LCC-VP
LANDSCAPE CLIMATE CHANGE VULNERABILITY PROJECT

Landscape Climate Change Vulnerability Project (LCC-VP):

What did the project accomplish?

Montana State University:

Andy Hansen, Nate Piekielek, Tony Chang, Linda Phillips

NPS / Great Northern LCC:

Tom Olliff

NPS I&M Program:

Bill Monihan and John Gross

CSU Monterey Bay / NASA Ames:

Forrest Melton, Weile Wang

Conservation Science Partners:

Dave Theobald

Woods Hole Research Center:

Scott Goetz, Patrick Jantz, Brendan Rogers, Tina Cormier, Scott Zolkos

Colorado State University

Montana State University Bozeman

California State University Monterey Bay

Woods Hole Research Center

NASA Applied Sciences Program
(NNH10ZDA001N - BIOCLIM)

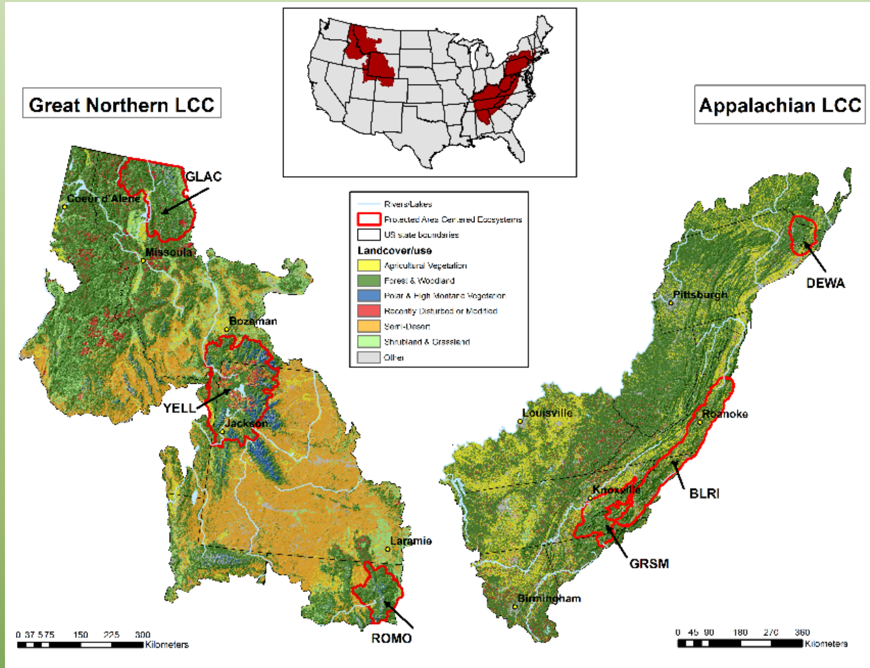
NPS I&M Program

National Park Service

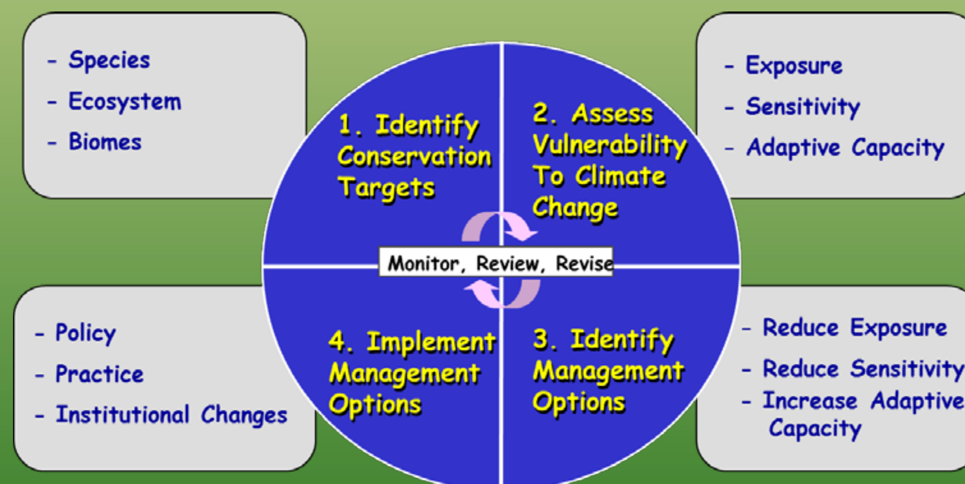
NASA

Great Northern Landscape Conservation Cooperative

Objective



Demonstrate climate adaptation planning in LCCs

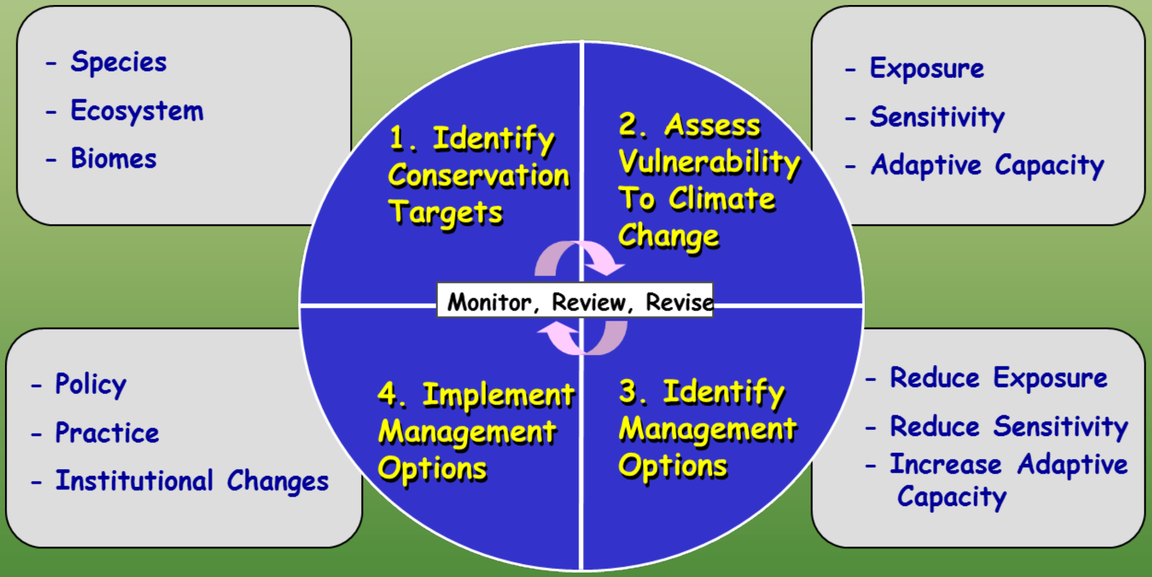


