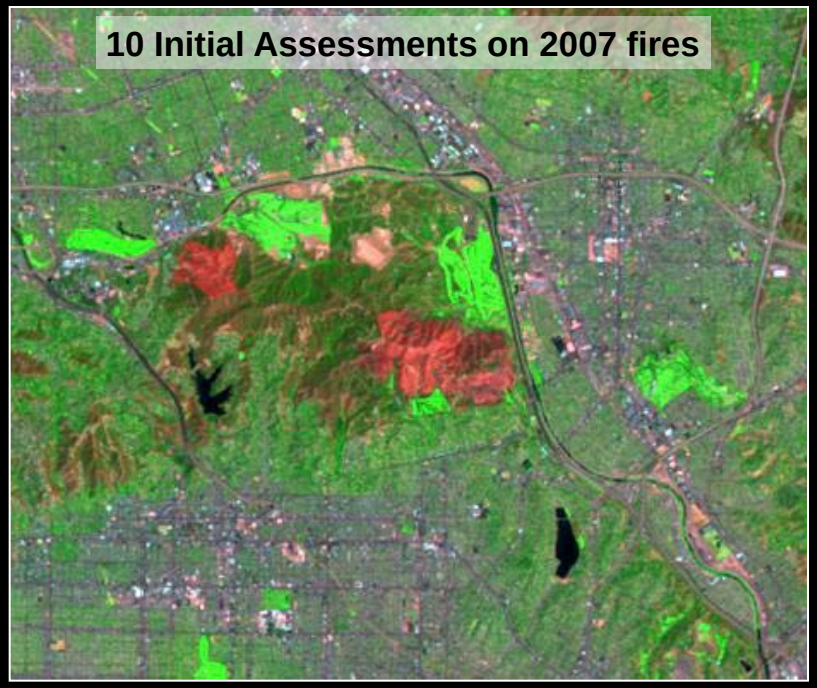
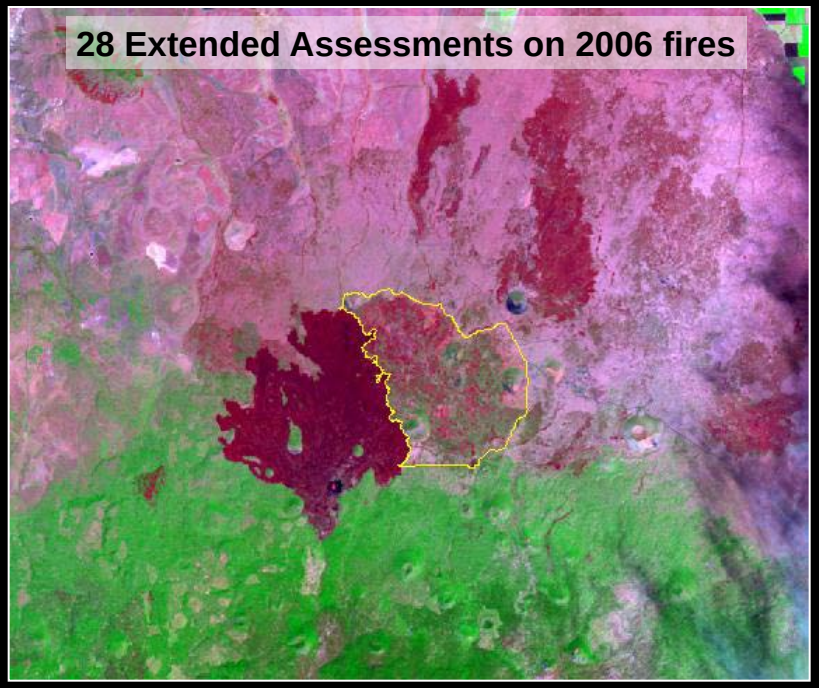
USGS science for a changing world

National Park Service - U. S. Geological Survey
National Burn Severity Mapping Project

Burn Severity | Abstract | Overview | Methodology | Data Contents | Resources | Data Archive | Contributors | Contact Us

Completed 38 dNBR Burn Assessments from 61 Landsat Scenes on over 60 Fires.


10 Initial Assessments on 2007 fires


28 Extended Assessments on 2006 fires

Fire Name:	Griffith Park
Park Name:	Santa Monica Mountains NRA
Start Date:	5/8/2007
Est. dNBR Acres:	890
Assessment Type:	Initial
Latitude / Longitude :	34 07 38 : 118 17 21
Landsat Path/Row:	41/36
Image Dates:	L5-05/04/2004; L5-05/13/2007

Fire Name:	Big Nasty
Park Name:	Lava Beds National Monument
Start Date:	10/24/2006
Est. dNBR Acres:	5190
Assessment Type:	Extended
Latitude / Longitude :	41 43 03 : 121 22 27
Landsat Path/Row:	44/31
Image Dates:	L5-06/29/2005; L5-06/19/2007

2006 Red Eagle Fire Extended Assessment 2007

Pre-fire

1º – July 21, 2003

2º – Aug. 27, 2005

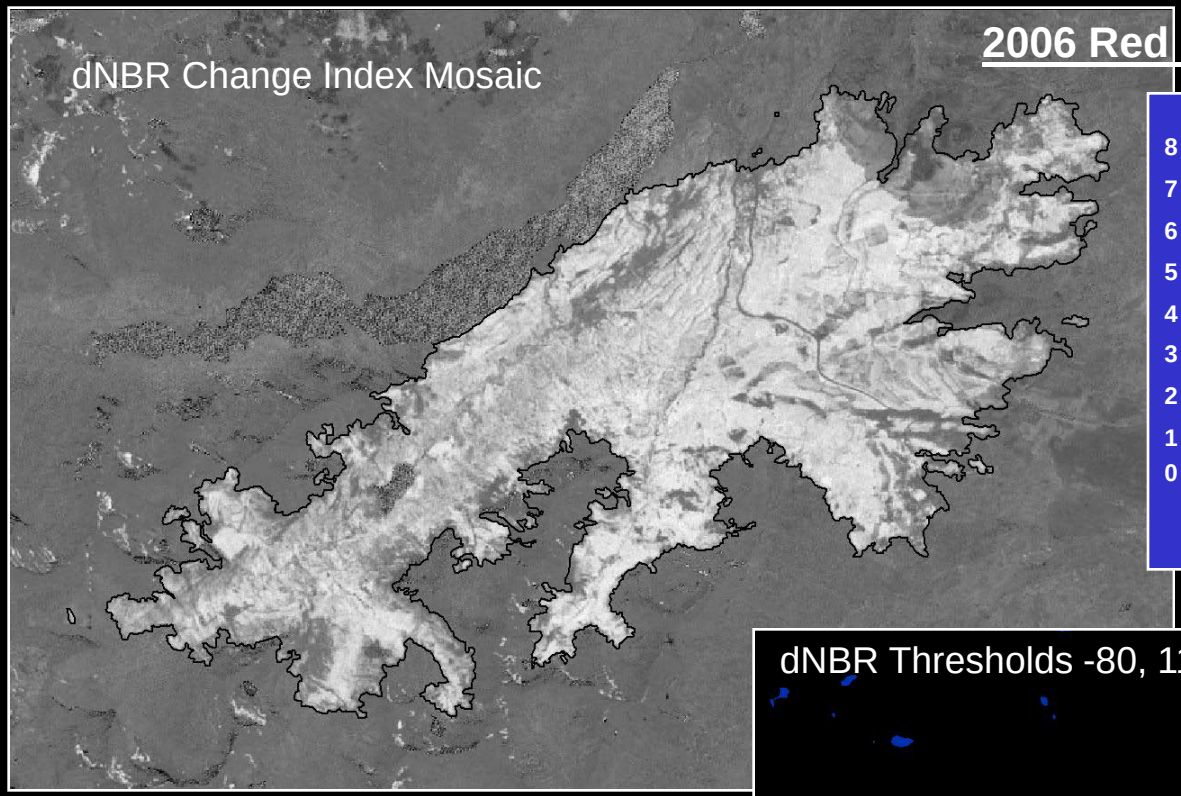
Post-fire

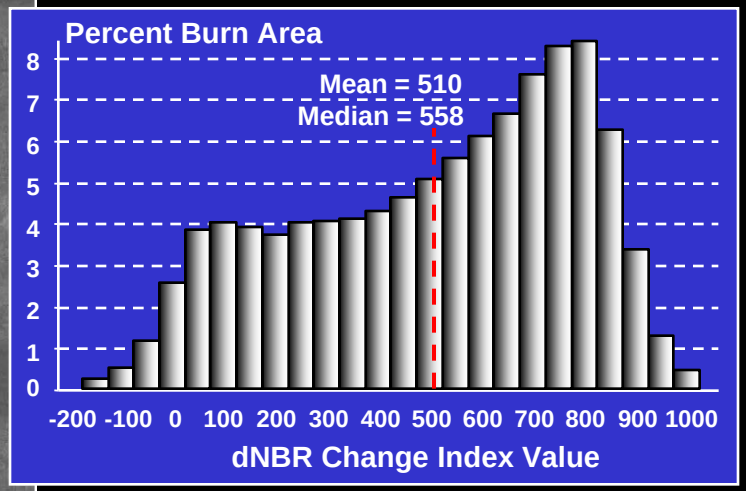
2º – July 16, 2007

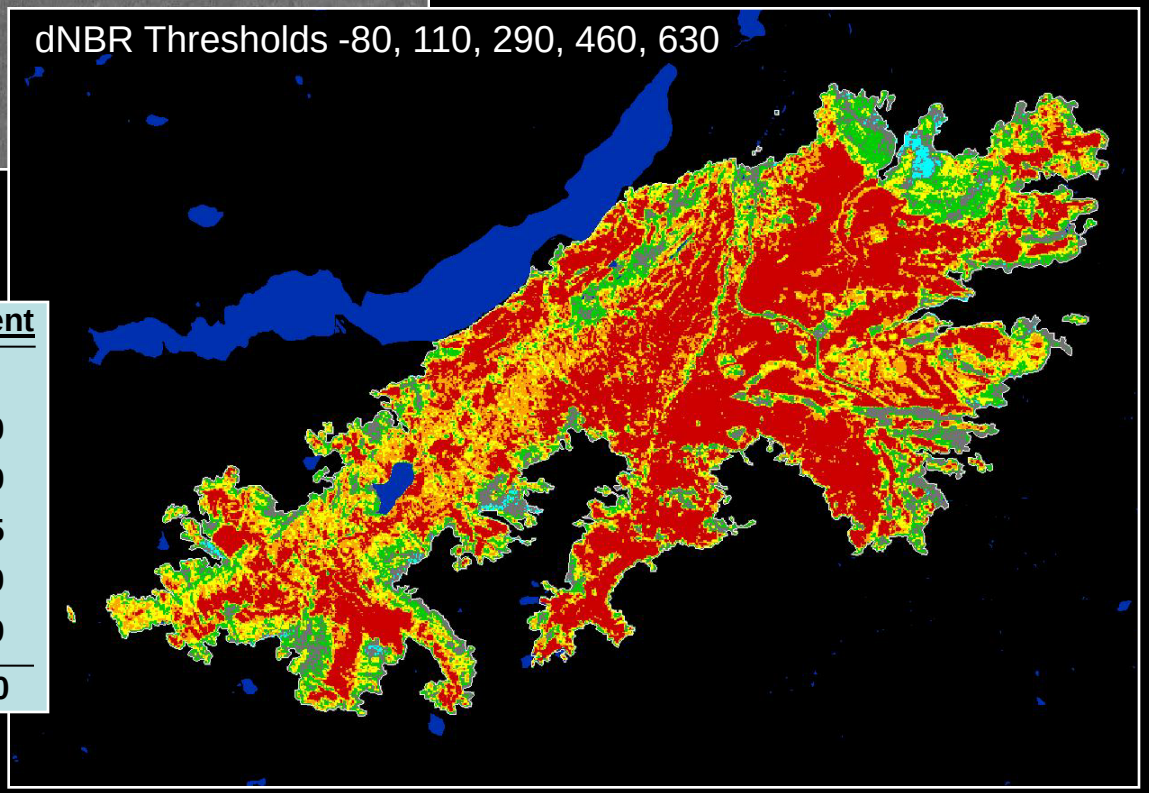
1º – Aug. 01, 2007

3º – Aug. 17, 2007

2006 Red Eagle, Extended Assessment 2007







Severity Class		Hectares	Acres	Percent
Incr. Greenness	1	96	238	.7
No burn-Very Low	2	1325	3274	10.0
Low	3	1855	4584	13.9
Moderate Low	4	1939	4792	14.5
Moderate High	5	2544	6285	19.0
High	6	5599	13835	41.9
Total		13358	33007	100.0

