

Appendix G – Colorado Statewide Forest Resource Assessment

Departure from Modeled Historical Conditions

Forest condition or health can be assessed by examining the interactions between three forest components: resilience to disturbance; ability to sustain a natural range of biological diversity; and ability to meet the current and future needs of people in terms of values, products and services. The majority of Colorado’s forested landscapes are considered disturbance driven, meaning their condition is integrally linked with natural cycles of wildfire and insect and disease infestations as well as periodic flooding, avalanches or windstorms. Without this regular rejuvenation, forests can become more crowded and less diverse than they were in the past. The stress of competing for sunlight, water and other essential resources under these conditions leaves trees extremely vulnerable to insect and disease activity, fire or drought, and sets the stage for much faster and more devastating events to move across the landscape¹.

Lack of regular disturbance is a primary cause of many of Colorado’s forest health challenges. More than a century of fire exclusion, in addition to inconsistent or changes in land management priorities and practices, have left many of the state’s forests highly susceptible to wildfire, insects and disease. Recent cycles of drought and warmer winter temperatures have exacerbated this situation. Land managers need to examine forest conditions and determine where forest management is necessary to restore resiliency to the landscape. Some areas will need constant intervention through direct management, especially where the risk of fire may be high and human lives and values are at risk. Other areas may be managed through fire use and other means to allow nature to essentially take its course.

- **Restore fire-adapted lands and reduce risk of wildfire impacts**

Overview: Although fire is one of many processes that operate within a forest, it often is such a dominant process that it can largely determine the composition, structure and dynamics of an entire ecosystem. Over thousands of years, forests and associated vegetation have adapted to specific cycles and intensity of fire. Adaptations such as thick bark or serotinous cones enable forests to respond favorably to naturally recurring events. When fire does not occur in these historic cycles, forest resilience can decrease and those fires that do occur can be severe enough to cause long-term damage to soil, vegetation, wildlife and other ecosystem components².

In an effort to better classify the role fire plays in various ecosystems, scientists have identified five primary fire regimes that describe the frequency and characteristics of historic (presettlement) natural fires. In Fire Regime I, for example, fires return every 1 to 35 years, are of low to mixed severity, and generally replace less than 25 percent of the dominant overstory vegetation. In Fire Regime V, fires occur every 200 years or more and usually are stand-replacing. In recent years, scientists and land managers have developed an additional method to classify and assess the role of fire using Fire Regime Condition Class (FRCC). This classification ranks ecosystems from 1 to 3 based on their level of departure

¹ From the 2002 *Report on the Health of Colorado's Forests* online at <http://csfs.colostate.edu/pdfs/02fhr.pdf>

² Pyne, S. J. 1996. *Nouvelle Southwest*. In: Covington, W. and Wagner, P. K., editors. *Conference on Adaptive Ecosystem Restoration and Management: Restoration of Cordilleran Conifer Landscapes of North America: Flagstaff, AZ, June 6-8, 1996*. General Technical Report RM-GTR-278. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.

from a set of historical reference conditions that reflect vegetation and structure that experts believe existed prior to European settlement³.

In Colorado, LANDFIRE data indicate that 6.8 million acres have significantly departed from the reference conditions expected for their particular forest types. The primary cause of this departure is a management regime that virtually excluded fire from the landscape for more than a century. Fire exclusion has been particularly damaging to forests in Colorado, including ponderosa pine, mixed conifer and piñon-juniper, all of which evolved with frequent, low- to moderate-intensity fires.

Analysis: Forest management, such as mechanical thinning of overly dense stands and use of prescribed fire, can reduce unwanted wildfire impacts by increasing forest resilience and restoring fire to a more natural role on the landscape. *(Note: it often is necessary to conduct silvicultural or fuels treatment before prescribed fire can be used safely.)* In Colorado's Statewide Forest Resource Assessment, three data layers were analyzed to identify areas where forest management could be beneficial in restoring fire-adapted ecosystems and reducing the risk of fire impacts to both the environment and human infrastructure. The layers are focused on ecological departure, wildfire susceptibility and potential for wildfire intensity. While these layers are useful on their own, they also can provide valuable information when combined with other data related to water supply, wildlife habitat, recreation and the wildland-urban interface.