Glick et al. 2011. Scanning the Conservation Horizon. National Wildlife Federation

Climate Adaptation Planning

Secretarial order 3289 (2010)

- **"apply scientific tools to increase understanding of climate change and to coordinate an effective response to its impacts".**
- **Climate Science Centers**
- **Landscape Conservation Cooperatives**
- **2010 – 2015 a period of rapid evolution and progress.**

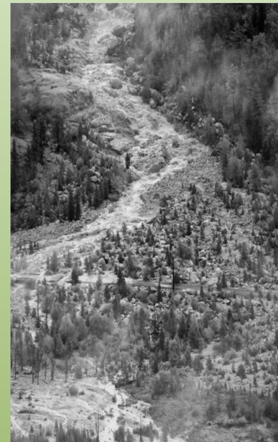


Glick et al. 2011. Scanning the Conservation Horizon. National Wildlife Federation

Engage Partners

Rocky Mountain NP

Ben Bobowski, Chief of Resources, Rocky Mountain National Park



Unprecedented winter fires and landslides.

<u>Issues:</u> Snow/runoff, fire, landslides, forest die-off, Cheatgrass

Great Smokey Mt, Shenandoah, Delaware Water Gap NP

Unprecedented winter fires and landslides.

<u>Issues:</u> Cove forests, subalpine communities, managing for resilience

Clingman's Dome. Balsam Wooly Adelgid damage to Fraser Fir on Clingman's Dome.