C. Key Photos

C. Key Photos

COMPOSITE BURN INDEX (CBI) PHOTO SERIES

Conifer Forest Examples

Scott Lang, NPS Glacier; Carl Key, USGS Northern Rocky Mountain Science Center;
Nate Benson, NPS Fire Management Program Center. 2007.

2007

The CBI PHOTO SERIES shows burn conditions taken from field plots along a gradient of fire impact. Representative plots were selected where photos and data illustrated composite site-effects at intervals of severity. Examples offer a means to calibrate field interpretations, and display the variety of stratum responses contributing to overall ratings. One can also see the difficulty in applying burn severity categories or labels. This poster covers three Northwest Montana fires from 2003 that were field sampled in 2004 by National Park Service and USGS crews.

The CBI is a field rating (0.0 to 3.0) of burn conditions averaged over a site. It is based on averaging 4-5 rating factors within Understory (A. - C.), Overstory (D. - E.), and over all strata (A. - E.) to rate the Total Plot.

Wedge Canyon Fire
Post-fire Photo Very Low Severity

Patchy burn with 21% understory charring throughout plot. 15% consumption of downed fuels. Regenerated grasses/forbs dominate understory 98%, with some small pockets of colonizers 2%. Shrubs and low trees show 5% mortality. Overstory trees show 3% scorching, and tree ground char remains < 1.8 m. Overstory tree mortality is < 2%. Pinegrass/fireweed understory. Overstory of mixed conifer Douglas fir, spruce, and lodgepole subcanopy, with larch upper canopy.

PLOT 1042

A. Substrates	0.56
B. Herbs and Shrubs	0.40
C. Tall Shrubs and Trees	0.45
D. Intermediate Trees	0.32
E. Big Trees	0.08
Understory CBI	0.48
Overstory CBI	0.18
Total Plot CBI	0.36

Robert Fire
Post-fire Photo Low Severity

Patchy burn with 39% charring of understory throughout plot. 17% consumption of downed fuels. Regenerated grasses/forbs dominate understory 92%, with some small pockets of colonizers 8%. Shrubs and low trees show 55% mortality. Overstory shows 15% scorching, and tree ground char remains <1.8 m. Overstory tree mortality is 12%. Pinegrass/fireweed understory. Overstory of birch subcanopy and lodgepole upper canopy.

PLOT 9009

A. Substrates	1.10
B. Herbs and Shrubs	0.53
C. Tall Shrubs and Trees	2.10
D. Intermediate Trees	0.60
E. Big Trees	0.66
Understory CBI	1.23
Overstory CBI	0.63
Total Plot CBI	0.95

Robert Fire
Post-fire Photo Moderate Severity

Consistent 55% charring of understory throughout. 14% downed fuels consumed. Mix of colonizers 75%, regenerated grass/forb understory 25%. Shrubs and low trees show 23% mortality. Scorch 45% overstory, some 10% torch, and tree ground char remains < 4.0 m. Subcanopy Tree mortality 90%. Overstory tree mortality 20%. Fine branching, and a few green crowns remain. Fireweed, foam-flower, and pathfinder understory. Overstory of open mixed conifer larch, spruce, and subalpine fir.

PLOT 1029

A. Substrates	0.80
B. Herbs and Shrubs	2.30
C. Tall Shrubs and Trees	1.92
D. Intermediate Trees	2.32
E. Big Trees	1.06
Understory CBI	1.58
Overstory CBI	1.69
Total Plot CBI	1.63

Wedge Canyon Fire
Post-fire Photo Moderate- High Severity

Consistent 95% charring of understory throughout plot. 18% consumption of downed fuels. Colonizers dominate understory 80%, with some regenerated grasses/forbs 20%. Shrubs and low trees show 90% mortality. Overstory has 80% scorch, some torching 10%, and tree ground char remains < 4.0 m. 100% mortality of overstory trees, with some branch consumption. Fireweed, Spiraea and seral lodgepole understory. Overstory of dead even aged lodgepole.

PLOT 2296

A. Substrates	1.24
B. Herbs and Shrubs	2.15
C. Tall Shrubs and Trees	2.50
D. Intermediate Trees	2.04
E. Big Trees	2.04
Understory CBI	1.91
Overstory CBI	2.04
Total Plot CBI	1.97

Robert Fire
Post-fire Photo Very High Severity

Consistent 98% charring of understory throughout plot. 35% consumption of downed fuels. Colonizers in low density dominate the understory 10%. Very little regeneration of pre-fire plants 2%. Shrubs and small trees show 100% mortality. Overstory shows 100% torching of trees. No green crowns remain. High branch consumption. Low density fireweed, willow, alder, and fire moss understory. Intermediate dead lodgepole overstory.

PLOT 1017

A. Substrates	2.10
B. Herbs and Shrubs	2.83
C. Tall Shrubs and Trees	2.95
D. Intermediate Trees	3.00
E. Big Trees	3.00
Understory CBI	2.58
Overstory CBI	3.00
Total Plot CBI	2.74

Trapper Fire
Post-fire Photo Low Severity

Patchy burn with 38% understory charring throughout plot. 13% consumption of downed fuels. Regenerated grasses/forbs dominate understory 88%, with some small pockets of colonizers 8%. Sapling conifers show 12% mortality. Overstory shows 10% scorch, and tree ground char remains < 1.5 m. Overstory tree mortality is 18%. Understory of thimbleberry with small pockets of fireweed. Mixed conifer overstory of spruce, Douglas fir, lodgepole, and larch.

PLOT 1135

A. Substrates	0.76
B. Herbs and Shrubs	0.88
C. Tall Shrubs and Trees	1.15
D. Intermediate Trees	0.78
E. Big Trees	N/A
Understory CBI	0.92
Overstory CBI	0.78
Total Plot CBI	0.88

Wedge Fire
Post-fire Photo Low Severity

Patchy burn with 36% charring of understory throughout plot. 12% consumption of downed fuels. Regenerated grasses/forbs dominate understory 90%, with some small pockets of colonizers 10%. Sapling conifers show 60% mortality. Overstory shows 31% scorch, and tree ground char remains < 1.8 m. Overstory tree mortality is 20%. Understory of pinegrass, with small pockets of fireweed. Overstory of moderately open Douglas fir and larch.

PLOT 1157

A. Substrates	0.76
B. Herbs and Shrubs	1.03
C. Tall Shrubs and Trees	1.73
D. Intermediate Trees	1.26
E. Big Trees	0.24
Understory CBI	1.14
Overstory CBI	0.75
Total Plot CBI	0.97

Robert Fire
Post-fire Photo Moderate Severity

Consistent 58% charring of understory throughout. 15% downed fuels consumed. Mix of regenerated grasses/forbs 60%, and colonizers 40% understory. Shrubs and small trees show 60% mortality. Overstory shows 75% scorch, some torching 3%, and tree ground char remains < 4.0 m. Overstory tree mortality is 65%. Some green crowns remain. Understory of *Spiraea*, pinegrass and fireweed. Overstory subcanopy of spruce and lodgepole, with open upper canopy of larch and spruce.

PLOT 2075

A. Substrates	0.92
B. Herbs and Shrubs	1.90
C. Tall Shrubs and Trees	1.63
D. Intermediate Trees	1.84
E. Big Trees	1.64
Understory CBI	1.43
Overstory CBI	1.74
Total Plot CBI	1.57

Robert Fire
Post-fire Photo High Severity

Consistent 65% charring of understory throughout. 34% downed fuels consumed, with much newly exposed soil. Colonizers dominate understory 88%. Shrubs and small trees show 85% mortality. Overstory shows 80% scorch, some torch 3%, tree ground char remains < 7.0 m. Overstory tree mortality is 98%, some branch consumption and isolated green crowns remain. Understory of dense fireweed with some fire moss. Overstory of mostly dead mixed conifer Douglas fir, larch, and spruce.

PLOT 1145

A. Substrates	2.12
B. Herbs and Shrubs	2.40
C. Tall Shrubs and Trees	2.50
D. Intermediate Trees	0.00
E. Big Trees	2.38
Understory CBI	2.32
Overstory CBI	2.38
Total Plot CBI	2.33

Robert Fire
Post-fire Photo Very High Severity

Consistent burn with 98% charring of understory throughout plot. 42% consumption of downed fuels, and much exposed soil. Colonizers in low density dominate the understory 15%. Very little regeneration of pre-fire plants 2%. Shrubs and small trees show 98% mortality. Overstory shows 98% torching, and high branch consumption in crowns. No green crowns remain. Understory of low density fireweed, fire moss, and seral lodgepole. Overstory of dead spruce and lodgepole.

PLOT 1012

A. Substrates	2.62
B. Herbs and Shrubs	2.70
C. Tall Shrubs and Trees	2.85
D. Intermediate Trees	2.95
E. Big Trees	2.85
Understory CBI	2.72
Overstory CBI	2.90
Total Plot CBI	2.79

COMPOSITE BURN INDEX (CBI) PHOTO SERIES

Piñon/Juniper – Sage Communities

Scott Lang, NPS Glacier; Carl Key, USGS Northern Rocky Mountain Science Center;
Nate Benson, NPS Fire Management Program Center. 2007.

The CBI PHOTO SERIES shows burn conditions taken from field plots along a gradient of fire impact. Representative plots were selected where photos and data illustrated composite site-effects at intervals of severity. Examples offer a means to calibrate field interpretations, and display the variety of stratum responses contributing to overall ratings. One can also see the difficulty in applying burn severity categories or labels. This poster covers two Utah fires from 2002 that were field sampled the following summer (2003) by National Park Service and USGS crews.

The CBI is a field rating (0.0 to 3.0) of burn conditions averaged over a site. It is based on averaging 4-5 rating factors within Understory (A. - C.), Overstory (D. - E.), and over all strata (A. - E.) to rate the Total Plot.

