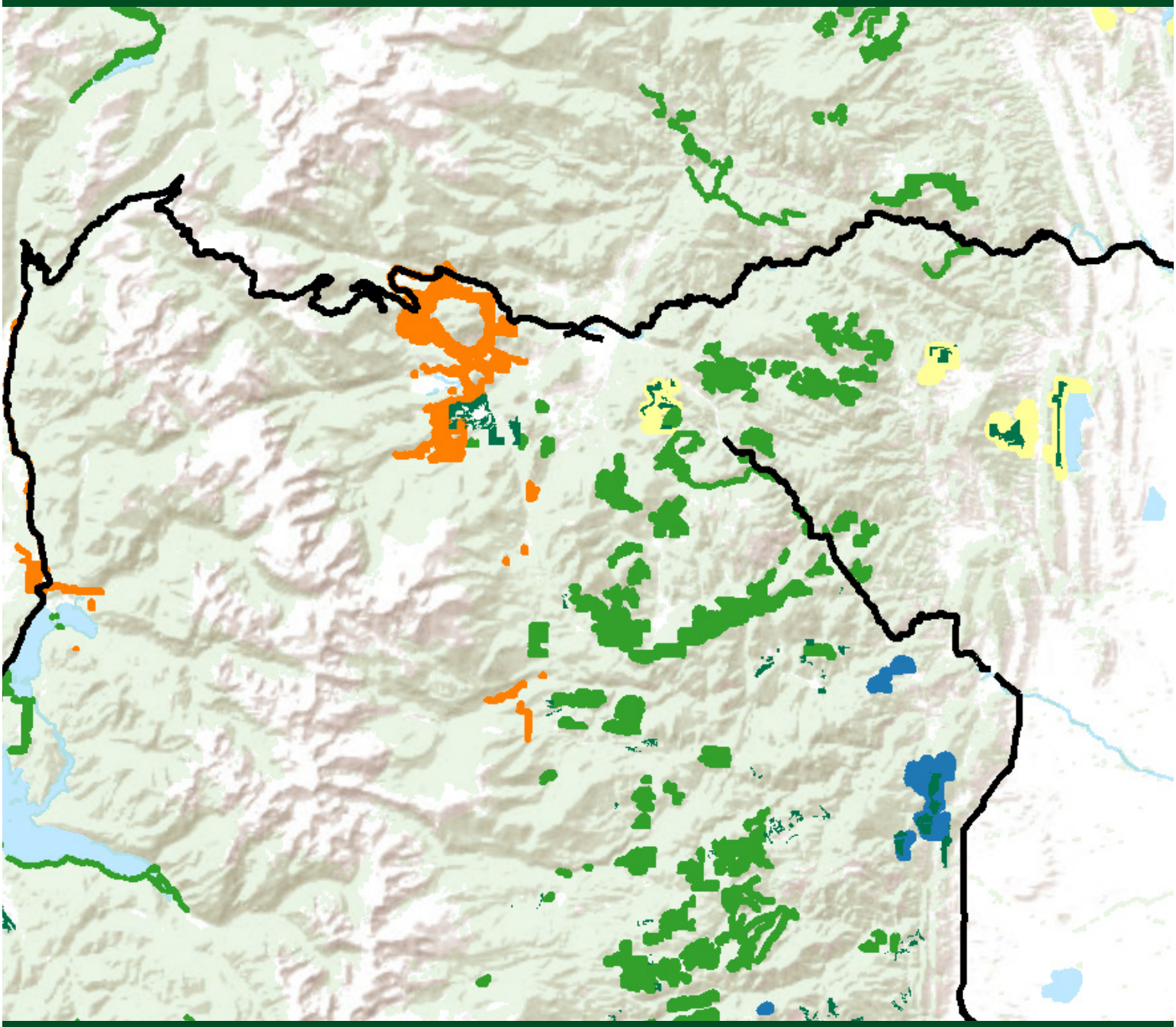
Colorado Interagency Fuel Treatment Database



COLORADO FOREST
RESTORATION INSTITUTE

February 2022
CFRI - 2202

Colorado Forest Restoration Institute

The Colorado Forest Restoration Institute (CFRI) was established in 2005 as an application-oriented, science-based outreach and engagement organization hosted at Colorado State University. Along with centers at Northern Arizona University and New Mexico Highlands University, CFRI is one of three institutes that make up the Southwest Ecological Restoration Institutes, which were authorized by Congress through the Southwest Forest Health and Wildfire Prevention Act of 2004. We develop, synthesize, and apply locally relevant, actionable knowledge to inform forest management strategies and achieve wildfire hazard reduction goals in Colorado and the Interior West. We strive to earn trust through being rigorous and objective in integrating currently available scientific information into decision-making through collaborative partnerships involving researchers, land managers, policy makers, interested and affected stakeholders, and communities. CFRI holds itself to high standards of scientific accuracy and aims to promote transparency in the production and communication of science-based information. Always carefully evaluate sources for rigor and appropriateness before applying in your own work.