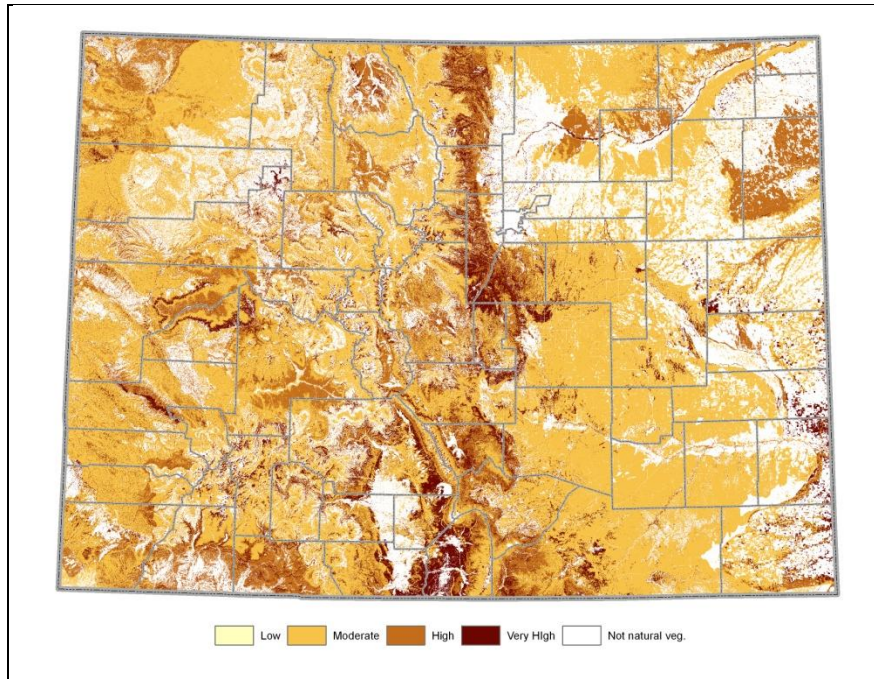
- **Ecological Departure**

The assessment team worked with LANDFIRE and a team of forest ecology experts to develop a data layer ranking forests across the state according to their level of departure from pre-settlement conditions. Examples of these conditions include the composition and structure of vegetation, and surface and canopy fuel characteristics. *(Note: available data was limited because stand-level information and conditions had to be extrapolated for landscape-level analysis.)*

Data reveal 6.8 million acres of forest vegetation and structure significantly departed from the historic range of conditions. Areas ranked high to very high could benefit from management to restore more resilient ecological conditions and to prevent wildfires of unnatural size or severity.

High levels of departure from historical models are most evident in the state's ponderosa pine forests; nearly 75 percent of this forest type is in the high to very high departure categories. The ecology work group was asked to identify forest types where the level of departure was specifically linked to fire exclusion, thus indicating heightened concern over damage from ecologically inappropriate fire (based on fire size and/or severity). The group identified a high level of concern for lower-montane ponderosa pine and mixed-conifer forests, and a moderate level of concern for the upper-montane components of those forests. All other forest types were of low concern with regard to this particular question.

³ FRCC Guidebook http://frames.nbj.gov/documents/frcc/documents/FRCC+Guidebook_2008.10.30.pdf.



Map 1 – Modeled Ecological Departure from Historic Structure & Conditions

ACRES	Modeled Departure From Historical Conditions				Total
	Low	Moderate	High	Very High	
Spruce-Fir	433,571	3,704,524	286,161	78,162	4,502,417
Lodgepole	287,952	1,328,056	21,666	18,215	1,655,890
Aspen	1,908,230	2,417,671	591,292	116,939	5,034,132
Mixed Conifer	140,382	421,827	493,805	720,027	1,776,041
Ponderosa Pine	176,432	459,115	1,214,376	658,144	2,508,068
Montane Riparian	37,323	235,945	399,116	242,724	915,109
Piñon-Juniper	762,893	3,360,931	734,354	281,343	5,139,521
Oak Shrubland	789,235	836,645	502,979	212,668	2,341,527
Plains Riparian	5,427	15,827	71,517	135,838	228,608
Introduced Riparian	7,416	11,874	61,838	29,313	110,440
Total	4,548,862	12,792,415	4,377,104	2,493,373	24,211,753

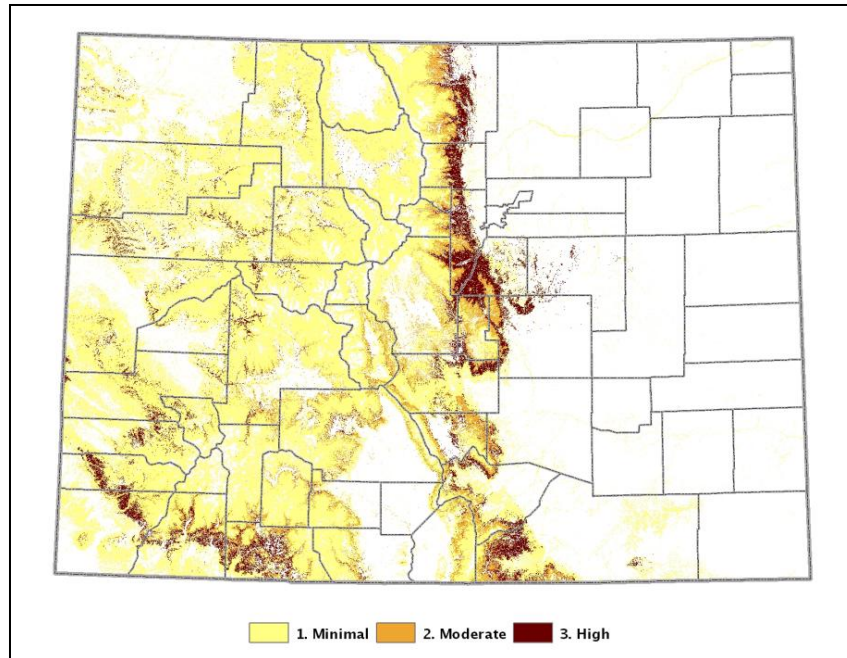
Table 1A – Departure from Historical Conditions by Forest Type (acres)