Sanford Fire
Post-fire Photo Very Low Severity

Patchy burn with light charring of understory throughout plot. Low consumption of litter and duff 10%. Small change in soil cover and color 10%. Regenerated forbs and grasses dominate understory. Shrub and small tree mortality is low 30%. Pinyon Juniper/Sage Grassland community.

PLOT 51

A. Substrates	0.60
B. Herbs and Shrubs	0.15
C. Tall Shrubs and Trees	1.67
D. Intermediate Trees	N/A
E. Big Trees	N/A
Understory CBI	0.74
Overstory CBI	N/A
Total Plot CBI	0.74

Sanford Fire
Post-fire Photo Low Severity

Patchy burn with light charring of understory throughout plot. Low consumption of litter and duff 15%. Small change in soil cover and color 12%. Regenerated forbs and grasses dominate understory with some pockets of sprouting shrubs and colonizers. Shrub and small tree mortality is low 35%. Pinyon Juniper/Sage Grassland community.

PLOT T-A

A. Substrates	0.17
B. Herbs and Shrubs	1.10
C. Tall Shrubs and Trees	2.40
D. Intermediate Trees	N/A
E. Big Trees	N/A
Understory CBI	1.30
Overstory CBI	N/A
Total Plot CBI	1.30

Bear Fire
Post-fire Photo Moderate-High Severity

Consistent burn with moderate charring of understory throughout plot. Moderately high consumption of litter and duff 70%. Some consumption of down fuels 30%. Moderate change in soil cover and color 50%. Some pockets of sprouting shrubs and colonizing grasses. Pinyon Juniper/Sage Grassland community.

PLOT 53

A. Substrates	1.70
B. Herbs and Shrubs	1.23
C. Tall Shrubs and Trees	2.93
D. Intermediate Trees	N/A
E. Big Trees	N/A
Understory CBI	1.95
Overstory CBI	N/A
Total Plot CBI	1.95

Bear Fire
Post-fire Photo High Severity

Consistent burn with moderately high charring of understory throughout plot. Moderately high consumption of litter and duff > 80%. High consumption of down fuels > 40. Moderate change in soil cover and color > 70%. Small pockets of sprouting shrubs and colonizing grasses. Pinyon Juniper/Sage Grassland community.

PLOT 03A

A. Substrates	2.85
B. Herbs and Shrubs	2.00
C. Tall Shrubs and Trees	2.93
D. Intermediate Trees	N/A
E. Big Trees	N/A
Understory CBI	2.59
Overstory CBI	N/A
Total Plot CBI	2.59

Bear Fire
Post-fire Photo Very High Severity

Consistent burn with high charring of understory throughout plot. High consumption of litter and duff > 90%. High consumption of down fuels > 60%. Moderate change in soil cover and color > 80%. Very small pockets of sprouting shrubs. Pinyon Juniper/Sage Grassland community.

PLOT 45

A. Substrates	2.93
B. Herbs and Shrubs	2.75
C. Tall Shrubs and Trees	2.93
D. Intermediate Trees	N/A
E. Big Trees	N/A
Understory CBI	2.86
Overstory CBI	N/A
Total Plot CBI	2.86

Sanford Fire
Post-fire Photo Moderate-High Severity

Plot 95% burned, consumed about 100% litter, 70% light fuels, <50% duff; exposed soil increased by 70%. Small pockets of sprouting shrubs and colonizing grasses. Juniper 75% scorch. Pinyon Juniper Sage Grassland community.

PLOT 103

A. Substrates	1.85
B. Herbs and Shrubs	1.63
C. Tall Shrubs and Trees	2.88
D. Intermediate Trees	N/A
E. Big Trees	N/A
Understory CBI	2.17
Overstory CBI	N/A
Total Plot CBI	2.17

Sanford Fire
Post-fire Photo High Severity

To be completed. high charring of understory throughout plot. High consumption of litter and duff > 90%. High consumption of down fuels > 60%. Few small patches unburned, sage stubs barely present. Moderate change in soil cover and color > 80%. Very small pockets of sprouting shrubs. Pinyon Juniper Sage Grassland community.

PLOT 32

A. Substrates	2.55
B. Herbs and Shrubs	2.70
C. Tall Shrubs and Trees	2.87
D. Intermediate Trees	N/A
E. Big Trees	N/A
Understory CBI	2.72
Overstory CBI	N/A
Total Plot CBI	2.72

Bear Fire
Post-fire Photo Low Severity

Patchy burn with light charring of understory throughout plot. Low consumption of litter and duff 25%. Slight change in soil color due to soil heating 10%. Regenerated forbs, grasses, and shrubs dominate understory, with some pockets of colonizers. Sage/Grassland understory community.

PLOT 12

A. Substrates	0.83
B. Herbs and Shrubs	0.57
C. Tall Shrubs and Trees	N/A
D. Intermediate Trees	N/A
E. Big Trees	N/A
Understory CBI	0.69
Overstory CBI	N/A
Total Plot CBI	0.69

Bear Fire
Post-fire Photo Moderate Severity

Consistent burn with moderate understory charring throughout plot. Moderately high consumption of litter and duff 80%. Moderate change in soil cover and color 40%. Regenerated forbs and grasses dominate understory with some pockets of shrubs and colonizers. Sage/Grassland understory community.

PLOT 13

A. Substrates	2.03
B. Herbs and Shrubs	1.68
C. Tall Shrubs and Trees	N/A
D. Intermediate Trees	N/A
E. Big Trees	N/A
Understory CBI	1.83
Overstory CBI	N/A
Total Plot CBI	1.83

Bear Fire
Post-fire Photo High Severity

Consistent burn with high understory charring throughout plot. High consumption of litter, duff, and medium fuels 98%. High change in soil cover and color >80%. Mix of regenerated and colonizer grasses with some small pockets of forbs and shrubs. Sage/Grassland understory community.

PLOT 05B

A. Substrates	2.98
B. Herbs and Shrubs	2.53
C. Tall Shrubs and Trees	N/A
D. Intermediate Trees	N/A
E. Big Trees	N/A
Understory CBI	2.75
Overstory CBI	N/A
Total Plot CBI	2.75

COMPOSITE BURN INDEX (CBI) PHOTO SERIES

PLOT 1042 Low (Wedge Canyon 2003)

A. Substrates	0.56
B. Herbs and Shrubs	0.40
C. Tall Shrubs and Tree	0.45
D. Intermediate Trees	0.32
E. Big Trees	0.08
Understory CBI	0.48
Overstory CBI	0.18
Total Plot CBI	0.36

Patchy burn, 21% understory charring throughout plot. 15% consumption of downed fuels. forb/grass regrowth dominates understory 98%, with some small pockets of colonizers 2%. Pinegrass and fireweed most common. Shrubs and low trees show 5% mortality. Overstory trees show scorch 3%, and tree ground char < 1.8 m. Overstory tree mortality is < 2%. Overstory of mixed conifer lodgepole, Douglas fir, and spruce subcanopy, and larch upper canopy.

PLOT 9009 Low (Robert 2003)

A. Substrates	1.10
B. Herbs and Shrubs	0.53
C. Tall Shrubs and Trees	2.10
D. Intermediate Trees	0.60
E. Big Trees	0.66
Understory CBI	1.23
Overstory CBI	0.63
Total Plot CBI	0.95

Patchy burn with 39% charring of understory throughout plot. 17% consumption of downed fuels. Regenerated forbs/grasses dominate understory 92%, with some small pockets of colonizers 8%. Shrubs and low trees show 55% mortality, but good resprouting. Overstory shows Scorch 15%, and tree ground char <1.8 m. Overstory tree mortality is 12%. Pinegrass, fireweed understory. Overstory subcanopy of birch, and even-aged lodgepole upper canopy.

PLOT 1157 Low (Wedge Canyon 2003)

A. Substrates	0.76
B. Herbs and Shrubs	1.03
C. Tall Shrubs and Trees	1.73
D. Intermediate Trees	1.26
E. Big Trees	0.24
Understory CBI	1.14
Overstory CBI	0.75
Total Plot CBI	0.97

Patchy burn with 36% understory charring throughout. 12% consumption of downed fuels. Regenerated forbs & grasses dominate understory 90%, with some small pockets of colonizers 10%. Beargrass in unburned patches, fireweed dominates where it burned. Sapling conifers show 60% mortality. Overstory shows scorch 31%, but with green terminal growth and tree ground char was low < 1.8 m. Overstory mortality is 20%. Understory of pinegrass and small fireweed patches. Overstory moderately open large Douglas fir and larch with saplings in understory.

Booklet Examples Grouped by Level of Severity

PLOT 1017 High (Robert 2003)

A. Substrates	2.10
B. Herbs and Shrubs	2.83
C. Tall Shrubs and Trees	2.95
D. Intermediate Trees	3.00
E. Big Trees	3.00
Understory CBI	2.58
Overstory CBI	3.00
Total Plot CBI	2.74

Consistent 98% charring of understory throughout plot. 35% consumption of downed fuels. Colonizers in low density dominate the understory 10%. Very little regeneration of pre-fire plants 2%. Shrubs and small trees show 100% mortality. Overstory shows 100% torching of trees. No green crowns remain. High branch consumption. Understory of low density fireweed, willow, alder, and some fire moss. Overstory of intermediate dead lodgepole.

PLOT 1012 High (Robert 2003)

A. Substrates	2.62
B. Herbs and Shrubs	2.70
C. Tall Shrubs and Trees	2.85
D. Intermediate Trees	2.95
E. Big Trees	2.85
Understory CBI	2.72
Overstory CBI	2.90
Total Plot CBI	2.79

Consistent burn with 98% charring of understory throughout plot. 42% Consumption of downed fuels, and much exposed soil. Colonizers in low density dominate the understory 15%. Very little regeneration of pre-fire plants 2%. Shrubs and small trees show 99% mortality. Overstory 98% torched, and high branch consumption in crowns. No green crowns remain. Understory of low density fireweed, fire moss, and seral lodgepole. Overstory of dead spruce and lodgepole.

PLOT 1084 High (Robert 2003)

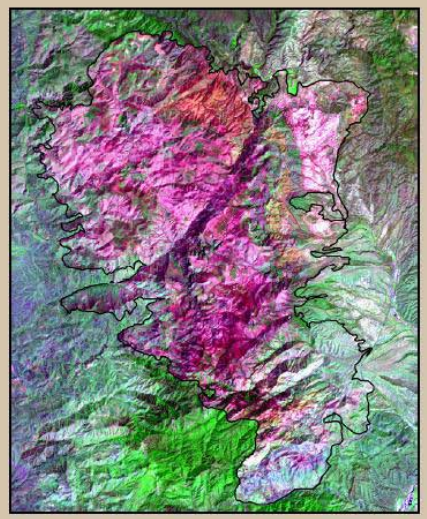
A. Substrates	2.78
B. Herbs and Shrubs	2.83
C. Tall Shrubs and Tree	3.00
D. Intermediate Trees	3.00
E. Big Trees	3.00
Understory CBI	2.86
Overstory CBI	3.00
Total Plot CBI	2.92

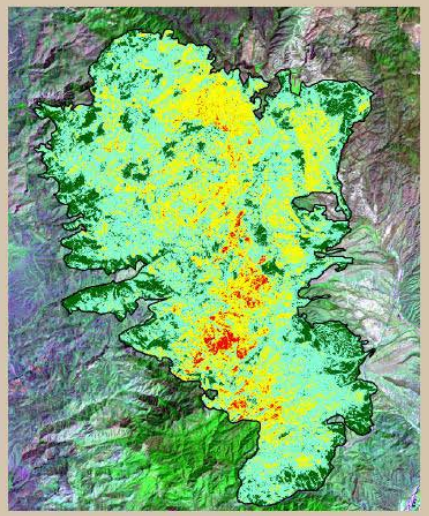
Consistent 100% charring of understory throughout plot. 70% consumption of downed fuels, with much newly exposed rock/soil. Colonizers present in understory 10%. Very little regeneration of pre-fire plants 3%. Shrubs and small trees show 95% mortality. Overstory torching 100%, and ground char < 7.0 m, tree mortality is 100%. Notable branch consumption, and no green in crowns. Understory of sparse fireweed with little fire moss. Overstory of dead hemlock and lodgepole.