CSU Land Acknowledgment

Colorado State University acknowledges, with respect, that the land we are on today is the traditional and ancestral homelands of the Arapaho, Cheyenne, and Ute Nations and peoples. This was also a site of trade, gathering, and healing for numerous other Native tribes. We recognize the Indigenous peoples as original stewards of this land and all the relatives within it. As these words of acknowledgment are spoken and heard, the ties Nations have to their traditional homelands are renewed and reaffirmed.

CSU is founded as a land-grant institution, and we accept that our mission must encompass access to education and inclusion. And, significantly, that our founding came at a dire cost to Native Nations and peoples whose land this University was built upon. This acknowledgment is the education and inclusion we must practice in recognizing our institutional history, responsibility, and commitment.

Document Development: In 2017, CFRI completed a geospatial database of hazardous fuel reduction and forest management activities conducted across private, local, state, and federally managed lands along the Colorado Front Range on behalf of the Front Range Round Table (FRRT). Our current efforts originated from a request by the FRRT to update the 2017 database and report. In consultation with other forest land management stakeholders, CFRI leveraged funding and partner desires to expand the data and reporting across Colorado. This facilitates a better understanding by managers, communities, and researchers regrading where on the landscape fuel treatments are occurring as well as highlighting where minimal forest management has taken place, the spatial and temporal trends associated with those activities, and cumulative effects. Our intent, and the aspirations of the broader forestry community encouraging this project, is that updating and maintaining basic information about fuel reduction and forest restoration treatments on federal and non-federal lands can help track management activities on a multi-jurisdictional landscape to foster learning and improve forest management outcomes.

Acknowledgements:

This project was made possible due to the desire of many partners working in forest management to increase transparency and accessibility of their data. We are indebted to them for their cooperation and data contributions towards a greater good, and value the thoughtful conversations and insights offered by our partners on cross boundary forest management through this process. Brett Wolk provided helpful feedback and manuscript reviews that improved this project and final report. Editing and document layout was completed by Hannah Brown.

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Cover photo credit: Abstract map of fuel treatments in Colorado. Credit: Stephanie Mueller

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COLORADO FOREST RESTORATION INSTITUTE

FOREST AND RANGELAND STEWARDSHIP
COLORADO STATE UNIVERSITY

Table of Contents

Interagency Fuel Treatment Database

As recent wildfires have indicated, there are growing concerns about wildfire risk and forest health in Colorado across a diverse range of landscapes. Numerous federal, state, and local organizations across the state are implementing forest restoration and hazardous fuel reduction treatments in an attempt to address this concern. Accordingly, there is an increasing need to track the activities and accomplishments being implemented by different groups. To this end, the Colorado Forest Restoration Institute (CFRI) is developing a spatial database of forest restoration and fuel treatment projects occurring in Colorado (hereinafter referred to as the Database; Figure 1). Organizations have unique authorities, priorities, and capacity for planning and implementing forest restoration and fuel treatment projects, which occur within diverse landscapes, forest types, and communities across Colorado. This database should help provide a consistent way of tracking accomplishments. It can also help forestry collaboratives and government organizations identify highest-need areas and develop priorities, and could contribute to developing a common understanding of wildfire risk.

The Database compiles and synthesizes spatial data for forest restoration and fuel treatment projects across the state over a 20-year time period (2000 through 2020), so it can help track activities and accomplishments across multiple scales. While it is important to track individual projects, it is also important to track activities at watershed scales. Tracking treatments at both smaller and larger scales can inform adaptive management and monitoring strategies for local groups and forestry collaboratives. Characterizing the cumulative impacts of fuel treatments at a broader landscape scale across the state can inform cross-boundary initiatives by assessing changes in wildfire risk, identifying priority areas for treatment, and improving our understanding of ecosystem recovery and climate change resiliency. Compiling and using coordinated spatial data across the state will enable agencies and stakeholders to better manage landscapes, set priorities, and evaluate if efforts are leading to meaningful progress toward shared goals.

