

Integrating Climate Adaptation Strategies into Local Collaborative Forest Management in Northern Colorado



PROPOSERS

Izzy Sofio, MESM 2025
isofio@bren.ucsb.edu | (704) 577 - 2629

Olivia Hemond, MESM 2025
ohemond@bren.ucsb.edu | (978) 460 - 7078

CLIENT

Rob Addington
raddington@tnc.org | (303) 444 - 2950

Director of Forest and Fire Program, Colorado
The Nature Conservancy (TNC)

FACULTY SUPPORT

Joan Dudney, PhD
dudney@bren.ucsb.edu

Assistant Professor of Global Change Ecology
Bren School of Environmental Science and Management

OBJECTIVES

1. Evaluate existing climate adaptation resources to identify best practices in operationalizing climate adaptation in local forest management and to develop equity and environmental justice ratings.
2. Develop recommendations and support tools for local-scale collaboratives (either the Upper South Platte Partnership (USPP) or the Northern Colorado Fireshed Collaborative (NCFC)) to incorporate and operationalize the most fitting and equitable climate adaptation resources into forest management processes.
3. Design an easily accessible and engaging strategic communication plan for USPP or NCFC members to highlight and communicate our findings and recommendations.

IMPLICATIONS: SIGNIFICANCE

Colorado's 24 million acres of forests provide valuable environmental, economic, and social benefits through ecosystem services¹². Healthy forests are critical for improving air quality, ensuring water supply, providing wildlife habitat, sequestering carbon, and generating economic opportunities for rural

communities through recreation and timber¹². However, Colorado's average annual temperatures have increased by 2°F over the last 30 years, with climate models predicting continued temperature increases, earlier snowmelt, more severe drought, and more extreme wildfire behavior resulting in unhealthy forests that are more susceptible to drought, severe wildfire, and insect and disease outbreaks^{1, 8, 10, 20, 22, 25}. Furthermore, the combination of land clearing by Western settlers and the federal fire suppression policies of the twentieth century altered fire regimes in some forest types by excluding fire from the landscape, resulting in today's overly dense forests and large amounts of vegetative fuel^{31, 46}.

The focal area for this project, the northern Colorado Front Range, is an area with high wildfire risk and thus a high priority for adaptive management actions. The region is composed of a mix of forest types, such as ponderosa pine, mixed conifer, lodgepole pine, and aspen; the composition and distribution of these forests are heavily influenced by fire and affect the nature of future fire events¹⁵. Recognizing changing fire regimes in the area, many firesheds in Colorado's Front Range were designated as "high-risk" for community wildfire exposure by the U.S. Forest Service (USFS), and will therefore receive priority for fuel treatments and resource investments^{23, 44}. The federal government has made sizeable investments into forest management in recent years: the Bipartisan Infrastructure Law (BIL) provided the USFS with \$3 billion to reduce wildfire risk, and the Inflation Reduction Act (IRA) designated \$2.15 billion for national forest system restoration and fuels reduction projects^{19, 30, 45}. The recognition of high wildfire risk, paired with the recent influx in funding, has created an opportunity for increased active forest management.

In the context of evolving threats to forest health and increasing support for forest management, there is now a need to operationalize climate adaptation in local-level forest management practices¹⁶. The impacts of climate change on forest ecosystems are well-established by the scientific community, yielding numerous widely available climate adaptation resources that are discussed in the existing literature. While climate adaptation resources are abundant, it is challenging for local land managers to sort through so much information and find relevant, applicable recommendations^{29, 43}. Therefore, managers require assistance to take advantage of the newest scientific resources and operationalize these frameworks at the local level^{16, 43}.

IMPLICATIONS: BACKGROUND

The northern Colorado Front Range forests face several threats that are exacerbated by climate change. One example is the Mountain pine beetle epidemic, which has impacted 3.4 million acres of forest across Colorado due to increasing tree susceptibility to insect attacks and reduction in the generation time of bark beetles^{20, 24}. Additionally, the accumulation of fuels from decades of fire suppression policies and increased drought conditions make forests more at risk of dangerous mega-fires, evident by Colorado's 2020 wildfire season³¹. In 2020, Colorado experienced three record-breaking wildfires¹⁷. The largest wildfire in state history, the Cameron Peak Fire, burned for over four months and across 208,913 acres of the northern Colorado Front Range^{1, 7}. Current conditions and increasing forest mortality risk threaten valuable ecosystem services and underscore a need for climate adaptation, which according to the United Nations (UN) is defined as "changes in processes, practices and structures to moderate potential damages or to benefit from opportunities associated with climate change."¹⁸

Local initiatives like the [USPP](#) and the [NCFC](#) focus on landscape-level resiliency, community protection, and wildfire response and recovery^{2, 42}. Due to the interdisciplinary nature of the collaborative's missions, participation includes a large array of stakeholders (see Appendix A). Climate adaptation resources like the Resist-Accept-Direct (RAD) Framework, the Resistance, Resilience, and Transformation (RRT), and the Climate Change Response Framework are designed to assist land managers and collaboratives like the USPP and NCFC with climate adaptation, but there are currently multiple barriers to implementation^{9, 16, 27, 32, 26}. These barriers include the lack of information about operationalizing such frameworks and managers' perceptions of the complexity of climate change,

limited capacity to address climate adaptation, low confidence in the efficacy of solutions, lack of direction, and most importantly a deficit in locally relevant information¹⁶.

