Unit 12 Ashland Forest Resiliency 2015 prescribed burn
Composite Burn Index (CBI) fire effects monitoring

Keith Perchemlides, The Nature Conservancy, February 19, 2016

Unit name: AFR Unit 12
Burn Date: April 30, 2015
Lead: *Forest Service, Siskiyou Mt. Ranger District*
RXB2: Jeremy DeLack
Fuel Types: Mixed timber, timber understory, shrub
Primary Fuel Model: TL3
Acres Planned: 78
Acres Burned: 30

Purpose and Resource Management Goals

This burn was a Stewardship project with the U.S. Forest Service, City of Ashland, Lomakatsi Restoration and The Nature Conservancy as part of the Ashland Forest Resiliency (AFR) project. Management goals included reducing forest fuel loads and reintroducing beneficial fire to achieve ecological restoration while protecting wildlife habitat features. The burn unit is located in an easily accessible area of high public use making it important for demonstration and outreach goals.

Specific Prescribed Fire Objectives

From the Forest Service Unit 12 burn plan (DeLack 2014, p. 10):

1) Reduce 60-95% of existing brush, small trees (<5"dbh), and hardwood stump sprouts
2) Limit mortality of small trees (5-11" dbh) to 40% or less with fire within 1 year post burn
3) Retain at least 90% conifer and hardwood trees 11-24" dbh
4) Retain at least 95% conifer and hardwood trees greater than 24" dbh
5) With fire, consume the following fuels:
    - 1 hour – 50-90%
    - 10 hour – 30-60%
    - 100 hour – up to 30%

Addition resource objective constraints:

6) Minimize fire intensity within the two fisher blocks located in the unit and maintain the existing canopy cover.
7) Maintain 90% large down woody material and snags over 15" dbh that do not pose a hazard to personnel or the public.
8) Retain 70% effective soil cover through application of fire leaving unburned mosaic patches.

Site Description

The 2015 burn unit covered approximately 30 acres of mixed conifer and hardwood forest with patchy shrub openings within the northern half of the larger 78-acre planning Unit 12 (see Map 1). Pre-burn the characteristic fuel model was timber-litter series TL3 (Scott and Burgan 2005). The unit is steep (45% slope) with a generally west-facing aspect. Public trails and a road with trail-head parking surround the unit. The 30-acre 2015 unit was defined by a constructed handline (~2 foot width) around the full perimeter, tying-in with public trails to the west and east. A Pacific Fisher habitat protection area (block) lies just outside the western edge of the unit. The unit had been recently thinned and pile-burned to reduce surface and ladder fuels.

Prescribed Fire Implementation Summary

Burn operations were completed within a single day by a team of Forest Service and City of Ashland staff. Positive results from a test fire at 1030 led to active ignitions starting at 1045. Ignitions were briefly suspended at 1330 to resolve issues with a homeless camp discovered within the unit, then resumed by 1345. Ignitions were completed by 1530 and transitioned to mop-up by 1545. Fire weather remained within prescription for the entire burn with temperatures and fine dead fuel moisture (FDFM) in the desired range, but relative humidity (RH) in the low-intensity range. Table 1 summarizes fire weather and fuel conditions during the burn. There was no FEMO monitoring during the burn for operations or fire/smoke behavior.

Fire Effects Monitoring Method

Responding to partner interest, we used Composite Burn Index (CBI) monitoring (Key and Benson 2006) to evaluate fire effects for this burn. CBI is a standardized method for assessing post-burn fire severity using a series of readily-observable fire effects (e.g. consumption of fuels, crown scorch, mortality) organized into five vertically arranged fuel/vegetation categories (CBI strata) from herbaceous and surface fuels to over-story canopy. Data are recorded on a severity scale of 0 to 3.0, corresponding to a range from no fire effects to high severity for each indicator. These indicator-specific index data can then be summarized by strata, for the unit as a whole, or in combinations most relevant to burn objectives (see below). CBI data can be collected in plots or by walk-though evaluation and can be limited to post-burn observations where pre-burn data are lacking. CBI has recently been adapted as a method for rapid monitoring of prescribed burns (e.g. Anderson 2012, Volpe 2011), yielding results with a simple burn severity rating bottom line comparable across burns.