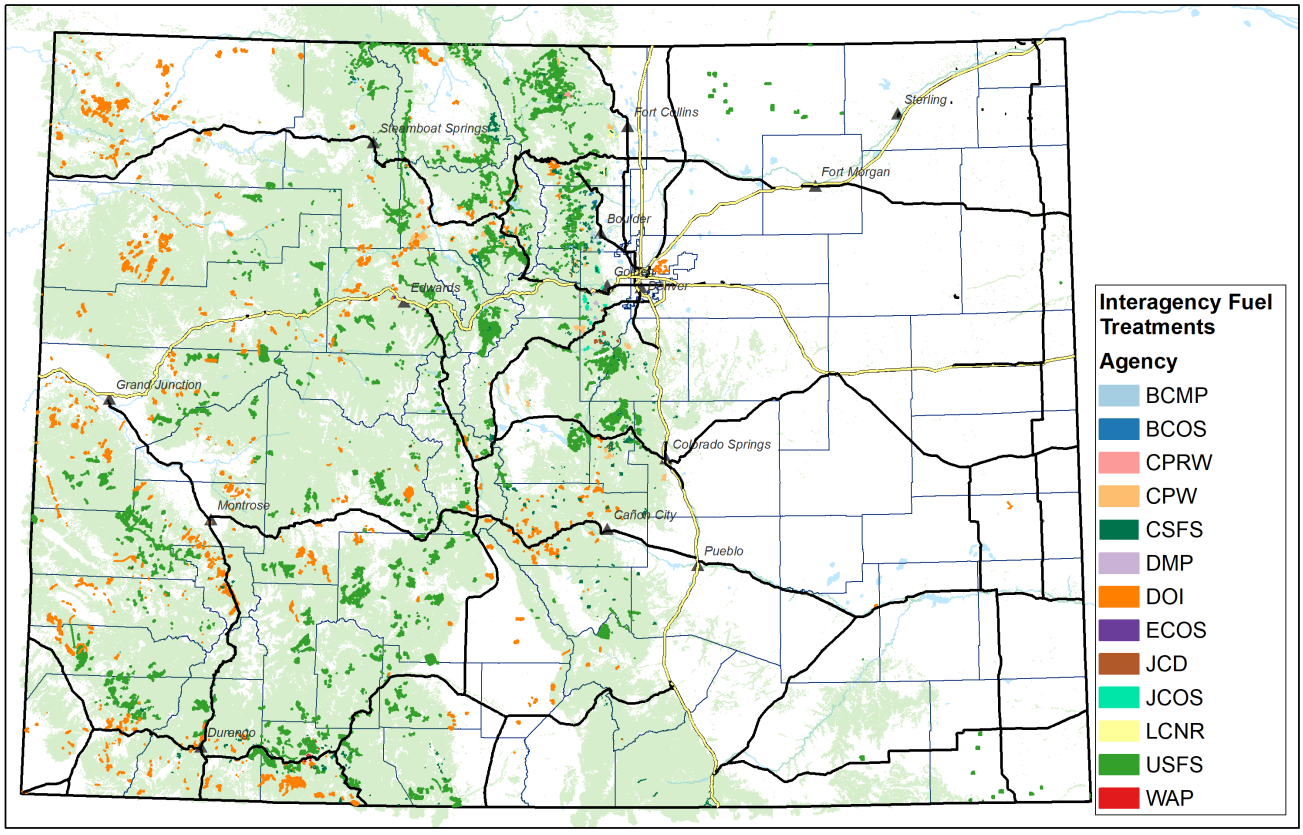


Figure 1. Overview map of interagency fuel treatments included in the Colorado Interagency Fuel Treatment Database.

The first version of the database was constructed on behalf of the Front Range Round Table (FRRT) collaborative partnership in 2016. It sought to catalog geospatial data and information on hazardous fuel reduction and forest management activities implemented on a variety of private, local, state, and federally managed lands. This facilitated tracking and evaluating the impact of treatments across the front range, to better assess costs and benefits, and promote transparency (Caggiano 2017). Multiple organizations requested that CFRI expand the geographic extent to the entire state, to increase its utility and make it more comprehensive. Continuing to expand, update, maintain, and refine basic information about forest restoration and fuel reduction treatments on public and private lands will allow federal, state, and local agencies, as well as other stakeholders to track cumulative accomplishments and gain a better understanding of where on the landscape fuel treatments are occurring.

Data Collection and Database Structure

Vegetation and wildland fuels management activities fall under a wide variety of classifications and terminology. The aim of this interagency treatment database is to inform management activities that physically alter or remove woody vegetation in Colorado, primarily through mechanical cutting and/or removal of woody vegetation, or the application of prescribed fire (Table 1). Other management activities such as herbicidal spraying or grazing can have large impacts on forest structure and wildfire behavior, but were not included in this database.

To collect this data, we solicited spatial data on forest management activities from land management agencies. This included agencies on the Colorado Front Range who had been contacted during our previous interagency treatment database compilation (Caggiano, 2017), and over thirty organizations and forestry collaboratives across the state as informed by the Colorado Collaborative Atlas (Huayhuaca and Reid, 2019). We requested spatial data on forest restoration and forest management activities conducted after 2000. Data was solicited via email in October of 2020, and follow-up calls were made to agency representatives as needed. We received data from 13 agencies (Table 2). Activity data for the US Forest Service and US Department of the Interior was downloaded directly from national corporate datasets, including the Hazardous Fuel Treatment Reduction: Polygon and the National Fire Plan Operations and Reporting System (NFPORS), respectively. Data was provided from at least four additional agencies, but the quality and/or privacy restrictions were not sufficient to include in this analysis at this time.

After collecting data from the organizations, CFRI assessed spatial data extent and attribute information provided by each organization. Treatment data attributes provided by each of the agencies varied widely, with some organizations providing very detailed information and others taking a more streamlined approach. The treatment attributes common across all organizations included: treatment shape and extent, size, dates of treatment, and treatment type. CFRI then undertook some quality control measures as further described below and reformatted data prior to aggregation into the database.

Other attributes were maintained if provided by the contributing agency. This included information like funding source, further description of treatment,

Table 1. List of generalized canopy and surface treatment types in Database.