Yellowstone NP, Grand Teton NP

Dan Wink, YNP Superintendent

<u>Issues:</u> Snow/runoff, subalpine forests, whitebark pine management

Collaborating Agencies

Great Northern
LANDSCAPE CONSERVATION COOPERATIVE

NORTH CENTRAL CLIMATE SCIENCE CENTER
UNIVERSITY CONSORTIUM

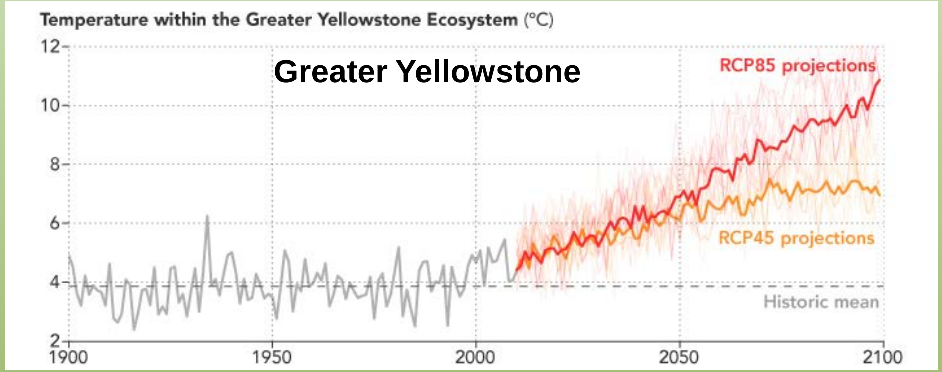
MONTANA INSTITUTE ON ECOSYSTEMS

<u>Issues:</u> Delivery of climate adaptation approaches

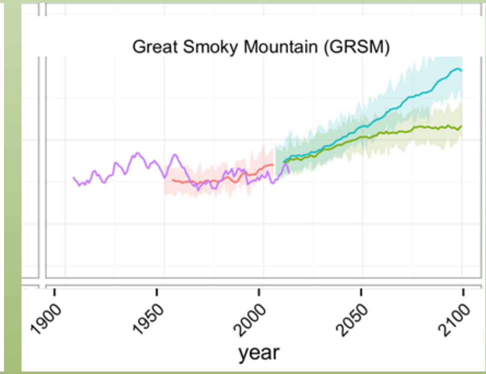
Ecological Hindcasting and Forecasting

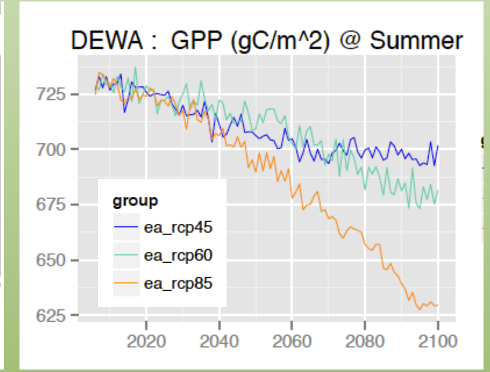
Ecological hindcasting and forecasting is invaluable for placing current patterns in context