For the 2015 Unit 12 burn, we used CBI plots combined with unit walk-through assessment. I randomly distributed a minimal sample of five 20-meter radius plots within the burn perimeter using GIS tools. Based on walk-though observations, I added a sixth plot to adequately represent fire effects in shrub openings that area a typical and substantial part of the unit. See Map 1 for the CBI plot locations. At each plot we followed the CBI method as detailed by Key and Benson (2006). To better cover AFR prescribed burning objectives, we included two additional metrics at each plot, effective ground cover and crown base height. Data from these plots were consistent with walk-through observations and used to evaluate performance on burn objectives. Impacts to Fisher blocks and large-diameter snags or logs were evaluated solely by walk-through. All our CBI data are post-burn only; there was no pre-burn monitoring for this unit.

Monitoring Results and Performance on Objectives

This burn met all prescribed fire objectives, including targets for surface fuels, shrub and tree mortality, and wildlife habitat. Approximately 85% of the unit burned and the dominant fuel model was reduced from TL3 to TL1 or TU1 across the unit (Scott and Burgan 2005). By CBI metrics, the burn averaged low severity overall, reaching moderate severity in the understory strata and shrub patches. Table 2 summarizes CBI burn severity results at the monitoring plot or CBI-strata scale, and for the unit as a whole, and provides descriptive interpretation of the CBI index in terms of typical fire effects (from Volpe 2011).

Table 3 presents our monitoring results and supporting information for each burn objective. Using CBI monitoring for this specific burn introduces some complexity in summarizing results relative to burn objectives. The objectives in the Unit 12 burn plan were not written to align with CBI indicators or strata. For example, burn objectives for mortality are expressed in DBH ranges but CBI monitoring assesses mortality in height strata that inconsistently overlap DBH ranges. Table 3 provides a crosswalk between burn objectives and CBI metrics used to assess performance, and includes specific comments identifying issues from misalignment between plan objectives and CBI monitoring indicators and how these were resolved.

For further transparency on the CBI method and how it was applied to Unit 12 monitoring, I include the full data from all six plots and all CBI indicators in Table 4. Table 4 provides information and data for the specific CBI metrics referenced in the Table 3 "*Relevant CBI indicator(s)*" crosswalk column.

At the end of this report are a series of representative photographs from each CBI plot showing post-burn conditions, a photo-pair example of the typically sparse ground cover in the unit and how it was reduced by burning, and an overview photograph showing a range of habitat types and fire effects typical of the unit.

Table 1. Unit 12 fire weather observations (as recorded by Tom Merritt).

	Time	Temp F	RH %	Wind, mph	FDFM %	POI %
April 30, 2015	1030	50	52	0-3, NNE	11	20
	1130	55	46	0-3, NNE	11	20
	1200	56	47	0-3, N	11	20
	1300	59	45	0-3, N	11	20
	1400	61	42	1-3, N	9	30
	1500	66	39	1-3, W	9	30
	1600	68	37	1-3, W	10	30
	1700	68	37	1-3, W	11	20

FDFM – fine dead fuel moisture, %
POI – probability of ignition, %

Table 2. Summary of CBI monitoring results by plot, height strata, and for the burn unit as a whole.

CBI strata severity ratings	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**	**Plot 6**	**Unit 12 Summary**	
Substrates (surface fuels)	1.4	1.0	1.0	1.3	1.4	2.4	***1.4***	*low*
Herbs, low shrubs and trees	1.0	1.1	1.1	2.1	n/a	2.2	***1.5***	*moderate*
Tall shrubs and small trees	2.0	2.1	n/a	1.8	1.8	2.3	***2.0***	*moderate*
Intermediate trees	0.3	1.5	0.1	1.0	0.6	2.0	***0.9***	*low*
Big trees (upper canopy)	0.2	0.1	0.1	0.6	0.3	n/a	***0.3***	*low-none*
	0.9	***1.1***	***0.6***	***1.3***	***1.0***	***2.2***		
CBI plot-level severity rating	*low*	*low*	*low*	*low*	*low*	*moderate*	***1.2***	***low severity***
Percent of plot area burned	75	85	75	80	100	100	***85.8***	*% area burned*
% decrease Effective Ground Cover	25	20	15	30	25	50	***27.5***	*% loss of ECG*
Post-burn Canopy Base Height, m	1.5	2.0	6.0	0.5	1.5	1.0	***2.1***	*CBH, meters*