Database Treatment Field	Treatment Type
Canopy Treatment	Broadcast Burn
	Hand Thin
	Mechanical Thin
	Other Thin
	Patch/Stand Clearcut
	None (surface only)
Surface Treatment	Biomass Removal
	Broadcast Burn
	Chip/Haul
	Lop and Scatter
	Machine Pile
	Mastication
	Manage
	Pile Burn
	None (canopy only)

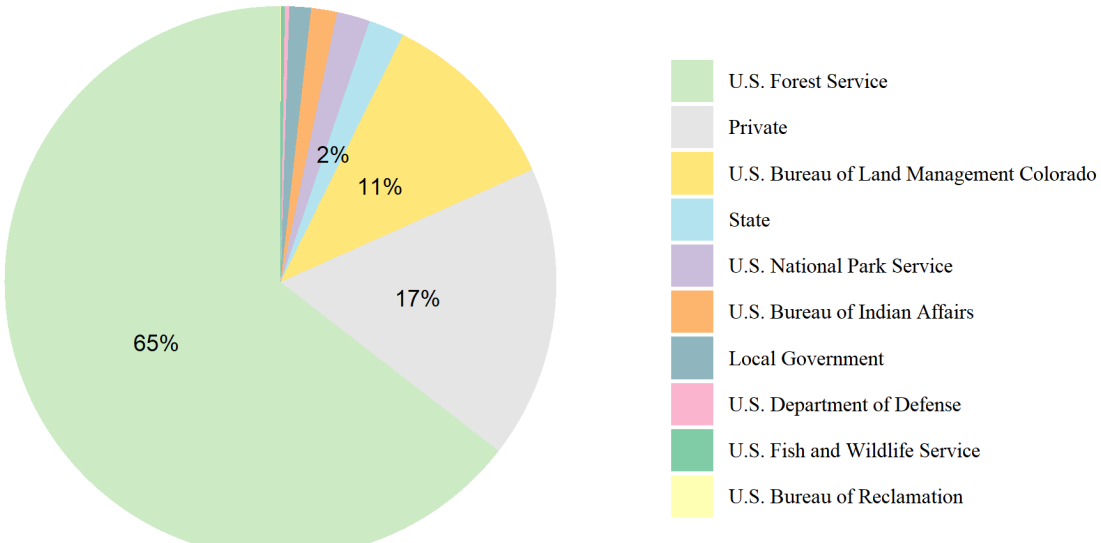
treatment status, and/or related other notes. In some cases, CFRI derived additional treatment characteristics, such as land ownership (Figure 2); however, these fields were not necessary for a treatment to be included into the Database. See metadata for a list and description of Database attributes.

Each treatment was further classified into a broad treatment type or general prescription type for both canopy fuels and surface fuels to allow for additional sorting and analysis (Table 1). Common treatment types for canopy fuels include prescribed fire (broadcast burning), thinning (mechanical thin, hand thin, other thin) or patch/clearcutting (patch/stand clearcut). Common treatment types for surface fuels include biomass removal from site, broadcast burning, chip and haul, lop and scatter, mastication and machine pile or pile burn. Although this approach may be overly simplified in some cases, our aim is to provide standardized information about woody vegetation management activities to provide a snapshot of forest and fire management that informs

Table 2. Treatment Database of contributing agencies with number of treatments and total acres.

Agency		Treatments	Acres
Boulder City Mountain Parks	BCMP	72	1,823
Boulder County Open Space	BCOS	44	1,092
Coalition for the Poudre River Watershed	CPRW	23	1,097
Colorado Parks and Wildlife	CPW	109	14,163
Colorado State Forest Service	CSFS	2,844	84,779
Denver Mountain Parks	DMP	11	1,454
Department of Interior	DOI	5,225	253,243
Eagle County Open Space	ECOS	106	144
Jefferson Conservation District	JCD	43	779
Jefferson County Open Space	JCOS	213	3,982
Larimer County Natural Resources Department	LCNR	83	2,879
US Forest Service	USFS	15,611	1,028,287
Wildfire Adapted Partnership	WAP	24	53
		Total Treated Acres	**1,393,773**

Figure 2. Percent of treatments by land ownership. Land ownership is defined by the BLM Surface Management Agency Geographic Information System (GIS) dataset.



a wide variety of interested stakeholders. In some cases, information provided did not clearly fit into our defined categories, and we classified treatment information using our best judgement to facilitate consolidation of disparate treatments into a single, useable Database. The original label or description of the treatment was retained when provided by the contributing agency.

Wildfires are sometimes classified as treatments and counted as accomplishments in agency reporting. While leveraging wildfires as treatments is important to consider in fuels management, treatments described as wildland fire use were not retained in this Database. CFRI has compiled a separate database of all wildfires across the state from 1984 to 2021, which is unpublished but available upon request. For comparison, since 1990 approximately 3.4 million acres have burned in wildfires in the state of Colorado; throughout the same two decades, agencies have treated approximately 1.3 million acres of forest. When paired together, the Fuels Treatment and Wildfire Databases can contribute to monitoring the effects of treatments on wildfire outcomes or ecosystem services.