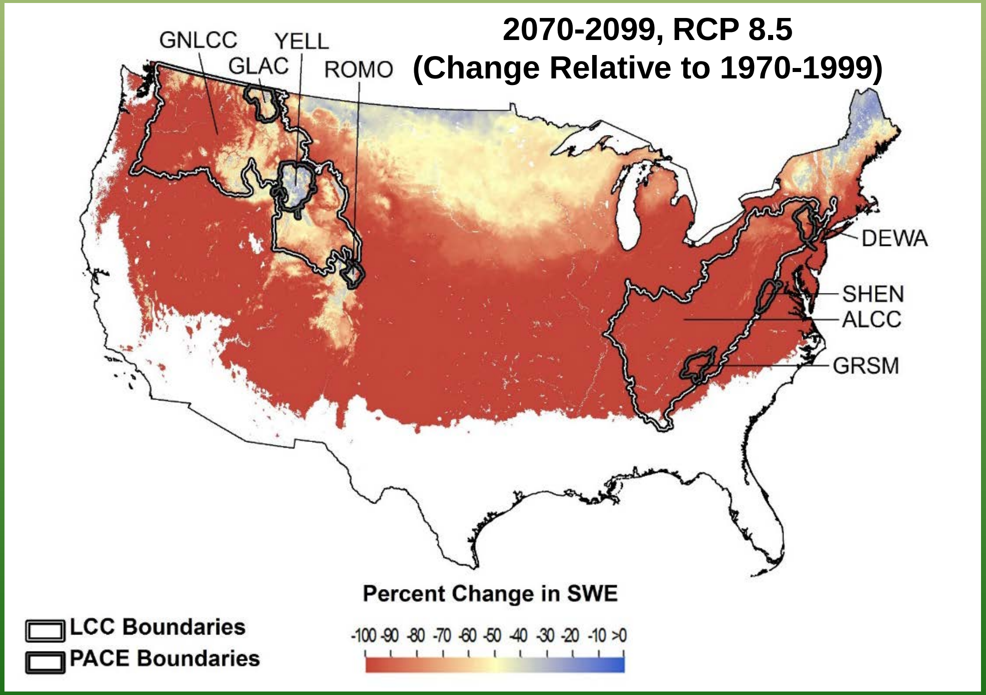
Northern Rockies

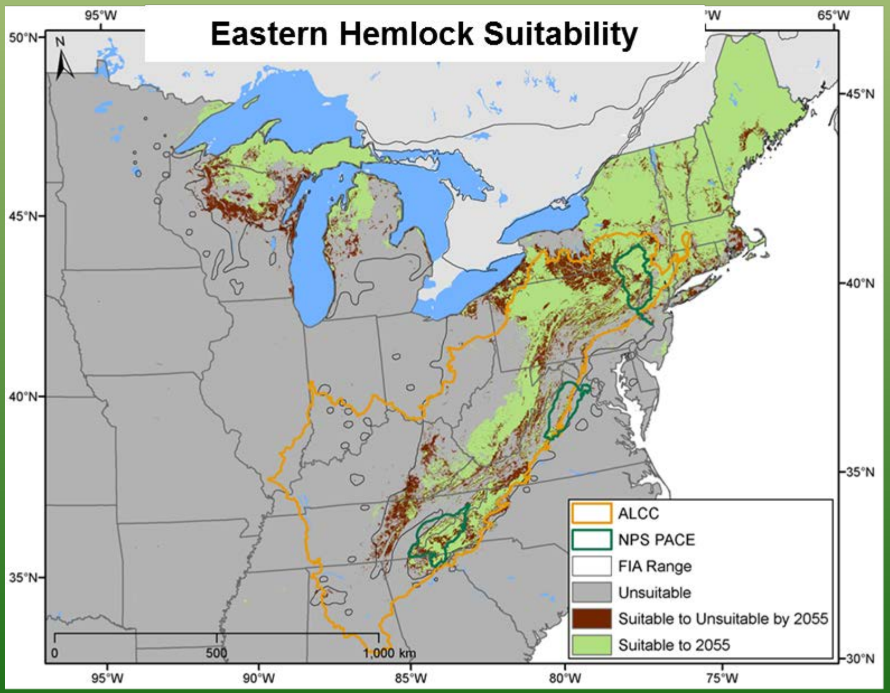


Appalachians



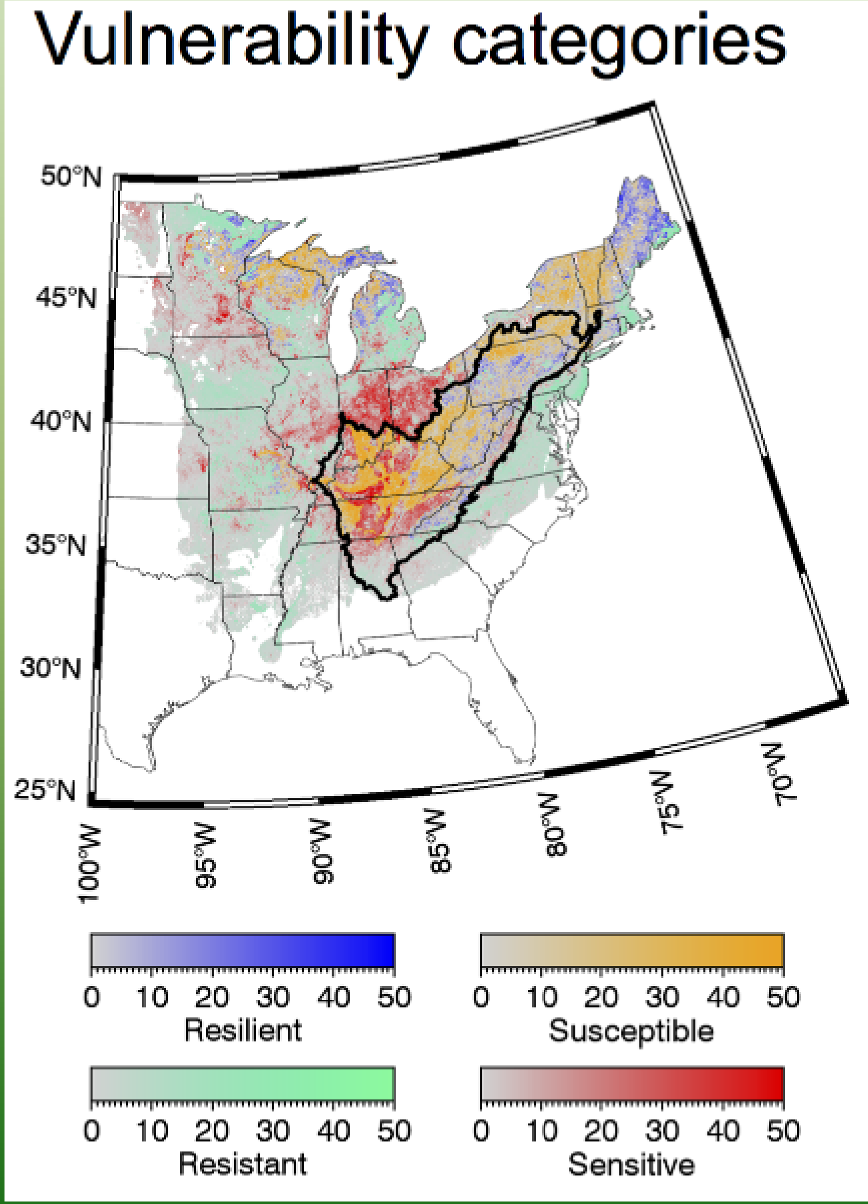


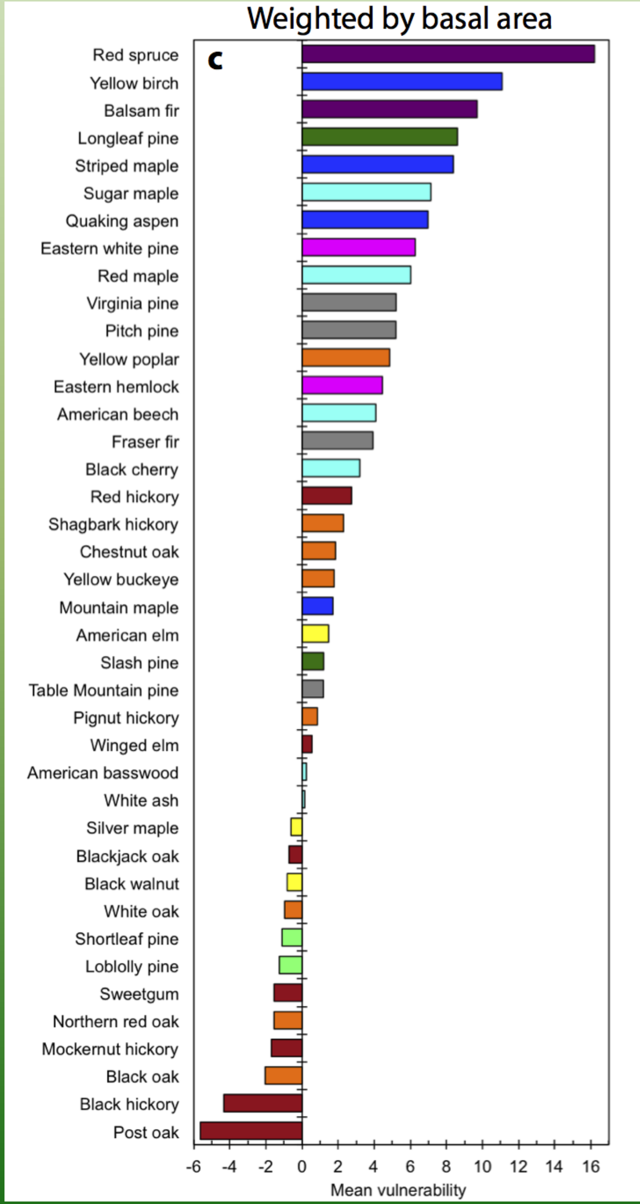




Vulnerability Assessment

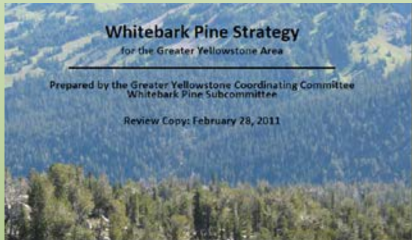
Vulnerability assessment provides a strong basis for prioritizing management





Management Evaluation and Implementation

Whitebark Pine

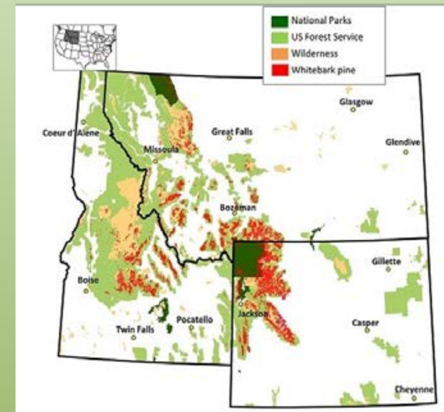


Our goal is to provide information back to the subcommittee for adaptive management under climate change

Modeling WBP Management Alternatives

Ireland, Hansen, Keane

Social Values Regarding WBP and Management



Tri-state survey to understand attitudes of residents in the Northern Rockies toward WBP and WBP management strategies across varying land designations.