2007

Monitoring Trends in Burn Severity:

Report on the 2004 Mapped Fires





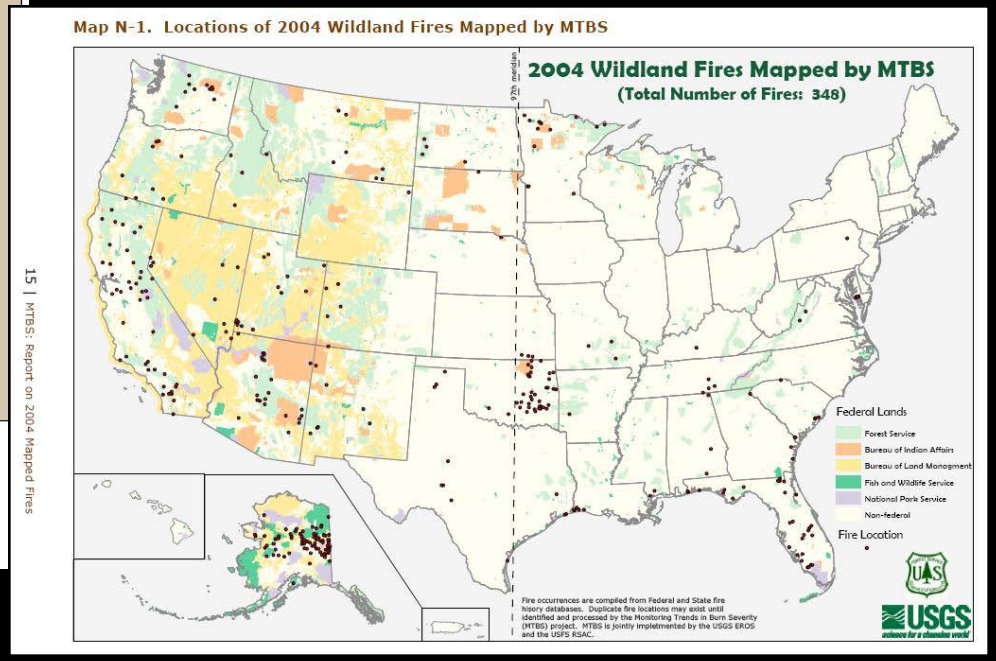
Acreage of Burn Severity—Willow Fire, AZ

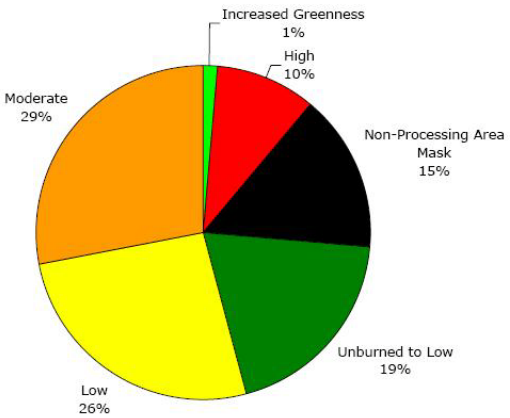
Burn Severity	Acres
Unburned to Low	20,691
Low	61,455
Moderate	33,993
High	2,297
Increased Greenness	51
Non-Processing Area Mask	0
Total	**118,487**

http://www.mtbs.gov

MTBS Assesses all fires
> 1000 Acres in West U.S.
> 500 Acres in East U.S.

2004 Fires Total = 348





U.S. Severity

Figure 6. Proportion of burn severity classes (CONUS, Alaska, and Hawaii)

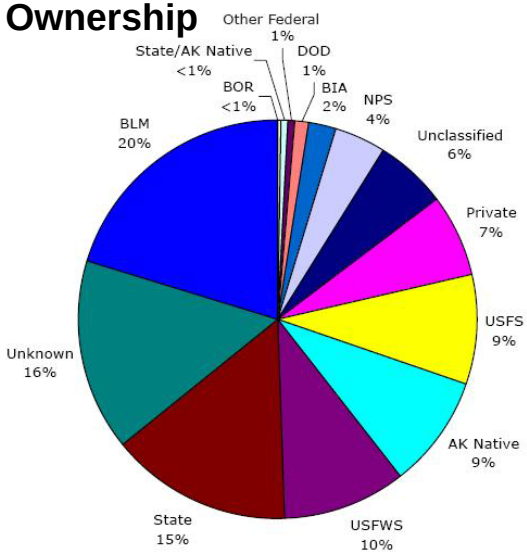
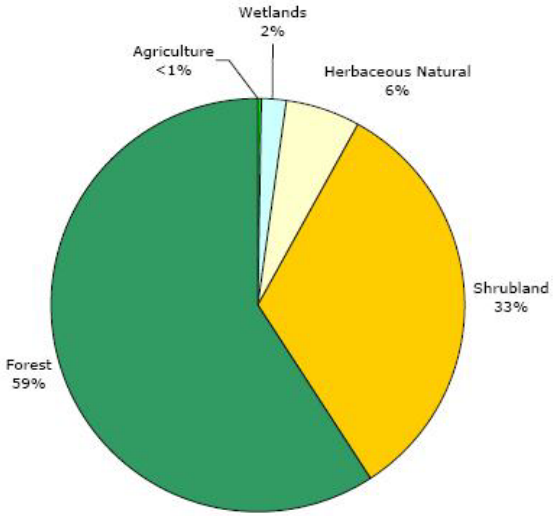


Figure 8. Proportion of mapped acres by Government ownership (CONUS, Alaska, and Hawaii)



U.S. Landcover

Figure 9. Proportion of vegetated land cover with mapped burn severity (CONUS, Alaska, and Hawaii)

Total Area Mapped 2004

- 7,781,049 acres (CONUS, AK, HI)
- 1,188,428 acres (CONUS)
- 6,592,621 acres (AK)

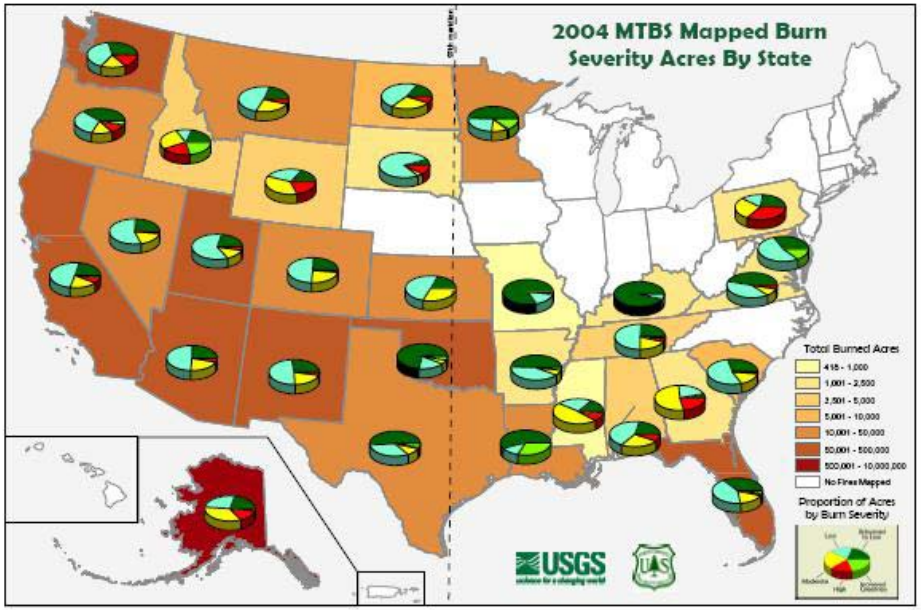
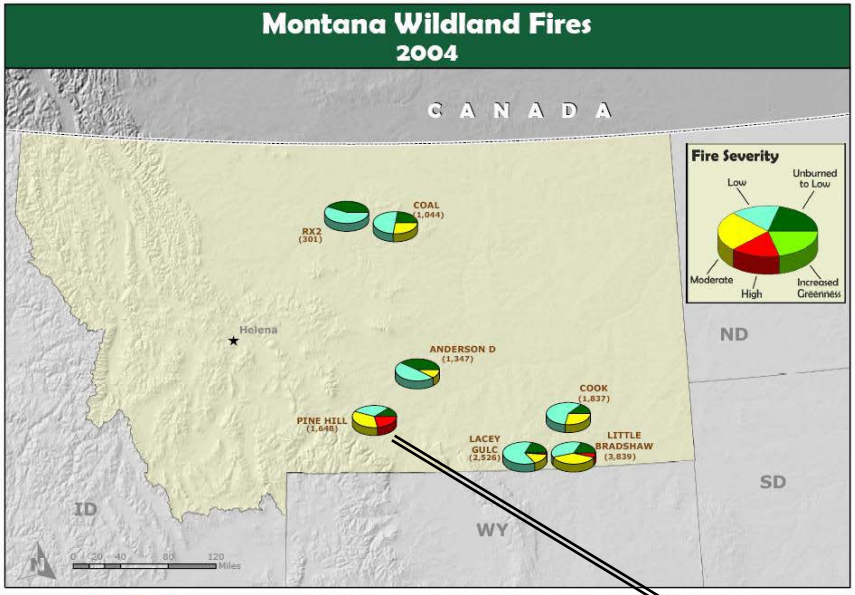


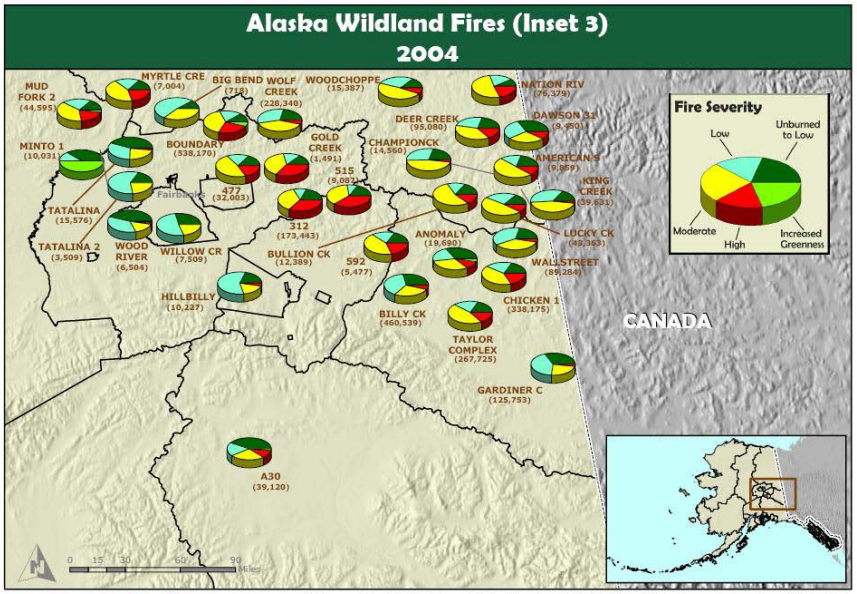
Figure 12. Total burned acres and proportion of acres by burn severity for each state where MTBS fires were mapped. Darker colors indicate a higher number of acres burned. Refer to appendix C of this report for exact burned acreage figures for each state.