It is important to note that overlapping treatments were not aggregated or removed from the Database. Specifically, for the US Forest Service Hazardous Fuel Treatments: Polygon duplication most often occurs when multiple activities are implemented on the same piece of ground, usually as part of a series of connected activities normally considered part of the same treatment. For example, a thinning, followed by a burning activity on the same 100-acre hillside is often represented by two separate, identical polygons. This would be recorded as two records in the Database: first as a mechanical thin with no surface management; and second, as a pile burn with no canopy management. Overlap may also occur where multiple agencies with shared agreements have reported treatment activities in their agency's databases. Any analysis using the Database will need to account for this overlap.

Database Completeness and Data Limitations

This Database represents the first step in collecting and assembling interagency fuel treatment data across multi-jurisdictional boundaries and groups across Colorado. It is difficult to capture all management activities across Colorado or precisely calculate the completeness of the treatment Database, partially because much of the data was self-reported. However, we did obtain data from Department of the Interior agencies and the US Forest Service corporate databases. Federal land constitutes approximately 65% of Colorado's forests, and agencies are legislatively mandated to report public-funded treatments. Because of this, we estimate that we have captured the majority of acreage treated by fuel reduction and forest restoration activities since 2000.

We attempted to contact over 30 organizations; however, we only included data from 13 organizations. Organizations were initially contacted via email and then a follow up phone call. Due to time and/or capacity constraints, some agencies were unable to provide data at this time. Furthermore, treatment contributions from large private landowners are likely underrepresented in the Database if they were not associated with financial or technical assistance from federal or state organizations.

Additionally, treatment data attributes provided by each of these agencies were highly variable. As a result, several treatment polygons were not included in the final combined Database. This often occurred because treatment polygons were lacking important core attributtes, specifically completion date, and a canopy fuel treatment type or surface fuel treatment type. In these cases, the treatments were excluded from the compiled treatment data but were still included in the retained raw data. Finally, treatment boundaries may, in some cases, represent the overall project area and not necessarily the exact area treated. In some cases, agencies did not provide data due to privacy concerns, and in other cases the polygon data which was provided represented the entire parcel on which management occurred instead of the specific extent of the treatment activity within the parcel.