<u>Support for Different for WBP Management Strategies on Federal Public Land</u>

No Management:	SUPPORT 16% (243)	NEUTRAL 23% (347)	OPPOSE 57% (874)
Protection:	SUPPORT 80% (1264)	NEUTRAL 11% (179)	OPPOSE 6% (98)
Restoration:	SUPPORT 80% (1265)	NEUTRAL 12% (199)	OPPOSE 5% (78)

Management treatments stratified by habitat suitability zones

		Treatments				
Climate Zone	Future Risk Factors	Planting	Thinning	Protection	Prescribed Fire	Wildland Fire Use
	Future Competition					
Core	Low	X	X	X	X	X
	Low-mid	X	X	X	X	X
	Mid-high	X	X	X	X	X
	High	X	X	X	X	X
	Future Competition					
Deteriorating	Low	X		X		
	Low-mid	X		X		
	Mid-high		X	X	X	X
	High		X	X	X	X
	Future Competition					
Future	Low	X		X*		
	Low-mid	X	X	X*	X	X
	Mid-high					
	High					

Decision Support Products

"It is imperative in a decision space that mandates science that managers understand the nuances of the science they are using as inputs into decision making. Managers can better understand scientific models and studies if they are integrated early in the scientific process."

Tom Olliff, GNLCC Co-coordinator

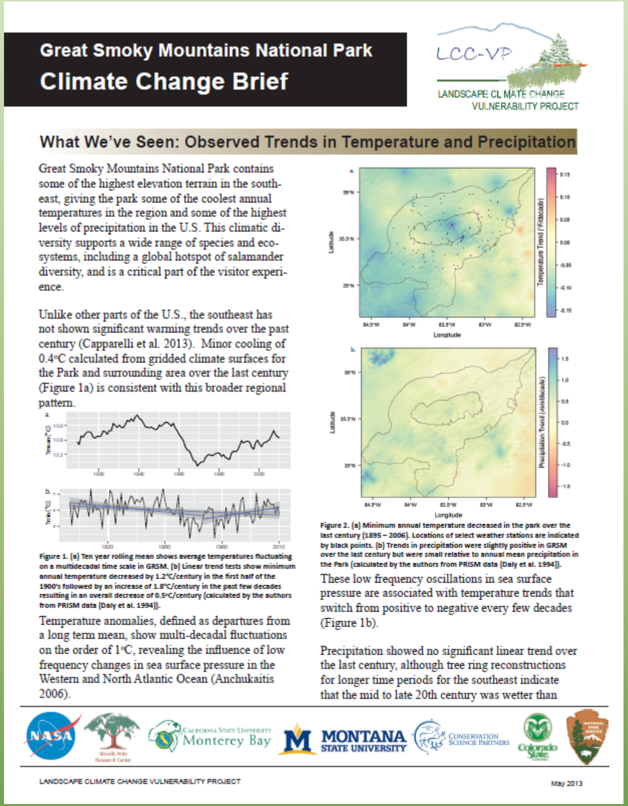
"We found that effective communication and information transfer required the project team to develop and present a multitude of products that vary in length, technical detail, and format to meet specific and different needs. The most effective communication requires the right information, delivered to the right people, in the right format, at the right time."

"The framework we described explicitly shows how the tools of climate change adaptation—vulnerability assessments, climate hindcasting and projections, ecological models, and adaption options—fit together to help inform decisions and build a foundation for scientists and managers to work together on climate adaptation."

John Gross, NPS Climate Change Scientist

Decision Support Products

Resource Briefs


Great Smoky Mountains National Park
Climate Change Brief

LCC-VP
LANDSCAPE CLIMATE CHANGE VULNERABILITY PROJECT

What We've Seen: Observed Trends in Temperature and Precipitation

Great Smoky Mountains National Park contains some of the highest elevation terrain in the southeast, giving the park some of the coolest annual temperatures in the region and some of the highest levels of precipitation in the U.S. This climatic diversity supports a wide range of species and ecosystems, including a global hotspot of salamander diversity, and is a critical part of the visitor experience.

Unlike other parts of the U.S., the southeast has not shown significant warming trends over the past century (Capparelli et al. 2013). Minor cooling of 0.4°C calculated from gridded climate surfaces for the Park and surrounding area over the last century (Figure 1a) is consistent with this broader regional pattern.

Figure 1. (a) Ten year rolling mean shows average temperatures fluctuating on a multidecadal time scale in GRSM. (b) Linear trend tests show minimum annual temperature decreased by 1.2°C/century in the first half of the 1900's followed by an increase of 1.8°C/century in the past few decades resulting in an overall decrease of 0.5°C/century (calculated by the authors from PRISM data (Daly et al. 1994)).

Temperature anomalies, defined as departures from a long term mean, show multi-decadal fluctuations on the order of 1°C, revealing the influence of low frequency changes in sea surface pressure in the Western and North Atlantic Ocean (Anchukaitis 2006).