Owner	Low	Moderate	High	Very High	Total
USFS	2,299,578	6,585,738	1,473,184	853,510	11,212,010
BLM	600,559	2,641,738	629,773	364,001	4,236,071
NPS	29,743	280,595	54,004	19,557	383,899
USFWS	281	4,559	2,601	4,553	11,994
DOD	23,322	5,782	7,734	12,216	49,055
Federal-Other	2,708	2,344	3,620	890	9,561
State	108,105	252,903	138,552	84,518	584,078
Tribe	101,149	128,881	131,833	37,589	399,452
Local Govt.	9,545	33,661	64,331	48,574	156,110
Private	1,371,423	2,848,154	1,868,499	1,066,240	7,154,316
Total	4,546,413	12,784,354	4,374,131	2,491,649	24,196,547

Table 1B – Departure from Historical Conditions by Ownership (acres)

Although Colorado’s lodgepole pine forests do not rank as highly departed in this analysis, many ecologists and land managers believe that the current bark beetle epidemic in high-elevation forests is a result of significantly more even-aged and less diverse stands than would have existed historically. Also suggested is that the changes in fuels resulting from loss of needles, the accumulation of large, deadfall trees on the ground, and potential for increased growth of grasses, forbs and shrubs could significantly increase the risk of wildfire impacts in the future. The impacts of the beetle epidemic, especially combined with large-scale wildfires, would greatly increase the homogeneity of the landscape. It is critical that large areas of regenerating lodgepole pine stands be managed to help restore and maintain greater diversity. Research is underway to begin resolving these areas of uncertainty⁴.

⁴ Joint Ecology Working Group Front Range Fuels Roundtable – Colorado Bark Beetle Cooperative Working Group Summary http://www.frftp.org/docs/JointEcologyWorkingGroup_LodgepolePineOnePageSummaries.pdf.



Map 2 – Areas of Concern Due to Fire Exclusion

- **Departure from Modeled Historical Conditions**

Departure from modeled historical conditions indicates the difference between current vegetation composition and structure, and modeled composition and structure conditions at the time of pre-European settlement. LANDFIRE refers to the data layer as Fire Regime Condition Class (FRCC) departure index, but in actuality, the LANDFIRE National FRCC data layer describes changes in vegetation composition and structure, and is only partially related to fire⁵. Land conversion and management practices also impact departure.

FRCC is the departure index divided into three equal categories: FRCC 1 corresponds to a departure index of 0-33 percent; FRCC2 34-66 percent; and FRCC3 67-100percent.

Methods (by LANDFIRE)

Modeled conditions at the time of pre-European settlement were obtained by simulating natural vegetation succession and disturbance over many hundreds of years using models developed by local experts. Results of several simulations were integrated to create an historic approximation of the percent of vegetation in each vegetation class (e.g., early seral, late seral, etc.). See Table 2A for an example of the modeled conditions for the southern Rocky Mountain ponderosa pine woodland biophysical setting⁶.

⁵ Smith, J. - personal communication, 2009.

⁶ Departure Index- FRCC departure index, LANDFIRE, 2006, <http://www.landfire.gov>.

Class	Description	Percent In Class
A	Openings with up to 10% cover by overstory dominated by ponderosa pine and sometimes Douglas-fir. Some openings may persist.	10%
B	Greater than 50% canopy cover in the northern Front Range (above c. 6,500ft) and >30% canopy cover in the southern Front Range.	10%
C	Greater than 50% canopy cover in the northern Front Range (above c. 6,500ft) and <30% canopy cover in the southern Front Range.	25%
D	Less than 50% canopy cover in the northern Front Range (above c. 6,500ft) and <30% canopy cover in the southern Front Range.	40%
E	Greater than 50% canopy cover in the northern Front Range (above c. 6,500ft) and >30% canopy cover in the southern Front Range.	15%

Table 2 A. Example of Pre-European Conditions

(Taken from the LANDFIRE National Model Description of the southern Rocky Mountain ponderosa pine woodland biophysical setting)

Current vegetation age class and structure were estimated from data layers derived from LANDSAT TM imagery (1999-2001). LANDFIRE national FRCC is computed for each biophysical setting (BpS) for each ecological subsection.