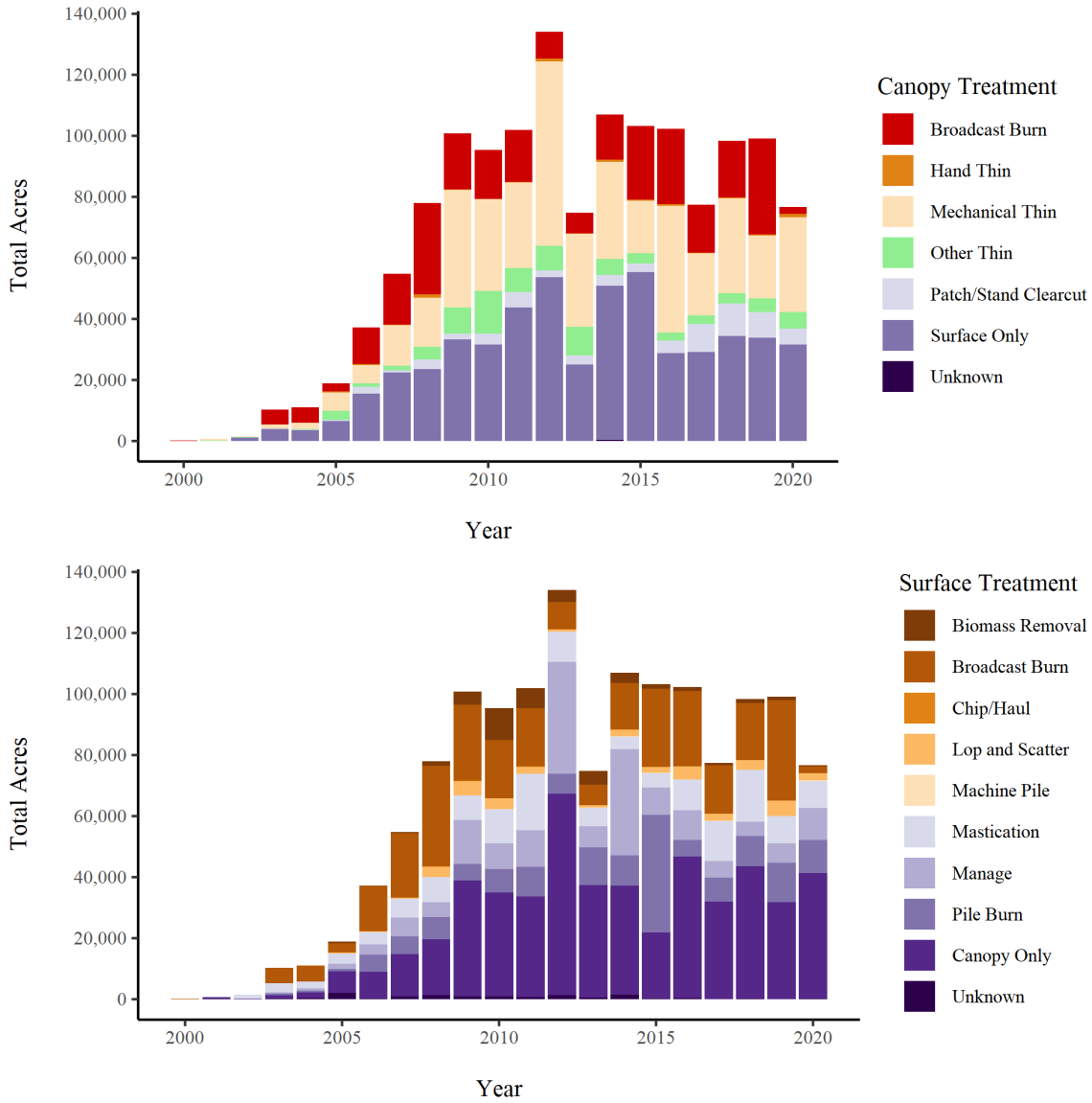
Tracking Accomplishments

CFRI has compiled and aggregated treatment data across the state and is making the dataset available to land management agencies and other stakeholders interested in using it to conduct additional analysis. Below we provide an overview of the database and present several basic analyses which better describe the organizations implementing treatments, the types of treatments, treatments over time, and treatment size in Colorado. Overall the dataset consists of treatment data from thirteen organizations consisting of 24,408 unique treatment extents totaling 1,393,773 acres (Table 2) across federal, state, and private lands (Figure 2). In addition to using the database to track accomplishments statewide, we provide several examples of additional analyses that could be conducted using the treatment database. Some of these analyses may require additional data.

Potential analyses:

1. Track treatments over time to see if the pace and scale of treatments is increasing (Figure 3).
2. Assess the average size of treatments by type to evaluate if treatments are meeting the scale of restoration necessary to make meaningful change (Figure 4).
3. Focus on a particular watershed or area of interest to assess if organizations are meeting treatment goals.
4. Use treatment data in conjunction with wildfire footprint or burn severity data to assess treatment effectiveness.

Figure 3. Total acres treated by canopy type (top) and surface type (bottom) from 2000 to 2020.



5. Compare treatment accomplishments between categories to understand the relationship between mechanical treatments and prescribed fire, and where treatment types are occurring.
6. Assess if treatments are being prioritized in critical watersheds or the wildland urban interface.
7. Assess the extent to which treatments are occurring across land ownership boundaries.

Database Structure, Maintenance, and Availability

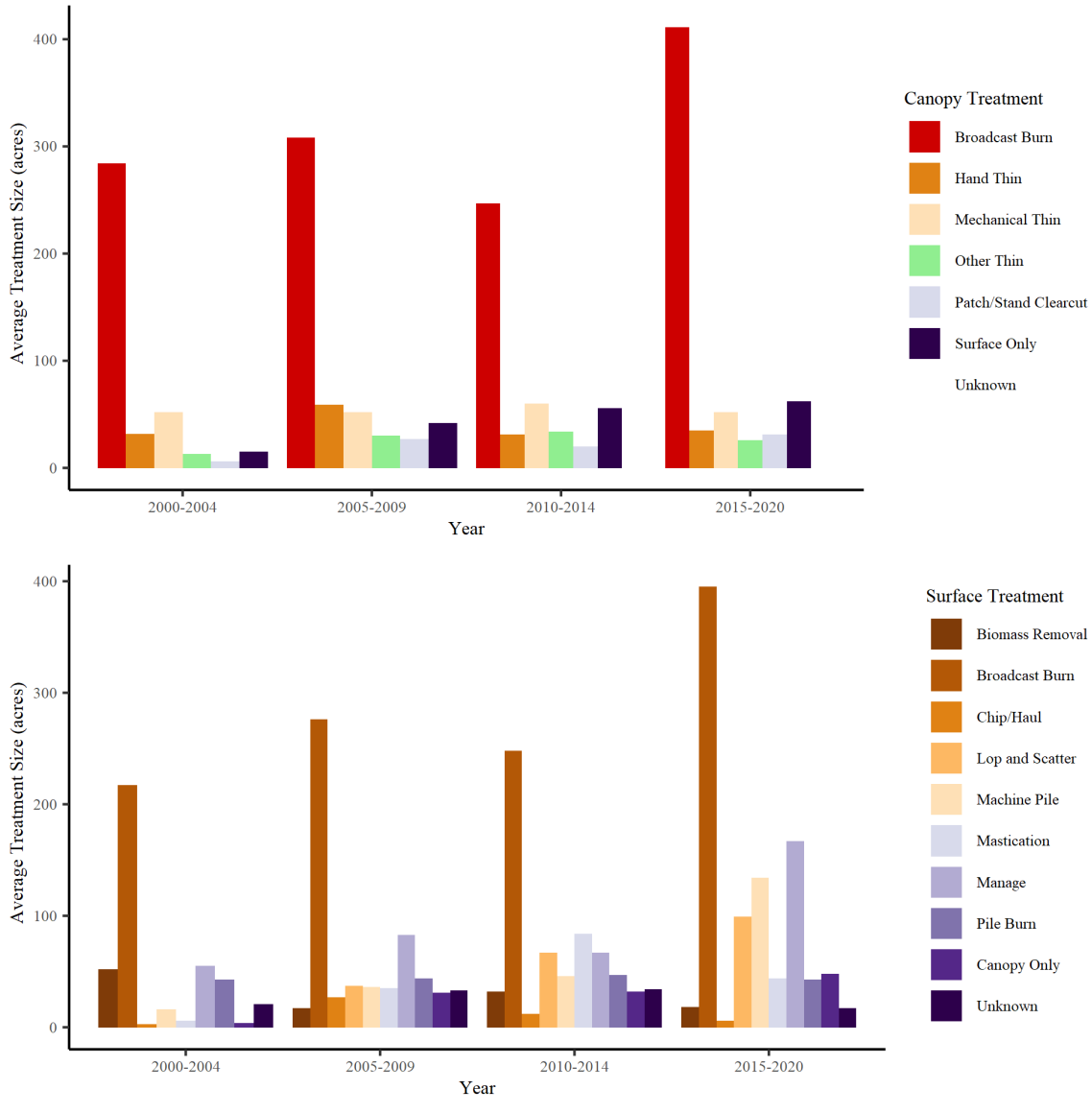
In an effort to make the data available and useful for organizations and other interested stakeholders, this data will be available by request through the CFRI website. Note these data are dynamic and may change over time, and users should be aware of the limitations in the geospatial data prior to use. CFRI will work with Southwest Ecological Restoration Institute (SWERI) partners in New Mexico and Arizona to update and increase the scope of the Database with funding from the 2021 Infrastructure Investment and Jobs Act within the next five years. To request a copy of the database please contact Stephanie Mueller or Michael Caggiano (contact information above and at cfri.colostate.edu).