Figure 2. (a) Minimum annual temperature decreased in the park over the last century (1895 – 2006). Locations of select weather stations are indicated by black points. (b) Trends in precipitation were slightly positive in GRSM over the last century but were small relative to annual mean precipitation in the Park (calculated by the authors from PRISM data (Daly et al. 1994)).

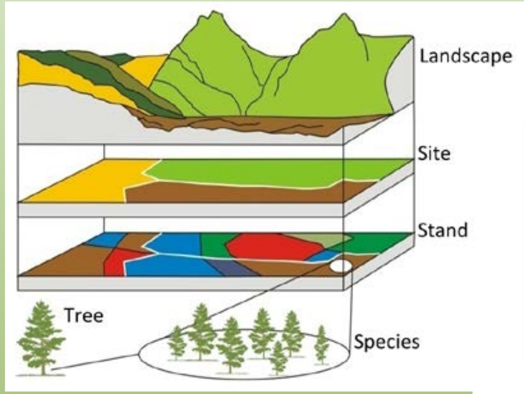
These low frequency oscillations in sea surface pressure are associated with temperature trends that switch from positive to negative every few decades (Figure 1b).

Precipitation showed no significant linear trend over the last century, although tree ring reconstructions for longer time periods for the southeast indicate that the mid to late 20th century was wetter than

LANDSCAPE CLIMATE CHANGE VULNERABILITY PROJECT

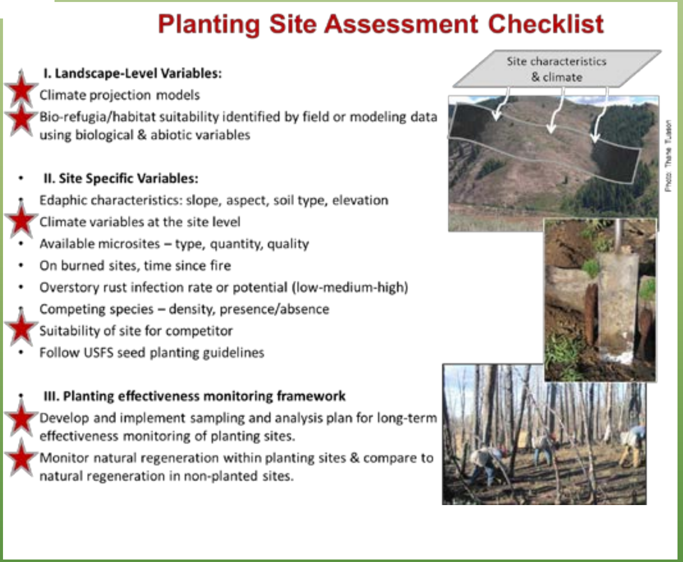
May 2013

Decision Support Tools



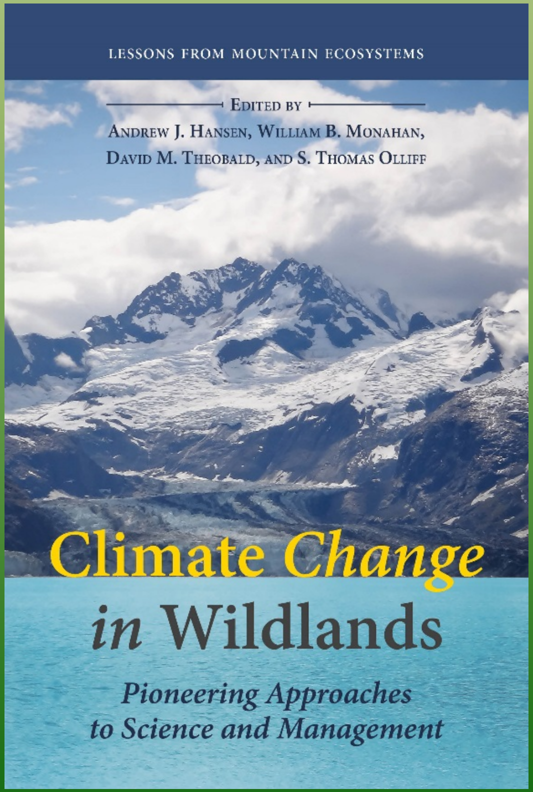
Evaluating Management Alternatives: Simulation Modeling with FireBGCv2

Scale	Description	Processes simulated
Landscape	Extent of simulation area	Fire, ignition, seed dispersal
Site	Same biophysical setting	Weather, soils
Stand	Vegetation communities	PSN, respiration, ET
Species	Trees, shrubs, grasses	Regeneration, Phenology
Tree	Individual tree elements	Mortality, growth, litterfall