CBI Severity Scale*	
0.0 < 0.5	Little to no evidence of fire.
0.5 < 1.5	Low: 50% reduction of litter and dead fuels up to 1", light duff char, <10% soil color/cover alteration, <10% canopy mortality, and >90% living understory vegetation.
1.5 < 2.5	Moderate: 50-80% consumption of litter and dead fuel up to 1", up to 50% deep duff char, 11-40% soil color/cover alteration, 11-50% canopy mortality, and 50-90% living understory vegetation.
2.5 - 3.0	High: >80% consumption of litter and dead fuel up to 1", 50-100% duff consumption, >40% soil color/cover alteration, 50-70% canopy mortality, and <20% living understory vegetation.

* from Volpe 2011.

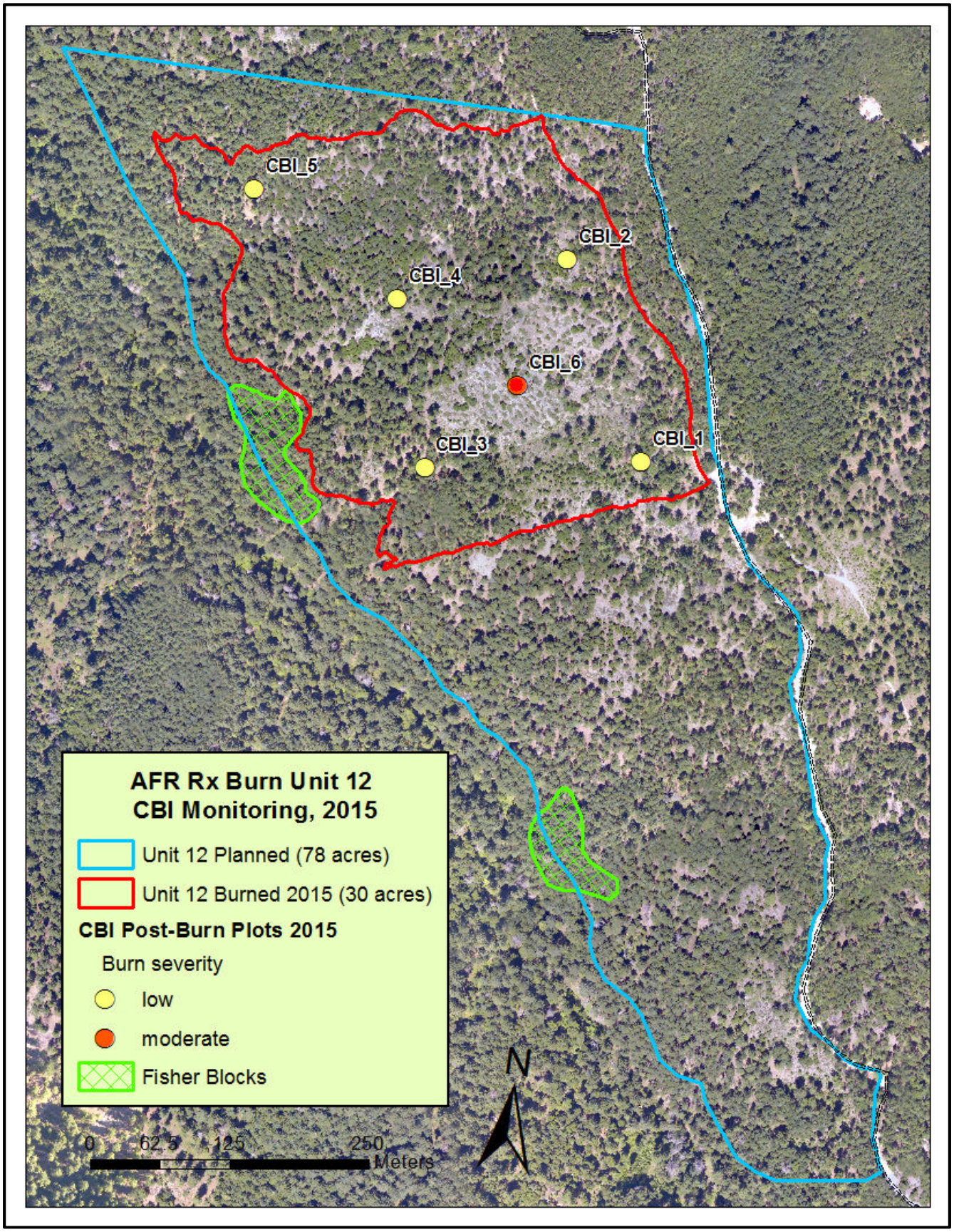
Table 3. *(Next-page).* Fire effects monitoring summary for Unit 12 burn objectives, with crosswalk to CBI indicators and severity.