References

Caggiano, M.D. (2017). Front Range Round Table 2016 Interagency Fuel Treatment Database. Fort Collins, CO: Colorado Forest Restoration Institute.

Huayhuaca, C., & Reid, R.S. (2019). The atlas of collaborative conservation in Colorado. Fort Collins, CO: Colorado State University.

Figure 4. Five-year average treatment size by canopy (top) and surface (bottom) treatment type from 2000 to 2020.



Appendix: Metadata

Database Feature Datasets and Feature Classes

Interagency_Fuel_Treatments:

Feature class containing the aggregated hazardous fuel treatments from contributing agencies that contained at least baseline data, including treatment date and treatment type (general prescriptions). Data underwent reformatting and quality control, and canopy and surface fuel treatments were classified into one of several general treatment prescriptions. See Interagency_Fuel_Treatments Attributes for information on fields contained within this feature class.

Interagency_Fuel_Treatments Attributes

Attribute Label: OBJECTID
Attribute Definition: Internal feature number.
Attribute Definition Source: ESRI
Attribute Domain Values:
Unrepresentable Domain: Sequential unique whole numbers that are automatically generated.

Attribute Label: SHAPE
Attribute Definition: Geometry data type.
Attribute Definition Source: ESRI
Attribute Domain Values:
Unrepresentable Domain: Data type field automatically generated.

Attribute Label: TRT_NAME
Attribute Definition: Name given to the treatment by the originating agency. Not all agencies provided names for treatments.
Attribute Definition Source: Originating agency defined.

Attribute Label: AGENCY
Attribute Definition: Name of the unique organization that provided the data.
Attribute Definition Source: Originating agency defined.

Attribute Label: AGENCY_C
Attribute Definition: Acronym or code for the name of the unique organization that provided the data.
Attribute Definition Source: Originating agency defined or CFRI.

Attribute Label: FUNDING
Attribute Definition: Funding agency
Attribute Definition Source: Originating agency defined.
Attribute Domain Values:
Unrepresentable Domain: Funding agency

Attribute Label: LANDOWNER
Attribute Definition: The landowner as defined by the Surface Management Agency Geographic Information System (GIS) dataset, which depicts Federal land for the United States and classifies this land by its active Federal surface managing agency.
Attribute Definition Source: Compiled and maintained by the U.S. Department of Interior, Bureau of Land Management (BLM)

Attribute Label: CANOPY
Attribute Definition: General description of the fuel treatment type for canopy or overstory fuels. Treatment types are broadly generalized into one of eight categories.
Attribute Definition Source: CFRI
Attribute Domain Values:
Enumerated Domain:
Enumerated Domain Value: Broadcast Burn
Enumerated Domain Value Definition: Any prescribed burning activity where fire is applied generally to most or all of an area within well-defined boundaries for reduction of fuels.

Enumerated Domain:
Enumerated Domain Value: Hand Thin
Enumerated Domain Value Definition: Selective thinning of trees and shrubs for hazardous fuels reduction purposes by hand.

Enumerated Domain:
Enumerated Domain Value: Mechanical Thin
Enumerated Domain Value Definition: Selective thinning of trees and shrubs for hazardous fuels reduction purposes using mechanical equipment.

