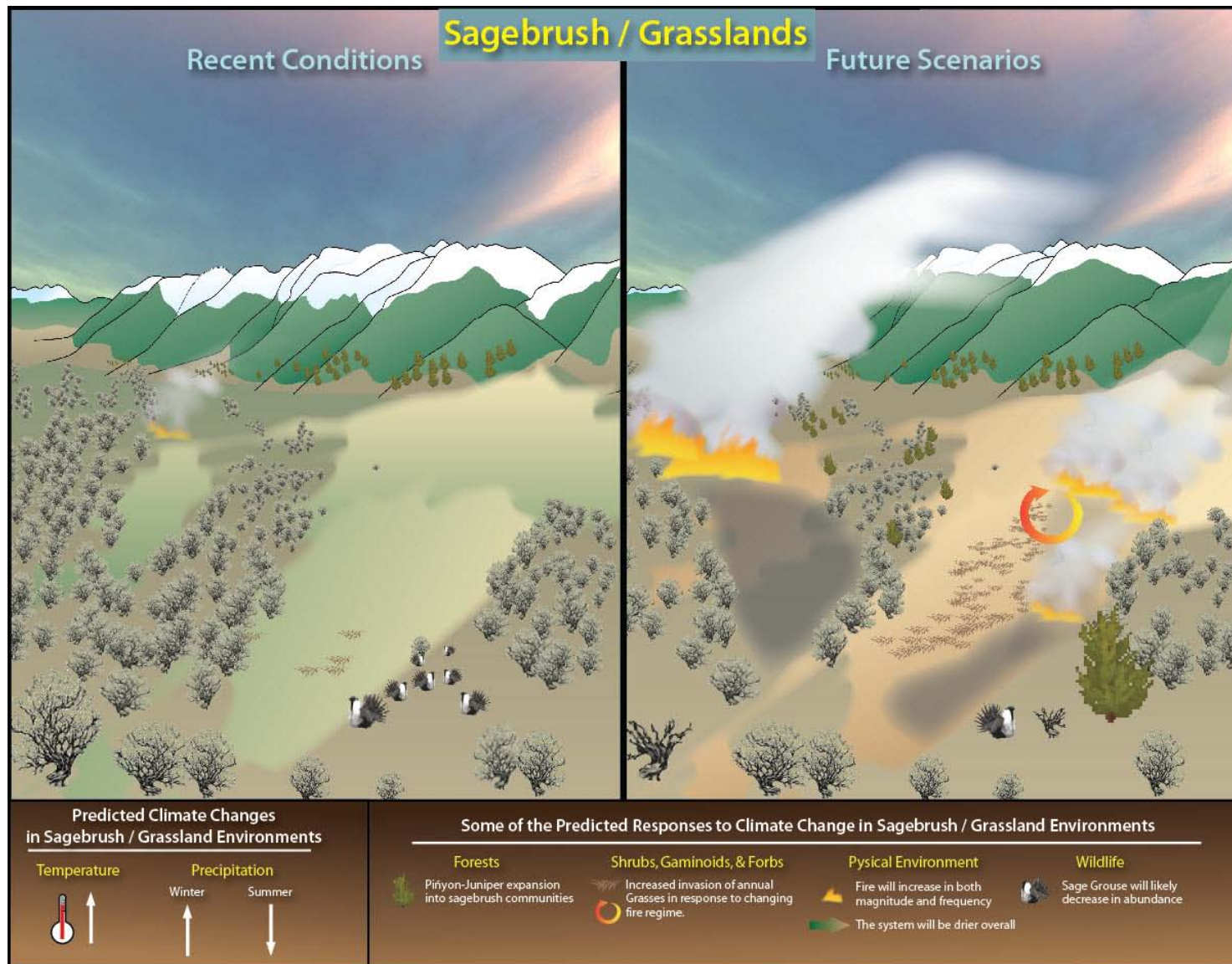


## High Elevations Parks and Climate Regions

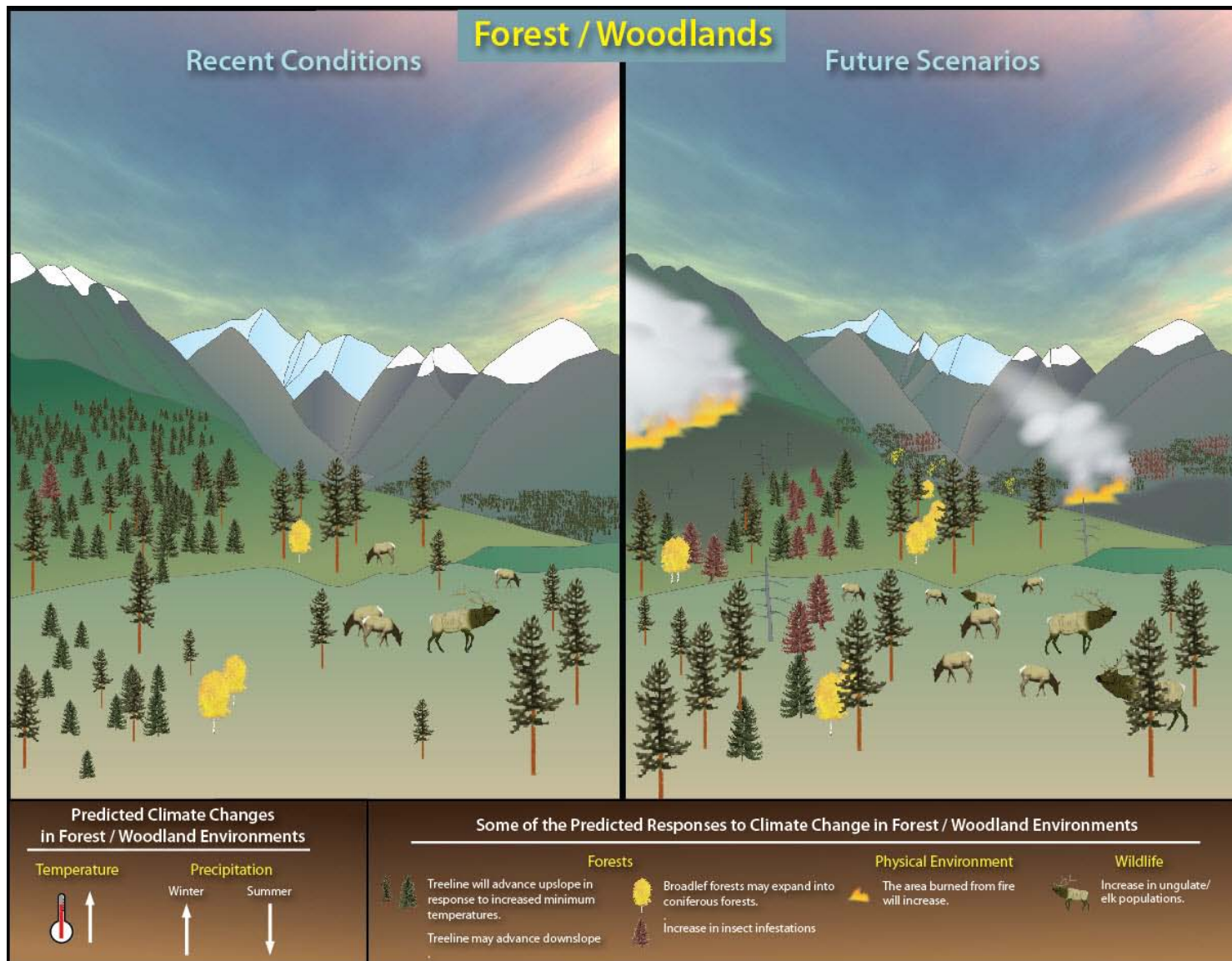


## Conceptual Diagrams











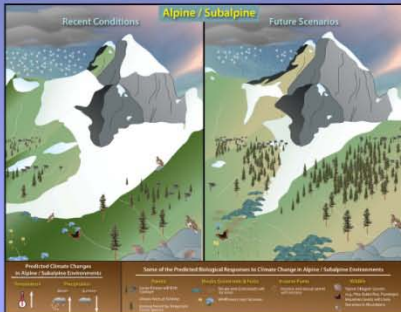




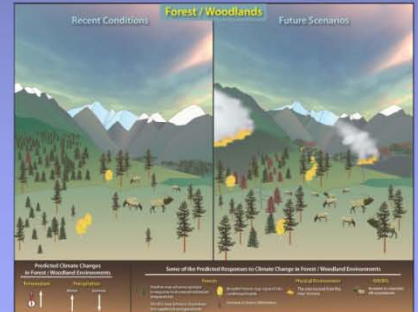
National Park Service  
U.S. Department of the Interior

Inventory and Monitoring Program

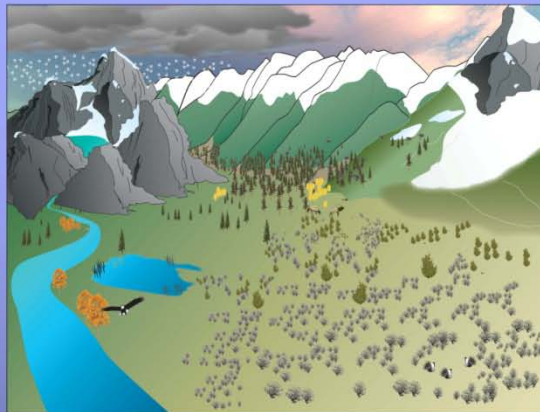
## Ecological Response to Climate Change in High Elevation Park Units of the Great Northern Landscape Conservation Cooperative



**Alpine and subalpine communities** occur in 7 of the 12 high elevation parks in the Great Northern LCC. These communities are most extensive in GLAC, GRTE, ROMO, and YELL, but are well represented in GRSA and JODR. Peripheral subalpine woodlands also occur in