Map S-25. Wildland Fires—Montana



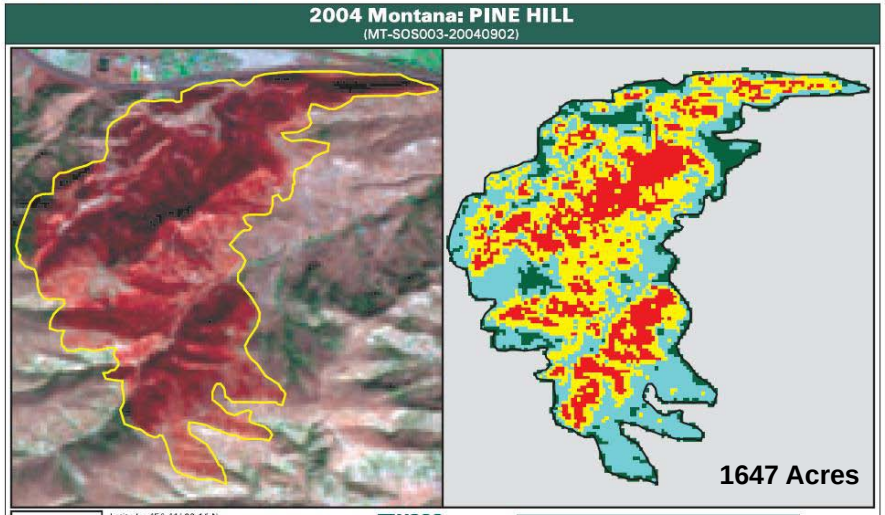
This map provides the location for fires within the state and year identified in the map title and summarizes proportions of fire severity classes for each mapped fire. Fire data are produced under the Monitoring Trends in Burn Severity (MTBS) project jointly implemented by the USGS EROS and the USFS RSAC. The MTBS project ascertains fire locations based on available fire occurence information provided by federal and state agencies, and other reliable sources. The MTBS project reserves the right to correct, update or modify geospatial inputs to this map without notification.

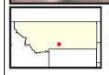
Map S-05. Wildland Fires—Alaska Inset 3



This map provides the location for fires within the state and year identified in the map title, and summarizes proportions of fire severity classes for each mapped fire. Fire data are produced under the Monitoring Trends in Burn Severity (MTBS) project jointly implemented by the USGS EROS and the USFS RSAC. The MTBS project ascertains fire locations based on available fire occurence information provided by federal and state agencies, and other reliable sources. The MTBS project reserves the right to correct, update or modify geospatial inputs to this map without notification.

Map F-227. Montana—Pine Hill





Latitude: 45° 41' 28.1" N
Longitude: 109° 32' 25.9" W
Fire Ignition Date: September 2, 2004
Assessment Type: Initial
Pre-Fire Image Date: September 27, 2003 (Landsat 5)
Post-Fire Image Date: September 29, 2004 (Landsat 5)

This map portrays fire severity for the fire specified in the map title and summarizes proportions of fire severity classes. These data are produced under the Monitoring Trends in Burn Severity (MTBS) project jointly implemented by the USGS EROS and the USFS RSAC. The MTBS project ascertains the locations of fires based on available fire occurence information provided by federal and state agencies, and other reliable sources. The MTBS project reserves the right to correct, update or modify geospatial inputs to this map without notification.

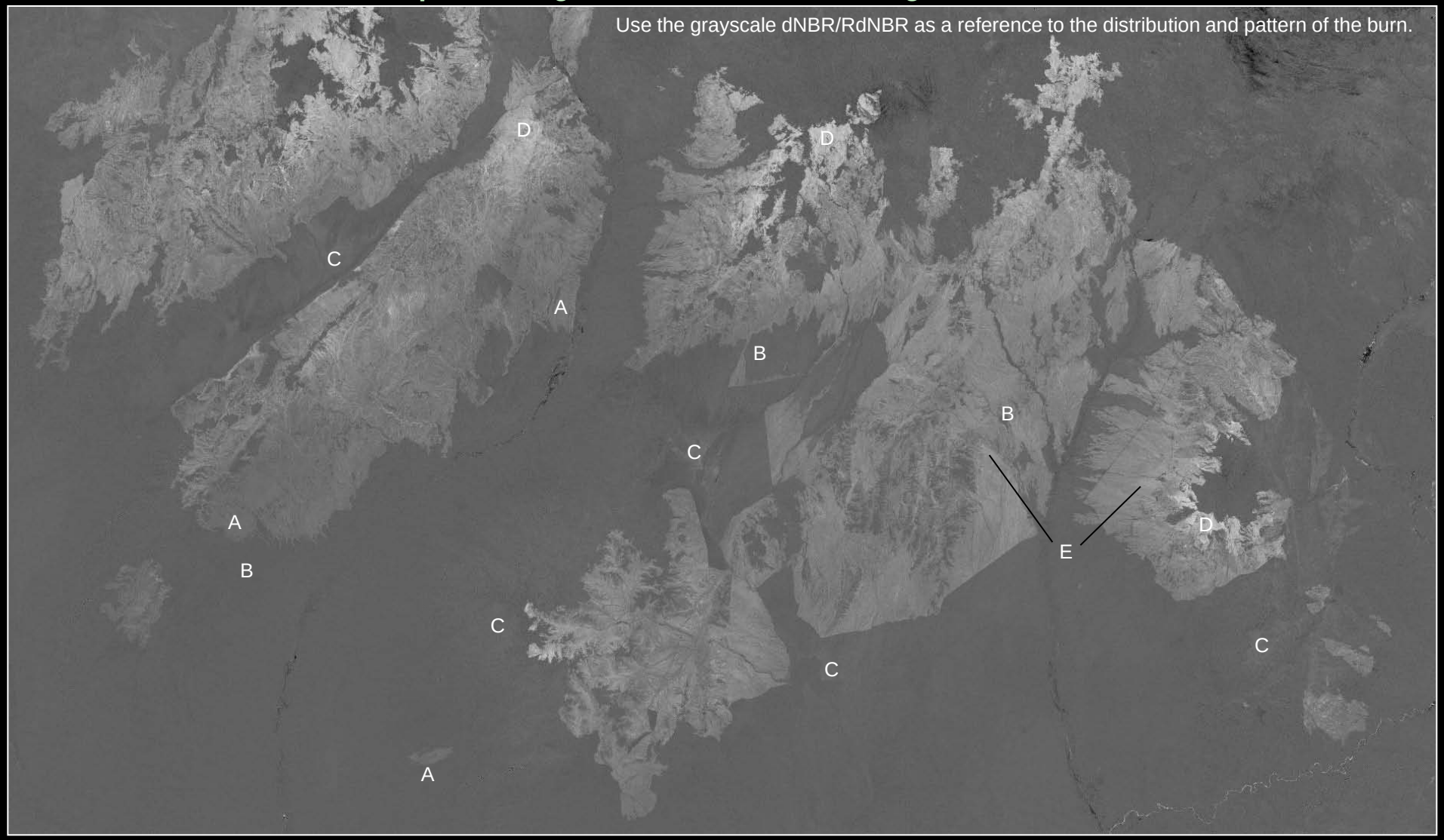
* - Areas in either the pre-fire or post-fire reflectance data containing clouds, snow, shadows, smoke, significantly sized water bodies or missing lines of data

0 0.25 0.5 0.75 1 miles

Acreage of Burn Severity

Burn Severity	Acres
Unburned to Low	186
Low	544
Moderate	560
High	357
Increased Greenness	0
Non-Processing Area Mask*	0
Total	**1,647**

MTBS workshops, training materials on thresholding, dNBR calibration etc.

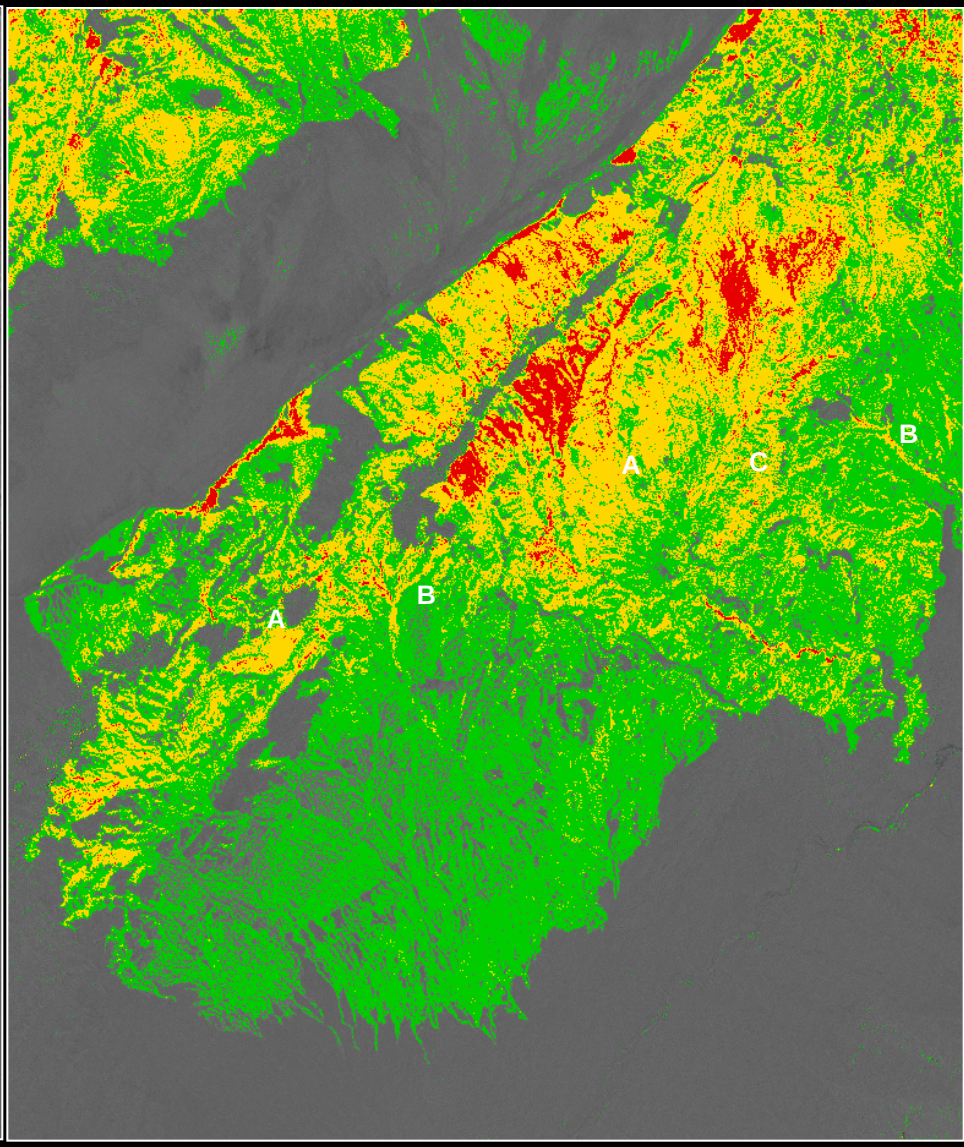


Look for the faintest areas of burn (A) that are distinct from nearby unburned. Find typical areas or islands of uniform unburned (B). The low threshold should include most of A, while B remains mostly unclassified (unburned). Low pixels are expected to show up in B, since value-ranges within categories overlap along the dNBR gradient. Find a happy medium between low pixels in B, and unburned pixels in A. The low threshold probably should be lowered if there are no low pixels in B. Minimize low in unburned (B), but also minimize unburned in low (A). Small unburned patches in the burn (B) should remain reasonably well defined after setting a low threshold. The MTBS "unburned to low" category is defined to include some burned area.