Planting Site Assessment Checklist

- **I. Landscape-Level Variables:**
  - Climate projection models
  - Bio-refugia/habitat suitability identified by field or modeling data using biological & abiotic variables
- **II. Site Specific Variables:**
  - Edaphic characteristics: slope, aspect, soil type, elevation
  - Climate variables at the site level
  - Available microsites – type, quantity, quality
  - On burned sites, time since fire
  - Overstory rust infection rate or potential (low-medium-high)
  - Competing species – density, presence/absence
  - Suitability of site for competitor
  - Follow USFS seed planting guidelines
- **III. Planting effectiveness monitoring framework**
  - Develop and implement sampling and analysis plan for long-term effectiveness monitoring of planting sites.
  - Monitor natural regeneration within planting sites & compare to natural regeneration in non-planted sites.

Book



Policy

NPS Revisiting Leopold Implementation Plan
IUCN Climate Adaptation Guide

Publications

22 peer-reviewed papers

Data

Housed in DataBasin and USGS ScienceBase

A Land Health Index to Evaluate Wildland Ecosystems

Sustaining Wildland Ecosystems: Overview of the Problems and Possible Solutions

Andy Hansen, John Gross, Scott Goetz

Sustaining Wildland Ecosystems through Monitoring and Communication to Stakeholders Workshop
February 17-20, 2016
B Bar Ranch in Emigrant, Montana

Assessing Ecological Condition of Wildlands: A Decision Support System

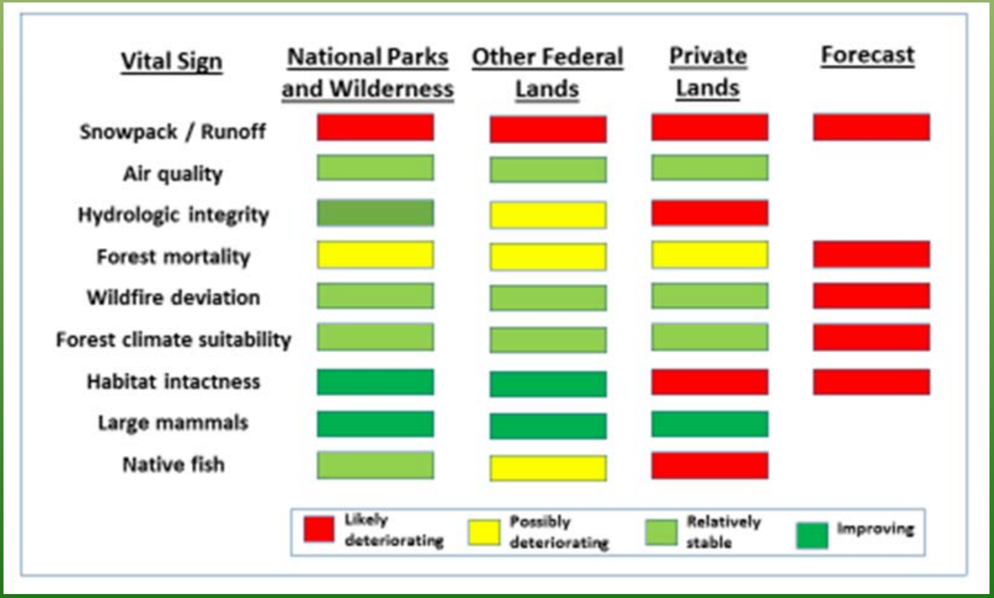
Criteria for Evaluation
Based on goals for wildlands: identify vital signs and assessment criteria

Monitoring of Vital Signs

Evaluating Trends and Condition

Communication and Engagement of Stakeholders

Level 1 Vital Sign	Level 2 Vital Sign	Level 3 Vital Signs
Stressors / Threats	Urbanization Intensive land use	Land cover and use Distance to roads & other infrastructure Integrated human footprint Night lights
Water	Water quantity Flow regime	Snow cover and extent Frozen - non-frozen season timing & duration Stream / river hydrology Soil moisture
Weather and Climate	Seasonality Climate	Climate & meteorology Climate change velocity and novel climates Land surface temperature
Habitat	Ecosystem extent Intactness / pattern Stream intactness Community naturalness	Habitat integrity / intactness Habitat fragmentation & connectivity Canopy structure, height, biomass Stream / river fragmentation
Species	Trophic structure Threatened species	Completeness of animal communities IUCN red-listed species
Ecosystem Processes	Disturbance Plant growth (productivity) Forest structure	Fire & deforestation extent and frequency Annual plant growth rate Start, peak & end of growing season



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NASA Land Cover Land Use Change Program

North Central Climate Sciences Center

Federal agency collaborators