In the following project, Bren students will evaluate existing climate adaptation resources, including decision-making frameworks and planning tools. Using this evaluation, the students will develop targeted recommendations for incorporating and operationalizing adaptation strategies into local-scale collaborative planning and forest management by addressing many of the current barriers to implementation and by advancing actionable solutions for forest resilience in a rapidly changing climate. The project will equip TNC and the USPP or NCFC with an evaluation of climate adaptation resources to support forest health, recovery, and resilience to benefit ecosystems and communities in the northern Colorado Front Range.

EQUITY

This project will prioritize equity and environmental justice in climate adaptation efforts²⁸. *Equity* describes the fair allocation of resources to communities to address disproportionate burdens and ensure equal outcomes. Equitable policies ensure no one group is at a disadvantage. *Environmental justice (EJ)* goes one step further to identify the root causes that led to these disproportionate burdens in the first place. It requires addressing these causes to ensure long-lasting, equitable outcomes.

Forest management decisions in Colorado have ramifications for both communities directly reliant on the forest economy, and those “downstream,” who depend upon the forest’s ecosystem services, such as clean water and air¹. In the United States, vulnerability to wildfire is greater in communities with majorities of Black, Hispanic, or Native American residents¹⁴, and inequitable government responses and resource allocations can perpetuate these disproportionate harms⁶. One cause of these inequities may be that participation in forest management decision-making does not always equally represent the full array of stakeholders^{3,47}. Bearing this context in mind, this project will ensure that local climate adaptation efforts include equity and environmental justice through the following mechanisms:

- **EJ Evaluation of Climate Adaptation Resources:** The team will assess how each climate adaptation framework or tool includes EJ in its data collection, methodology, and applications.
- **EJ Impact Assessment:** When developing local climate adaptation recommendations, the team will review literature to identify modern practices for evaluating EJ impacts of natural resource management decisions^{4, 21}. In addition, the team may identify EJ communities in the area using tools such as EPA’s EJScreen and Colorado EnviroScreen^{11, 36}.
- **Stakeholder Engagement:** When developing the communication strategy, the team will engage with stakeholders and identify opportunities to bring additional voices to the table. For example, the team will explore how to connect Denver-metro area residents, whose clean water and clean air are directly related to healthy, forested watersheds, with forest adaptation management and decisions.
- **Organizational alignment:** Throughout the project, the team will align their actions and engagements with The Nature Conservancy’s strategies for Diversity, Equity, Inclusion, and Justice (DEIJ). TNC’s DEI pillars are: highlighting their people’s contributions towards DEI, centering human rights in their approach to work, amplifying the voices of diverse stakeholders and collaborators, and allocating global resources through a DEI lens³⁴.

AVAILABLE DATA

We plan to use several of the following resources for forest management, as a starting point:

- **Climate Adaptation Frameworks and Informational Resources:** 1) [Climate Change Response Framework](#)^{9, 33}; 2) [Resist-Accept-Direct Framework](#)^{27, 32}; 3) Resistance, Resilience, Transformation Framework²⁶; 4) [Adaptive Silviculture for Climate Change](#)⁵.
- **Climate Adaptation Planning Tools:**
 - [U.S. Forest Service Climate Risk Viewer](#)³⁷: The Beta ArcGIS Online application provides accessibility to geospatial data layers that can overlap resource values with climate exposure,

vulnerability, and current management intent on national forests and grasslands by drawing from 30 datasets. Useful datasets and tools within this application include (but are not limited to) the Climate by Forest Dashboard, the Drought Summary Tool, and Forest Inventory and Analysis data.

- [Colorado Forest Atlas](#)¹³: This web-based portal provides a suite of interactive mapping applications such as the 2020 Forest Action Plan Viewer, The Wildfire Risk Reduction Planner, and The Wildfire Risk Viewer. These applications provide geospatial layers that map priority areas for management, vegetation and geographic features, and fire history.
- [Resilient Land Mapping Tool](#)³⁵: This online map application provides raster layers for resilient sites, recognized biodiversity value, connectivity and climate flow, and resilient and connected networks within the U.S.
- **Literature Review:** We will obtain additional data through published literature and reports on climate adaptation frameworks and tools for forest management.