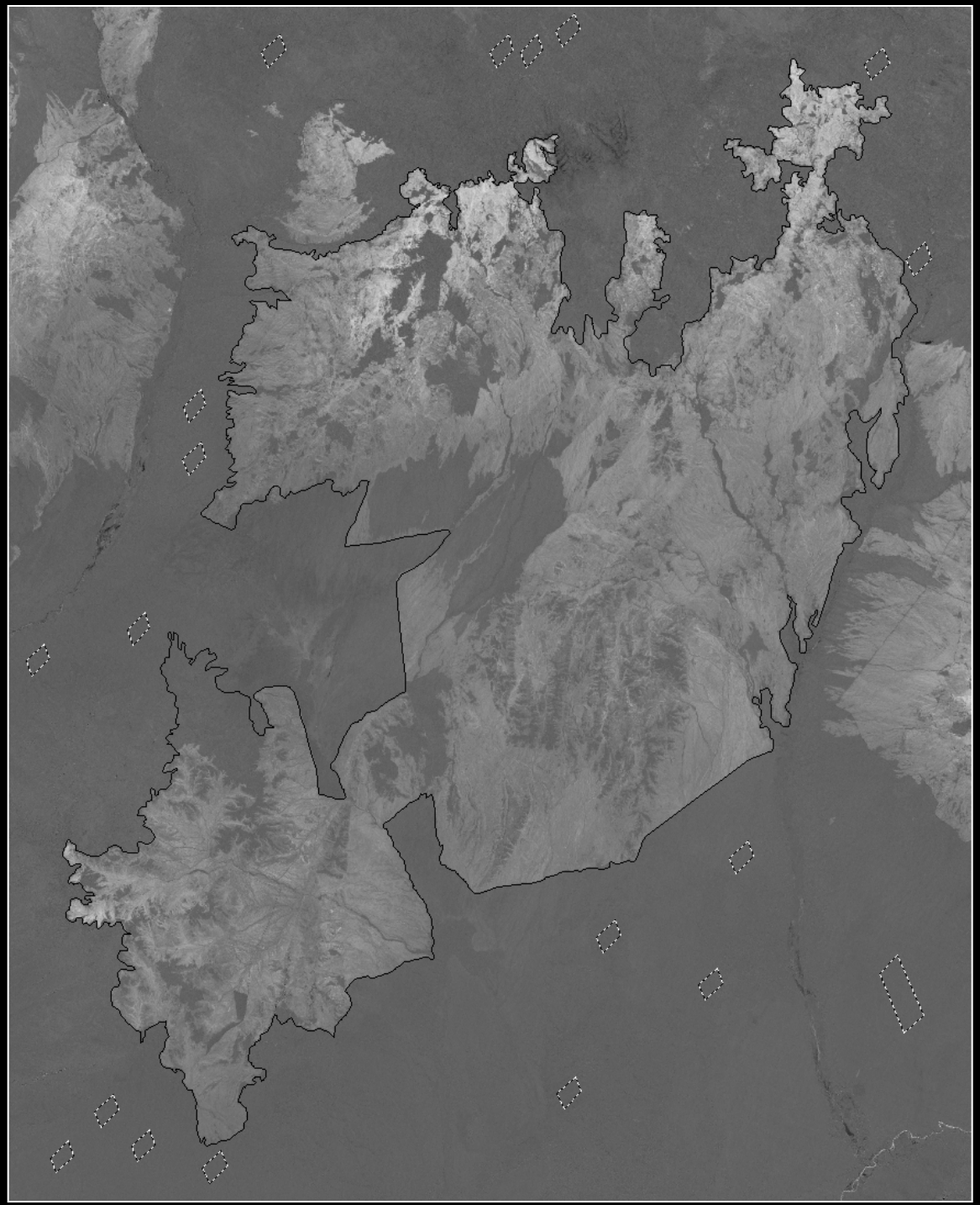
C – Note areas outside the burn that are lighter than other more typical unburned areas, where detected changes are not likely due to fire. Do not be too concerned about "burn pixels" showing up here in quantity or patches. Also, avoid these areas when sampling for the unchanged mean value (i.e. unburned bias). This dNBR is good; it has little variation in unburned.

D – Note brighter areas in the burn are not well delimited and rather nebulous, spread over the highest ridges from which there is only gradual decrease into lower-change values. Thus, one should not expect very clear demarcation between moderate and high classes. One can try to find some smaller candidate training areas like (E) where slight distinctions appear.

Thresholds: Unburned dNBR >= 70 set to 0.80 Green, Moderate dNBR >= 170 Gold, High dNBR >= 300 set to 0.90 Red



At a 170 threshold, some of the lighter dNBR pattern seems to fill out, e.g. B, and a little more uniformity within yellow patches like A. At 160 threshold, the previous trends continue, but now there begins to be a breakdown in the green pattern, e.g. some areas around A and C (smaller more fragmented spots). There is no clear breakpoint between 200 and 160, however, as changes in the classification occur gradually by similar increments of pixels. If you move this slide up below slide 16 (200 threshold) and flicker between the two, the impression is that 200 is too high and 160 is probably getting too low for a moderate threshold. Both 170 and 180 seem reasonable. One needs examine other areas in default zoom to confirm. Go back and forth between slides to see the affect.



The Unburned Bias: Total Sample for IA.

The previous AOI's outlined general areas where it looked suitable to sample. Now, we consider a complete lay-out of actual samples for the burn.

As far as overall sample size is concerned, at least 10,000 pixels is recommended. That sounds like a lot, but it's not such a large area. The upper AOI in the previous slide (E-F) is about 12,000 pixels.

More pixels are desirable, as well as large AOI. This tends to lessen the influence of included undesirable pixels on the mean. Larger AOI are also more practical and efficient to create. But do not sacrifice quality by including a lot of garbage in order to get larger sample sizes.

The SNC IA lends itself to ease of sampling with larger AOI. Certainly the AOI in previous slides could have been used. However, to emphasize getting samples from around the burn, and to illustrate a technique that may save time in more difficult situations, another option is illustrated.

Create one or a couple standard-shape AOI and just copy and paste those (several at once) to various localities. By pasting similar numbers of these in each region, one can try to equalize the number of pixels sampled around the burn.

The AOI object needs to be small enough so it does not include unwanted variation where the smallest target patch is located. It is helpful to find that smallest target first. I started with one of the north patches. If the AOI object fits there, the same object should fit in other locations, avoiding further adjustments.

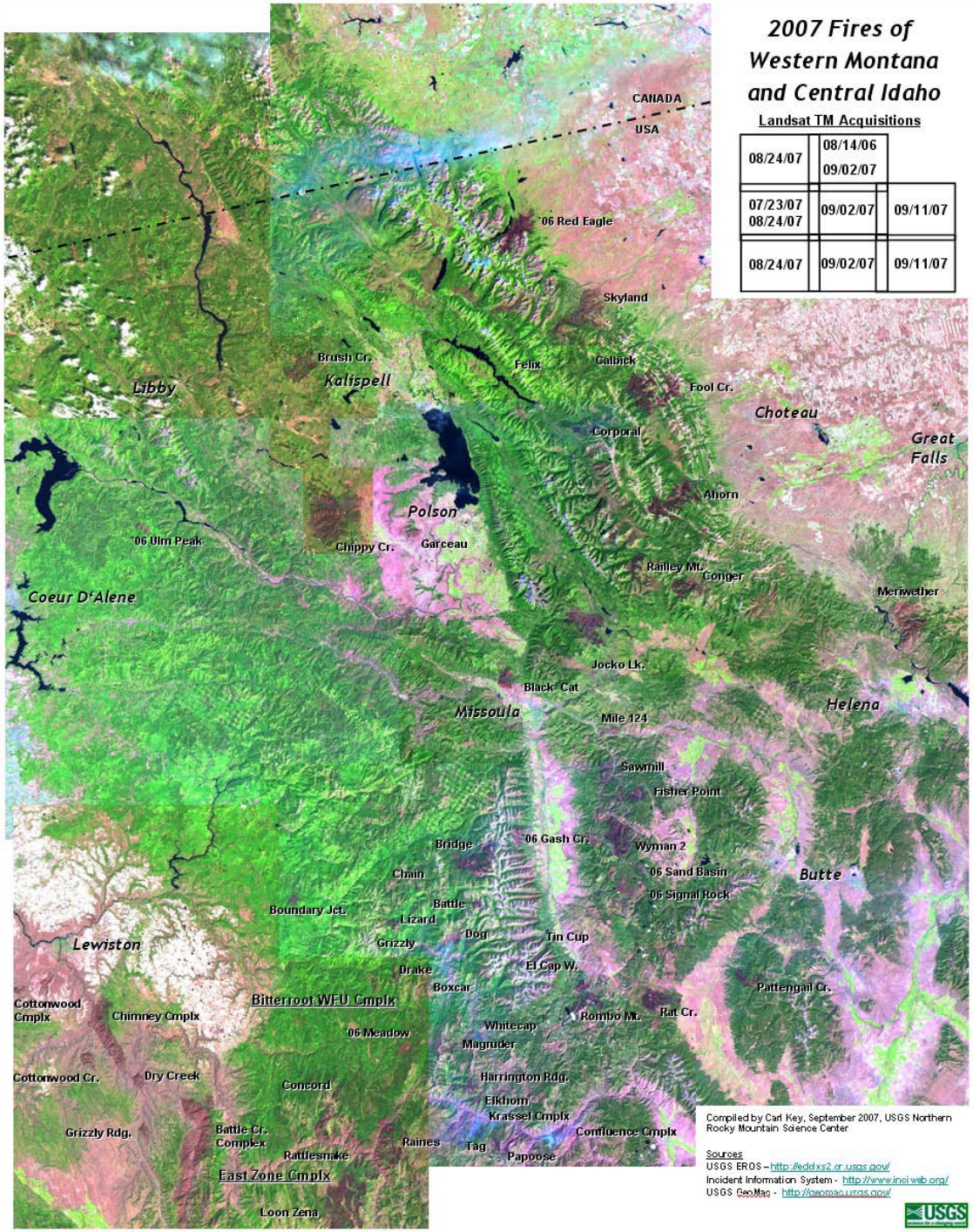
You can convert the square-meter size of the first AOI (through AOI element properties) to pixels, and determine how many are needed. In this case, one AOI ≈ 1288 pixels. About 4 samples were taken from each region. I ended up with 22 or over 28,000 pixels total. Good enough; you could do more if you like.