Objectives and constraints	**Relevant CBI indicator(s)**	**CBI severity**	**Objective met?**	**Comments** (also see Table 4)
Consume 50-90% 1-hour fuels	Substrates: *Litter/light fuels (< 3"); Duff*	1.4, low	**Yes**	The CBI litter/light fuels category merges 1 (< 0.25"), 10 (0.25 < 1.0"), and 100 hour (1.0 < 3.0") fuels. CBI results do not discern at the level of specific fuel classes identified in these 3 burn objectives.
Consume 30-60% 10-hour fuels	Substrates: *Litter/light fuels (< 3")*	1.5, low to moderate	**Yes**	
Consume <= 30% 100-hour fuels		1.5, low to moderate	**Yes**	
Reduce 60-90% of existing brush, small trees (< 5" DBH), and stump sprouts	Herbs, low shrubs and trees < 1 m tall; & Tall shrubs and trees 1 - 5 m tall: *% Foliage altered; % Change in cover*	2.3, moderate	**Yes**	The objective in DBH overlaps two CBI height strata categories. Same-season re-sprouting of madrone replaced cover, lowering burn effectiveness.
Limit mortality of small trees (5-11" DBH) to 40% or less within 1 year post burn	Tall shrubs and trees 1 - 5 m tall: *% Change in cover;* Intermediate trees: *% Canopy mortality*	1.5, low to moderate	**Yes**	Objective in DBH overlaps two CBI height strata categories. We recorded top-killed hardwoods as dead within their pre-burn height-strata even if re-sprouting.
Retain at least 90% [live] conifer and hardwood trees 11-24" DBH	Intermediate trees (sub-canopy); Big trees (upper canopy): *% Canopy mortality*	0.5, low to none	**Yes**	The objective in DBH overlaps two CBI canopy-height strata. Depending on stand structure 11-24" DBH could be sub-canopy or upper canopy.
Retain at least 95% [live] conifer and hardwood trees > 24" DBH	Big trees (upper canopy, (co)dominant): *% Canopy mortality;* Walk-through	0.1, trace to none	**Yes**	Included in CBI big tree strata in stands with trees >24" DBH present, but the strata is not limited to this diameter.
Retain 70% effective soil cover...leaving unburned mosaic patches. *(Interpreted as 70% of the pre-burn cover, not as retaining 70% absolute cover.)*	Not specifically covered by CBI. Recorded directly, but informed by Substrates: *Soil and rock cover/color*	CBI: 1.6, moderate. By direct measure: 27.5% cover decrease.	**Yes**	Effective ground cover for AFR is cover of litter + duff + rock + wood debris + ground-cover vegetation, and is not directly covered by CBI. We included % change in effective ground cover as an additional metric in our plots.
Maintain 90% large down woody material and snags over 15" DBH.	Substrates: *Heavy fuel > 8";* Walk-through	1.3, low	**Yes**	The CBI heavy fuel category also includes smaller diameter (8 < 15") fuel with higher consumption rates than >15".
Minimize fire intensity and maintain existing canopy cover within Fisher blocks.	Not covered by CBI; Walk-through and mapping	0, none	**Yes**	The 2015 burn-unit perimeter fully excluded both Fisher blocks contained in the larger Unit 12 - see Map 1.

Table 4. Full 2015 monitoring plot data for all CBI indicators by strata, including additional AFR-specific metrics.