CIRO. Increased woody vegetation, weed invasion, and upslope range contractions of high-elevation obligate species are some of the possible responses to projected climate change. Loss of glaciers and reduced snowpack will affect park ecosystems widely and will fundamentally alter the scenery and visitor experiences in these parks.



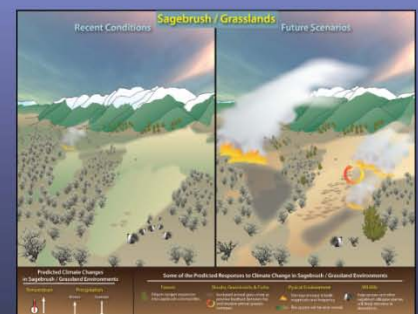
**Aquatic and wetland communities** have ecological importance in all 12 GNLCC parks disproportionately higher than their spatial extent would suggest. Glaciers, alpine lakes, and high mountain wetlands are particularly sensitive to climate change. Projections suggest that many GNLCC watersheds will become rain-dominated systems, leading to earlier runoff and lower base flows. Water temperatures are expected to increase and affect cold-water fishes and other aquatic organisms. Stream channel incision and degraded riparian communities may result from flashier runoff patterns and lower water tables.



**Forest and woodland communities** are present in all 12 GNLCC high elevation parks. Extensive conifer forests, aspen woodlands, and pinyon-juniper savannahs provide some of the most characteristic elements of GNLCC park scenery. Disease and beetle outbreaks, fire, and herbivory are contributing to a changing forest landscape and an increasingly complex resource management environment. Climate change projections suggest that both lower and upper treeline ecotones will shift, and that extensive die-offs from fire, drought stress, and pest and pathogen outbreaks may increase.