I also created an AOI (lower right) which was 4 times the original to get more pixels in one. I could have used 4X versions in the other expansive areas. One could even double that for some of the larger areas; many configurations are possible.

2007 Fires of Western Montana and Central Idaho

Landsat TM Acquisitions

08/24/07	08/14/06 09/02/07	
07/23/07 08/24/07	09/02/07	09/11/07
08/24/07	09/02/07	09/11/07



Compiled by Carl Key, September 2007, USGS Northern Rocky Mountain Science Center

Sources
USGS EROS – http://edcdaac.usgs.gov/
Incident Information System - http://www.inciweb.org/
USGS GeoMac - http://geomac.usgs.gov/

Considerations for Remote Sensing on Southeastern Burns.

Carl Key, U.S. Geological Survey, Northern Rocky Mountain Science Center, carl_key@usgs.gov
Nathan Benson, National Park Service, National Interagency Fire Center, nate_benson@nps.gov
Duncan Lutes, U.S. Forest Service, Missoula Fire Sciences Lab, dlutes@fs.fed.us

Both initial and extended assessments may be necessary to detect landscape effects concealed due to southeastern burning conditions.

Abstract: No matter what remote sensing approach is applied, timing and environmental factors greatly influence fire effects detection and evaluation quality. Particularly in the southeastern U.S., several factors control the ability to map and characterize burned areas. First, areas tend to be vegetatively productive under relatively warm and moist climate. Regrowth may be rapid and dense following fire, while clouds and haze often reduce data suitability. Second, many tree and shrub species can resprout from burned canopies, so observations too near the time of fire can be misleading about the actual impact from mortality. Both these factors argue for remote sensing at two intervals post fire. Once soon after fire to better detect the extent of burning and changes to surface fuels, and then again some months later when comparison to the earlier sampling can reveal the extent of survivorship and mortality. This strategy is hindered, however, because many fires occur in October through February, a period of low sun angle and leaf-off conditions. Low illumination and shadow created by low sun elevation is most detrimental, yielding very low to no discrimination of effects over significant areas. Moreover, leaf-off conditions mean that litter and ground fuel may be charred or consumed, but little impact to live crowns can be detected. When fire intensity is low, mostly unaffected canopies leaf out the following spring and show little change from before fire, making portions of the burn essentially indiscernible. Again, conditions argue for two samplings by remote sensing, and a blending of results for the final assessment of the burn.

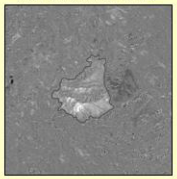
Late Fall burn, leaf off. The *Green Mountain Fire*, Great Smoky Mountains National Park. 2313 ac, started November 20, 2001.

Initial Assessment (IA)

12/01/2000 Pre-fire

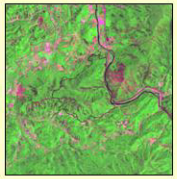
12/04/2001 Post-fire

Initial Assessment dNBR



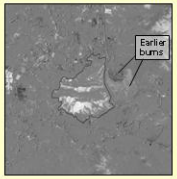
Extended Assessment (EA)

05/16/2000 Pre-fire



05/22/2002 Post-fire

Extended Assessment dNBR



December imagery detects the fire scar, but low illumination and shadow make patterns less clear. Speckling (artificially high + or –values) signifies less than meaningful reflectance levels. IA is useful to show footprint of the burn, especially where plants will exhibit little lasting affect from fire, and leaf out by next spring. EA shows higher values where dead and charred canopies persist, because effects contrast more with green pre-fire vegetation, compared to IA where pre-fire vegetation is senescent. Such areas are reported as higher severity in EA than in IA. Areas with detected change in IA but little to no change in EA are interpreted as burned with low severity.

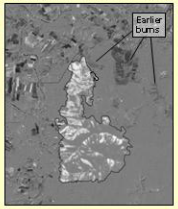
Late Winter burn, leaf off. The *Fultz Run Fire*, Shenandoah National Park. 4323 ac, started February 26, 2002.

Extended Assessment (EA)

05/26/2000 Pre-fire

05/24/2002 Post-fire

Early Extended Assessment dNBR

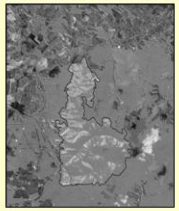


Extended Assessment (EA)

07/19/1999 Pre-fire

08/12/2002 Post-fire

Late Extended Assessment dNBR



First assessment opportunity followed spring green-up; IA imagery was not adequate. Early EA is sufficient to define perimeter, and indicate high degrees of change and patchiness. Where little change is detected, underburning with low-severity effects are likely, e.g. canopies fully leafed out to pre-fire levels. Patch distribution is essentially the same by mid-August EA, indicating persistent effects, but dNBR magnitudes are generally reduced, most likely due to regrowth.

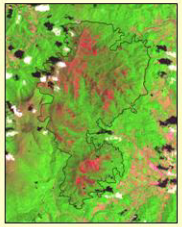
We gratefully acknowledge assistance and support from the USGS Center for Earth Resource Observation and Science (EROS), the USGS-NPS Burn Severity Mapping Project, and NPS Fire Ecologists and Fire Monitors from Shenandoah NP, Great Smoky Mountains NP, and Tall Timbers Research Station.

Late Fall burn, leaf off. The *Shenandoah Complex*, Shenandoah National Park. 22,226 ac, started November 1, 2000.

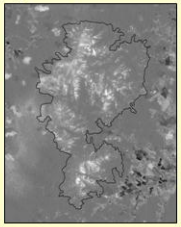
Extended Assessment (EA)

05/26/2000 Pre-fire

05/13/2001 Post-fire



Early Extended Assessment dNBR



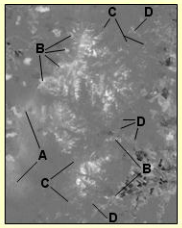
With no imagery available for IA, the EA dNBR alone can be confusing for this type of burn. Only careful comparison of scenes with dNBR helps locate perimeter. Considerations:

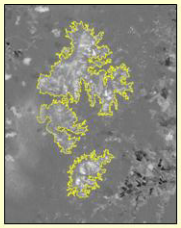
A) Phenology less advanced at high elevation in post-fire scene.

B) Clouds and cloud shadow.

C) Small-scale mottled burn pattern, disjunct spots.

D) Features present in pre-fire scene, not likely fire related.





Major revisions were needed to first perimeter, bottom right, generated from an automated routine.

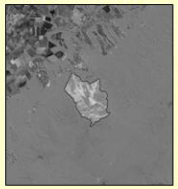
Summer burn, leaf on. The *Rocky Top Fire*, Shenandoah National Park. 1468 ac, started June 21, 2002.

Initial Assessment (IA)

07/19/1999 Pre-fire

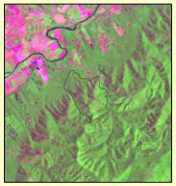
08/12/2002 Post-fire

Initial Assessment dNBR



Extended Assessment (EA)

06/30/2001 Pre-fire



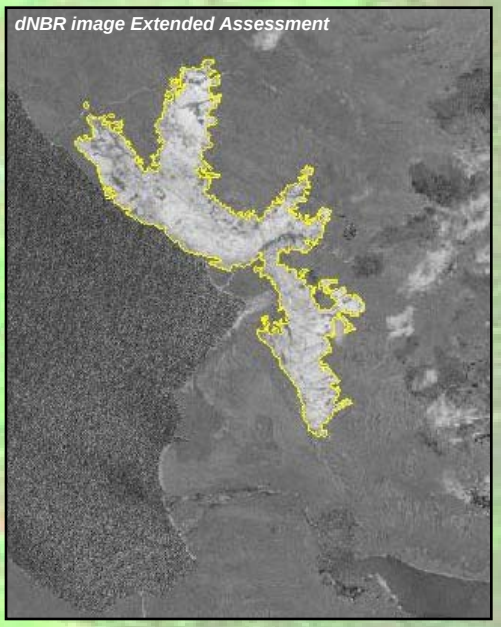
07/06/2003 Post-fire

Extended Assessment dNBR

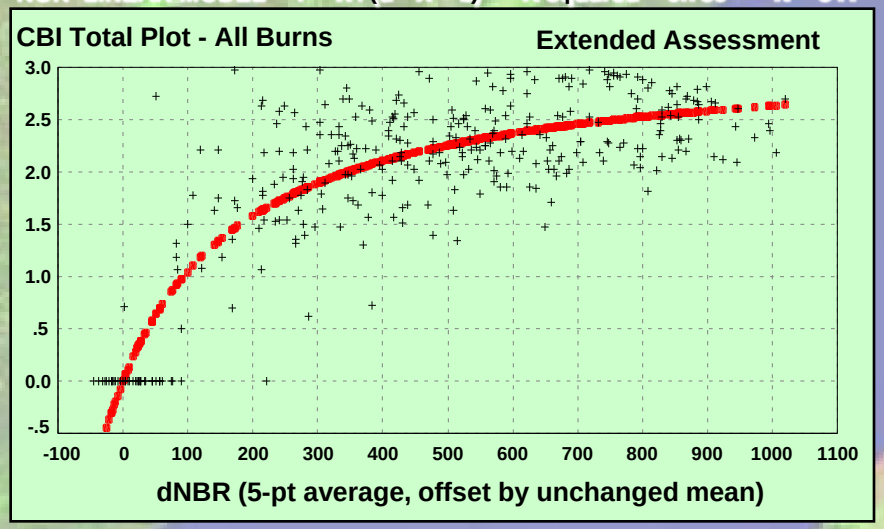
The burn pattern and dNBR gradient are very similar between IA and EA, indicating relatively high severity persisting a full year after fire. Such results may be a function of burning when canopy fuels are greater, resulting in higher fire intensity and mortality, compared to fall or winter burns that seem to recover more quickly when only litter and light fuels burn. Clouds impact the EA, a common regional problem, but shadows tend to be less detrimental to dNBR than the cloud itself.