Burn unit: AFR Unit 12
Date of burn: 4/30/2015
Date post-fire monitoring: 8/13 & 9/24/2015

	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6
Plot aspect, degrees	265	250	150	132	210	204
Plot slope, %	33	40	50	40	50	58
Plot diameter, meters	20	20	20	20	20	20
Percent of plot area burned	75	85	75	80	100	100
Post-burn fuel model (S & B 40)	TU1	TU1	TL1	TU1	TL1	SH2
CBI Monitoring Strata:						
A - Substrates	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**	**Plot 6**
A1 Litter/Light fuels consumed	1.0	1.2	1.3	1.5	1.6	2.5
A2 Duff consumed	1.7	1.0	1.0	1.5	1.5	n/a
A3 Medium fuels 3 -8" consumed	1.0	0.8	0.5	1.1	1.2	2.5
A4 Heavy fuel > 8" consumed	2.0	1.0	0.5	1.2	1.0	2.0
A5 Soil and rock cover change	1.5	1.2	1.5	1.2	1.5	2.6
B - Herbs, low shrubs and trees < 1 m tall						
B1 % Foliage altered	2.0	2.0	2.0	2.4	n/a	2.7
B2 % Survival, by count	0.3	0.2	1.0	2.5	n/a	2.0
B3 Colonization potential	1.0	1.5	1.0	1.5	n/a	2.0
B4 Change in species composition	0.5	0.5	0.5	2.0	n/a	2.0
C - Tall shrubs and trees 1 - 5 m tall						
C1 % Foliage altered	2.4	2.5	n/a	2.0	2.3	2.5
C2 % Survival, by count	2.5	2.7	n/a	1.5	1.5	2.0
C3 % Change in canopy cover	2.5	2.6	n/a	2.0	2.0	2.4
C4 Change in species composition	0.5	0.5	n/a	1.5	1.2	2.2
D - Intermediate trees (subcanopy, pole)						
D1 % Green (unaltered)	0.5	2.2	0.1	1.5	1.0	2.5
D2 % Black (torched)	0.0	0.0	0.0	0.0	0.0	1.0
D3 % Brown (scorch/girdle)	1.0	2.5	0.1	1.5	1.0	2.8
D4 % Canopy mortality	0.0	2.2	0.0	1.0	0.2	1.5
D5 Bole char height	0.2	0.5	0.5	1.0	1.0	2.0
E - Big trees (upper canopy, (co)dominant)						
E1 % Green (unaltered)	0.0	0.1	0.0	1.0	0.1	n/a
E2 % Black (torched)	0.0	0.0	0.0	0.0	0.0	n/a
E3 % Brown (scorch/girdle)	0.0	0.1	0.0	1.0	0.1	n/a
E4 % Canopy mortality	0.0	0.0	0.0	0.5	0.0	n/a
E5 Bole char height	1.0	0.5	0.5	0.5	1.1	n/a
Add-ons for AFR objectives						
% Decrease in Effective Ground Cover, plot average, (ECG)	25	20	15	30	25	50
Post-burn Canopy Base Height, plot minimum, meters	1.5	2.0	6.0	0.5	1.5	1.0



Map 1. The 78-acre AFR Unit 12 (blue) and the 30-acre prescribed burn unit accomplished in 2015 (red), with locations of CBI monitoring plots color-coded by burn severity. Note the large patch of sparse shrub in the area of plot CBI_6. Two Fisher habitat blocks overlap the larger unit but were not included within the 2015 burn perimeter.

Representative post-burn photographs

Plot 1. Low severity in conifer and madrone, re-sprouting.

Plot 2. Mixed low-moderate severity in conifer, madrone, shrub.

Plot 3. Low severity in closed, smaller diameter pine and fir.

Plot 4. Mixed low severity in conifer, madrone, shrub.

Plot 5. Low severity in mixed maturity pine and fir.

Plot 6. Moderate severity in open shrub, sparse pine.

Photo pair 1. Example of change in effective ground cover and generally sparse soil cover conditions in Unit 12 – unburned on left, burned on right. The burn removed most surface litter but only partially burned or charred underlying duff, seen as black on right.

Unit overview photo. Range of fire effects looking south from center of Unit 12, August 2015

References

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