In addition to data from the above tools, the following datasets are publicly available for geospatial illustration and use in ArcGIS StoryMaps: [National Map Viewer](#) (USGS)³⁸, [National Land Cover Database](#) (USGS)³⁹, [National Agricultural Imagery Program](#) (NAIP)⁴⁰, and [USDA Raster Data Warehouse](#)⁴¹. These datasets include (but are not limited to) raster layers for national forest biomass, national forest types, post-fire vegetation conditions, normalized difference vegetation index (NDVI), and climate conditions.

POSSIBLE APPROACH

1. **Climate Adaptation Assessment:** Complete a literature review to evaluate existing frameworks, informational resources, and planning tools for climate adaptation in forest management. The assessment will include a summary table of strengths and weaknesses of existing frameworks and tools and a rating for how each incorporates equity and EJ.
2. **Climate Adaptation Selection Tool:** Develop a selection tool to assist local collaboratives with climate adaptation planning and operationalizing.
3. **On-the-Ground Application:** Provide recommendations for integrating best climate adaptation practices into USPP or NCFC management plans with input from managers.
4. **Strategic Communication Plan:** Create an easily accessible and engaging strategic communication plan that identifies potential audiences, key insights, communication platforms, and supporting materials (e.g., ArcGIS story map, educational materials, web content).

DELIVERABLES

In addition to a final written report, executive summary, and oral presentation, this team will produce:

- A table and summary of climate adaptation resources including strengths and weaknesses of each approach and an equity and environmental justice rating for decision-makers to use.
- A selection tool (e.g., R Shiny app) providing recommendations for incorporating and operationalizing climate adaptation into USPP or NCFC forest management in the northern Colorado Front Range.
- A communication strategy for Partnership/Collaborative members to use when discussing the benefits of climate adaptation planning with land managers, policymakers, community members, and other local decision-making entities.

INTERNSHIPS

The Nature Conservancy has committed to providing at least one summer internship to further the objectives of this project. It is likely that some level of funding will be available to support the intern(s), though the specific amount has not yet been determined.

SUPPORTING MATERIALS

APPENDIX A - List of USPP and NCFC Stakeholders

- Water providers and watershed coalitions such as Denver Water, Aurora Water, and the Coalition for the Poudre River Watershed
- Local government conservation districts and county-level departments
- Federal agencies: the U.S. Forest Service (USFS), National Park Service (NPS), and the Natural Resources Conservation Services (NRCS)
- State agencies: the Colorado State Forest Service (CSFS)
- Local fire protection districts
- Nonprofit organizations such as the National Forest Foundation, the Ember Alliance, and our client The Nature Conservancy.

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The Nature Conservancy in Colorado
2424 Spruce Street
Boulder, CO 80302

tel [303] 444-2950
fax [303] 444-2986
nature.org/colorado

Master of Environmental Science (MESM) Group Project Committee
Bren School of Environmental Science & Management
University of California, Santa Barbara

January 10, 2024

Subject: Project Proposal – Integrating Climate Adaptation Strategies into Local Collaborative Forest Management in Northern Colorado

Dear MESM Project Review Committee,

The Nature Conservancy is pleased to express its support for and commitment to the project proposal “Integrating Climate Adaptation Strategies into Local Collaborative Forest Management in Northern Colorado.”

The Nature Conservancy in Colorado has long been involved in collaborative forest management on the Colorado Front Range aimed at improving forest health, reducing wildfire risk, sustaining important ecological values and services, and increasing forest resilience to climate change. We recognize the importance of developing climate adaptation strategies for forest management, yet we are also aware of numerous barriers to adoption and implementation faced by land management agencies, especially as they relate to navigating available climate adaptation information and translating concepts into tangible, on-the-ground management approaches.

The proposed project aims to evaluate climate adaptation resources for forest management – including decision-making frameworks and planning tools – with the goal of operationalizing climate adaptation concepts for local-scale management. Additionally, the project will evaluate the extent to which current climate adaptation tools and practices consider equity and environmental justice, an area of growing importance to The Nature Conservancy and partners.

The Nature Conservancy will support this project through mentoring the project participants, providing guidance and oversight of project activities, facilitating communications with local forest collaboratives, and offering at least one summer internship. There are no non-disclosure agreements required for this project.

We appreciate the committee’s consideration of this project and would be excited to work with students from the Bren School, if selected. Please let me know if additional information is needed.

Thank you,

A handwritten signature in dark ink that reads "Rob Addington".

Rob Addington
Forest and Fire Program Director
The Nature Conservancy – Colorado Chapter
Email: raddington@tnc.org; Phone: 970-449-2049