Burn Plots from Alaska USFWS 2004 Fires

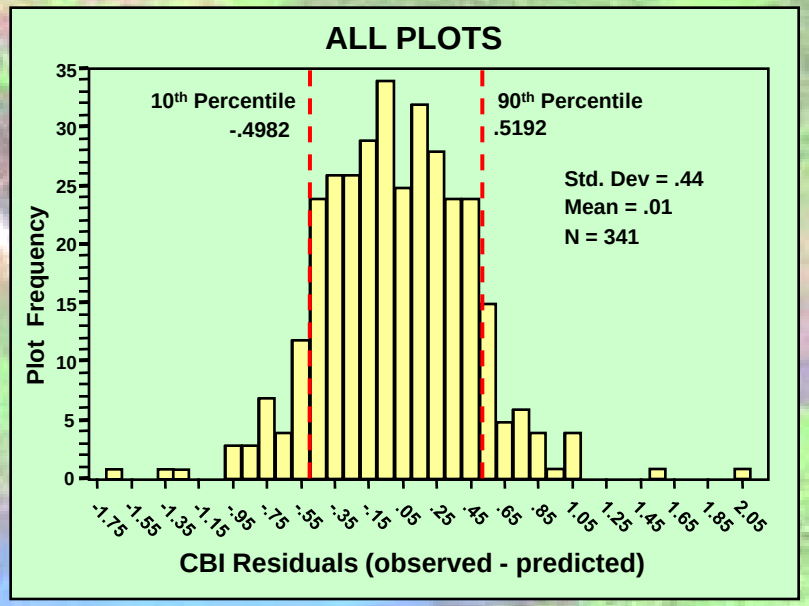
2004 Glacier Creek Burn, Kenai AK

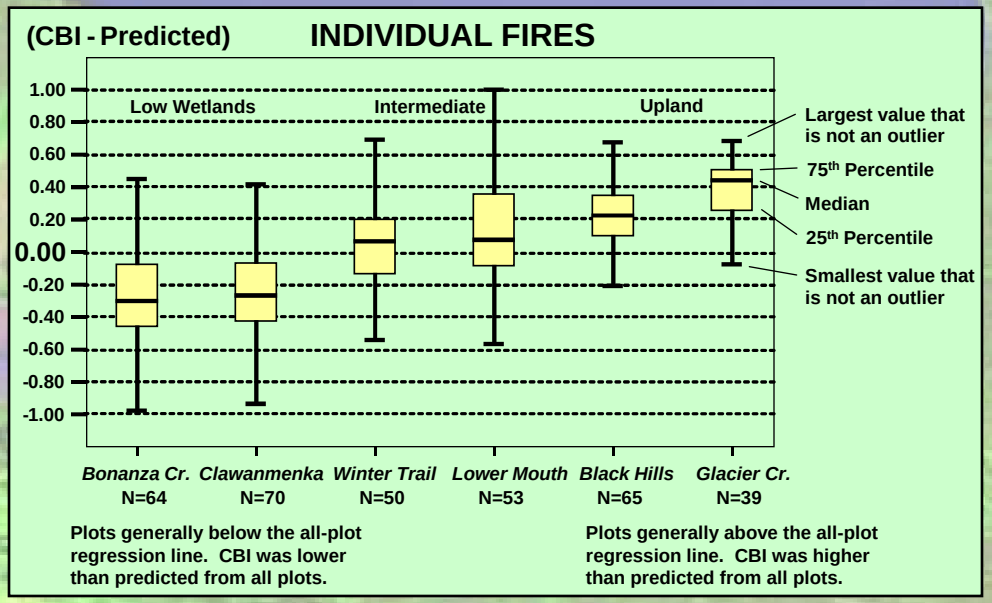


NON–LINEAR MODEL Y = X / (a * X + b) R squared = 0.730 N = 341

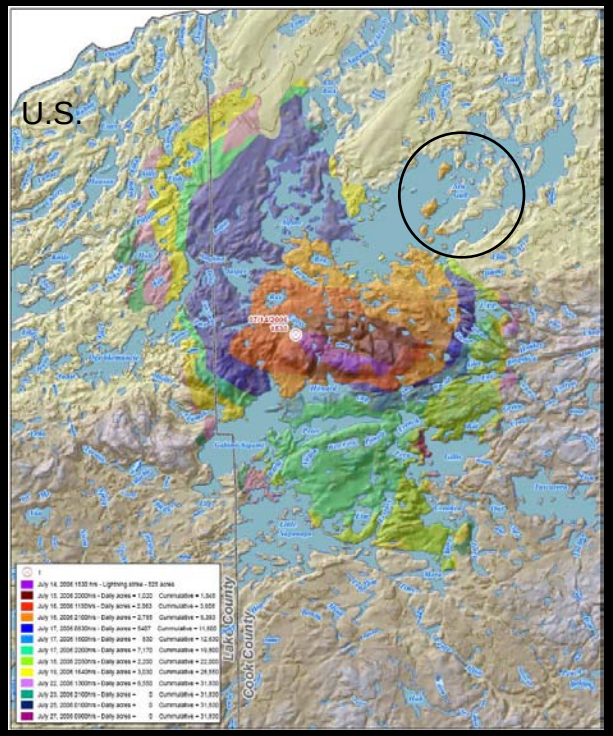


RESIDUAL VALUES FROM NON-LINEAR MODEL USING ALL PLOTS. N = 341

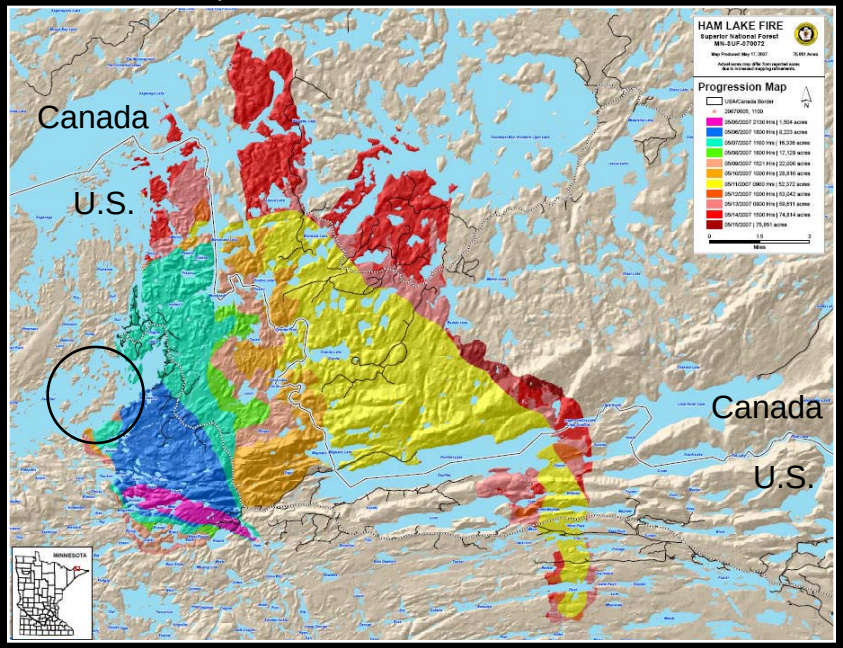


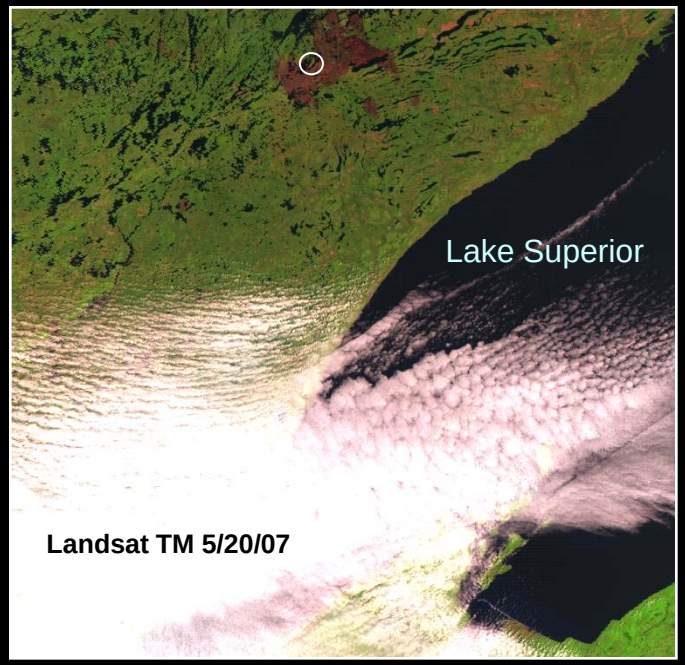


Cavity Lake Fire July 14, 2006
32,000 Ac.



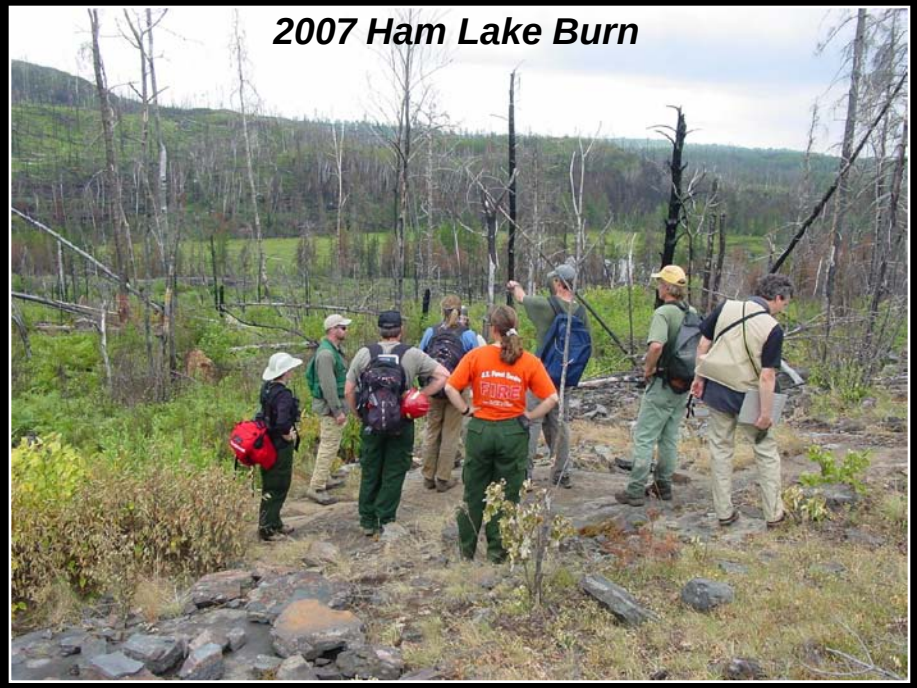
Ham Lake Fire May 5, 2007
76,000 Ac.





Superior National Forest &
Boundary Waters Canoe Area

2007 Ham Lake Burn



C. Key, N. Benson, J. Clark Photos

C. Key Photos

2006 Cavity Lake Burn

C. Key Photos

C. Key Photos

2006 Cavity Lake Burn from Seagull Lake

2007 Ham Lake Burn

C. Key Photos

Key, C.H. 2006. *Ecological and sampling constraints on defining landscape fire severity.* Fire Ecology: 2(2): 178-203.

Keane, R.E.; J. Agee; P. Fule; J. Keeley; C. Key; S. Kitchen; R. Miller; and L. Schulte. (in press). *The ecological effect of large fires in North America: benefit or catastrophe.* International Journal of Wildland Fire. [2007].

Zhu, Z.; C. Key; D. Ohlen; N. Benson. 2006. *Evaluate Sensitivities of Burn-Severity Mapping Algorithms for Different Ecosystems and Fire Histories in the United States.* Final Report to the Joint Fire Science Program, Project JFSP 01-1-4-12: 35pp. Submitted 10/12/2006, Revised and updated 9/21/2007.

Fire Ecology and Management Congress, San Diego CA, Nov 2006:

At least 19 papers and 6 posters incorporated the Normalized Burn Ratio, the Composite Burn Index, and/or spatial data that we produced.

C. Key Photo