Class	A	B	C	D	E
Pre-European	10%	10%	25%	40%	15%
Current	10%	53%	32%	4%	1%
Similarity	10%	10%	25%	4%	1%

Table 2 B. Departure Index

The departure index is computed as 100 minus Similarity, where Similarity is the sum of the minimum of Pre-European and Current percentage across the seral stages^{7,8}). See below for an example using the southern Rocky Mountain ponderosa pine woodland (values are approximate). For this example, the departure from modeled historical conditions is 50 percent, 100 minus the total Similarity (the sum of the final row).

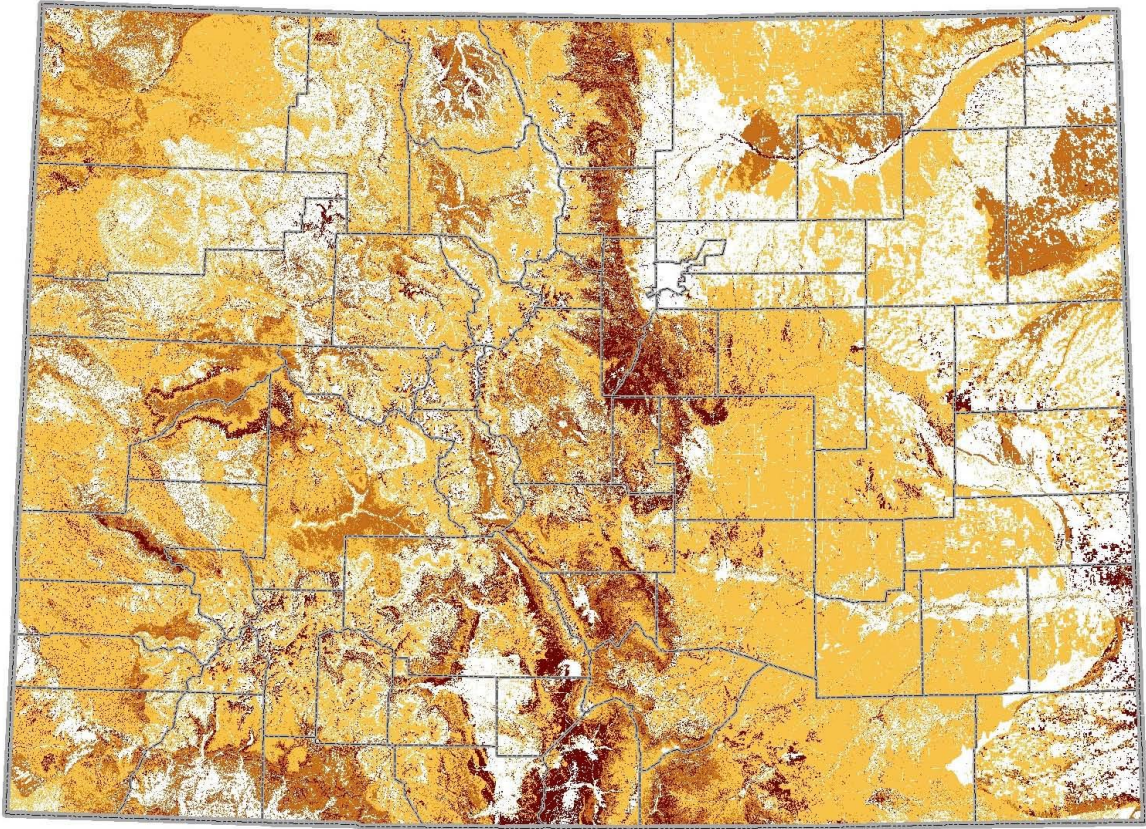
Ranking

Departure index values were categorized into equal intervals in a similar fashion to FRCC. Whereas FRCC divided the departure index into three equal (33 percent) categories, we used four equal 25 percent categories (low, moderate, high and very high departure).

⁷ Smith, J. - personal communication, 2009.

⁸ Hann, W.; Shlisky, A.; Havlina, D.; Schon, K.; Barrett, S.; DeMeo, T.; Pohl, K.; Menakis, J.; Hamilton, D.; Jones, J.; Levesque, M.; Frame, C. 2004. Interagency Fire Regime Condition Class Guidebook. Last update January 2008: Version 1.3.0 [Homepage of the Interagency and The Nature Conservancy fire regime condition class website, USDA Forest Service, US Department of the Interior, The Nature Conservancy, and Systems for Environmental Management] at www.frcc.gov.

Departure Index



Low Moderate High Very High Not natural veg.