**Sagebrush steppe and grasslands** are present in all 12 high elevation parks. Sagebrush is a particularly important component at CRMO, CIRO and BICA. Grasslands increase in importance in eastern portions of the GNLCC, including NEPE's Bear Paw Battlefield. Many ongoing management issues facing parks with steppe communities are projected to be exacerbated by accelerated climate change. Fires may become more extensive and frequent, driving weed invasion and loss of native species. Woodland-steppe ecotones will continue to be dynamic; drought and fire may offset woodland expansion into these steppe communities.



For more information please visit the NPS GNLCC Website at [http://www.greateryellowstonescience.org/CC\\_workshops/](http://www.greateryellowstonescience.org/CC_workshops/)

## Workshop Evaluation

The Planning Team for this NPS I&M High Elevation Parks Workshop greatly appreciates and values your feedback! As such, we request a moment of your time to help evaluate the workshop. Your comments will be directly applicable and of use in preparations for a similar I&M workshops to be held in the future. We are looking for honest feedback. Help us understand how we could have made the workshop better for you.

*Again, our sincere thanks for taking a few moments to provide your thoughts!*

Please rate the following characteristics of the workshop on a scale of 1 to 5 using the scale shown. Circle the applicable number and please provide us any comments you have.

	1 <i>No value</i>	2	3 <i>neutral</i>	4	5 <i>high value</i>
--	----------------------	---	---------------------	---	------------------------

*How would you rate  
this workshop overall?*

➤ Your comments/suggestions (positive or negative) \_\_\_\_\_

---

---

➤ Do you have suggestions for follow up activities based on the results of the workshop? Any specific areas you would like to be involved? \_\_\_\_\_

---

### **Tuesday**

*Synthesis presentations from Gray, McWethy, and Britten on state of the knowledge of climate change impacts on high elevation parks*

	1	2	3	4	5
<i>Tuesday AM/PM panel presentations on background/vision/partnership opportunities for the GNLCC</i>	1	2	3	4	5

	1	2	3	4	5
<i>Tuesday PM NPS presentation (Beer) on data sharing and integration across landscapes</i>	1	2	3	4	5

	1	2	3	4	5
<i>Tuesday PM NPS presentation (Blackford) on the Greater Yellowstone Science Learning Center</i>	1	2	3	4	5

➤ Your comments/suggestions (positive or negative) on any of these items appreciated \_\_\_\_\_

---

---



**Wednesday***Wednesday AM presentations on NPS CC strategy (Olliff) and I&M Network strategy (Bingham)*

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
----------	----------	----------	----------	----------

*Wednesday AM conceptual diagram presentations*

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
----------	----------	----------	----------	----------

*Wednesday work groups*

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
----------	----------	----------	----------	----------

Your comments/suggestions (positive or negative) \_\_\_\_\_

---

---

---

**Logistics***Facilitation*

<i>Overall</i>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
----------------	----------	----------	----------	----------	----------

<i>Your work group</i>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
------------------------	----------	----------	----------	----------	----------

➤ Your comments/suggestions (positive or negative) \_\_\_\_\_

---

<i>Meeting rooms</i>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
----------------------	----------	----------	----------	----------	----------

<i>Food</i>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
-------------	----------	----------	----------	----------	----------

<i>Workshop planning efforts</i>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
----------------------------------	----------	----------	----------	----------	----------

*including advance materials and website*

➤ Your comments/suggestions (positive or negative) \_\_\_\_\_

---

**Your background** (feel free to sign this form or remain anonymous)I served on the Planning Team for the workshop (*check one only*):

<input type="checkbox"/> yes	<input type="checkbox"/> no
------------------------------	-----------------------------

I work for (*check one only*):

<input type="checkbox"/> NPS	<input type="checkbox"/> a non-NPS federal or state agency	<input type="checkbox"/> other (indicate)
------------------------------	--	---

My primary function as associated with the NPS I&M program (whether working for NPS or not) is as a (*check one only*)

<input type="checkbox"/> researcher / scientist	<input type="checkbox"/> manager	<input type="checkbox"/> educator	<input type="checkbox"/> other (indicate)
---	----------------------------------	-----------------------------------	---