Enumerated Domain:
Enumerated Domain Value: None
Enumerated Domain Value Definition: No canopy treatment was performed.

Enumerated Domain:
Enumerated Domain Value: Other Thin
Enumerated Domain Value Definition: Selective thinning of trees and shrubs for hazardous fuels reduction purposes. Method of thinning uncertain.

Enumerated Domain:
Enumerated Domain Value: Patch/Stand Clearcut
Enumerated Domain Value Definition: Patch of whole Stand clearcut or thinning method that removes most trees in the stand.

Enumerated Domain:
Enumerated Domain Value: Unknown
Enumerated Domain Value Definition: Treatment type unknown. If both canopy and surface treatments are unknown, polygon not included in the Database.

Attribute Label: SURFACE
Attribute Definition: Internal feature number.
Attribute Definition Source: ESRI
Attribute Domain Values:
Enumerated Domain:
Enumerated Domain Value: Biomass Removal
Enumerated Domain Value Definition: Removal of biomass from site after treatment.

Enumerated Domain:
Enumerated Domain Value: Broadcast Burn
Enumerated Domain Value Definition: Any prescribed burning activity where fire is applied generally to most or all of an area within well-defined boundaries for reduction of fuels.

Enumerated Domain:
Enumerated Domain Value: Chip/Haul
Enumerated Domain Value Definition: Breaking down/or slicing of trees, changing the size or shape into smaller pieces and removal from site.

Enumerated Domain:
Enumerated Domain Value: Lop and Scatter
Enumerated Domain Value Definition: Cutting of smaller trees or slash into smaller pieces and scattering the pieces throughout the site.

Enumerated Domain:
Enumerated Domain Value: Machine Pile
Enumerated Domain Value Definition: Piling of large woody materials with the intent to burn or remove at a future date.

Enumerated Domain:
Enumerated Domain Value: Manage
Enumerated Domain Value Definition: Activity of treating surface fuels occurred but was vaguely or not clearly defined. Generally, this category includes treatment where limited manual and/or hand removal/scattering fuels was carried out.

Enumerated Domain:
Enumerated Domain Value: Mastication
Enumerated Domain Value Definition: Breaking down of woody material into smaller pieces and distributing them on the ground surface using mechanized equipment.

Enumerated Domain:
Enumerated Domain Value: None
Enumerated Domain Value Definition: No canopy treatment was performed.

Enumerated Domain:
Enumerated Domain Value: Pile Burn
Enumerated Domain Value Definition: Burning of piled material including hand and machine piles and decks.

Enumerated Domain:
Enumerated Domain Value: Unknown
Enumerated Domain Value Definition: Treatment type unknown. If both canopy and surface treatments are unknown, polygon not included in the Database.

Attribute Label: DESCRIBE
Attribute Definition: Description of treatment or additional information on treatment provided by originating agency.
Attribute Definition Source: Originating agency defined.

Attribute Label: DATE_PLAN
Attribute Definition: The date that work was planned to be accomplished.
Attribute Definition Source: Originating agency defined.
Attribute Domain Values:
Unrepresentable Domain: Date field.

Attribute Label: DATE_COMP
Attribute Definition: The date that work is physically completed.
Attribute Definition Source: Originating agency defined.
Attribute Domain Values:
Unrepresentable Domain: Date field.

Attribute Label: STATUS
Attribute Definition: Current status or completeness of the treatment.
Attribute Definition Source: Originating agency defined.
Attribute Domain Values:
Enumerated Domain:
Enumerated Domain Value: complete
Enumerated Domain Value Definition: Treatment completed. Treatment is assumed to be completed if the treatment date provided is prior to the current year unless otherwise noted by the originating agency.

Enumerated Domain:
Enumerated Domain Value: complete (pile burn incomplete)
Enumerated Domain Value Definition: Thinning treatment completed except pile burns expected to be conducted at a future date.

Attribute Label: ACRES
Attribute Definition: Area in acres as calculated in ArcGIS.

Attribute Definition Source: ESRI
Attribute Domain Values:
Enumerated Domain:
Enumerated Domain Value: acres
Enumerated Domain Value Definition: Area

Attribute Label: NOTES
Attribute Definition: Notes or additional relevant information provided by the originating agency.
Attribute Definition Source: Originating agency defined or CFRI.

Attribute Label: ORGFILE
Attribute Definition: Name of the original feature class containing the RAW data provided directly from the Originating agency.
Attribute Definition Source: Originating agency defined.

Attribute Label: Shape_Length
Attribute Definition: Shape length.
Attribute Definition Source: ESRI
Attribute Domain Values:
Unrepresentable Domain: Shape length is automatically generated and maintained in ArcGIS.

Attribute Label: Shape_Area
Attribute Definition: Shape area.
Attribute Definition Source: ESRI
Attribute Domain Values:
Unrepresentable Domain: Shape area is automatically generated and maintained in ArcGIS.

Attribute Label: UPDATED
Attribute Definition: Date data was processed and uploaded to Database.
Attribute Definition Source: Date