

Operational Use of Landsat in the Intermountain West

Current Examples of Resource Agency Applications



USDA Forest Service, Remote Sensing Applications Center,
FSWeb: <http://fsweb.rsac.fs.fed.us>
WWW: <http://www.fs.fed.us/eng/rsac/>

Remote Sensing Applications Center (RSAC)

RSAC Mission:

- Technical support - evaluating and developing remote sensing, image processing, GIS, GPS, and related geospatial technologies.
- Project support and assistance using remote sensing technologies.
- Technology transfer and training to field users.

Operational Applications of Landsat are Extensive, Diverse & Critical

- Mid-level vegetation mapping applications
- Landfire refresh
- TEUI – basis for natural breaks and classification
- Whitebark pine change detection
- Aspen decline
- Forest health - risk maps
- Great lakes change detection
- National all-lands disturbance mapping - MTLC
- FAO Land cover change
- Groundwater Dependent Ecosystem (GDE) Inventory
- Strata for inventory - bare earth on WCU
- Imputation using FIA plots
- Disaster assessment - hurricanes, tornadoes, etc
- Post-fire mapping & monitoring applications



Representative Landsat-based Applications Significant to ID and the IW

- Disturbance Mapping - Fire
 - Monitoring Trends in Burn Severity
- Existing Vegetation Mapping
 - Intermountain Region Forests
- Forest Health Monitoring
 - Whitebark Pine Mortality

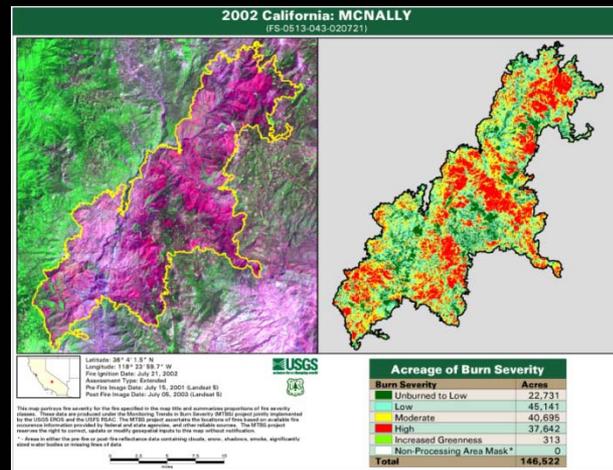
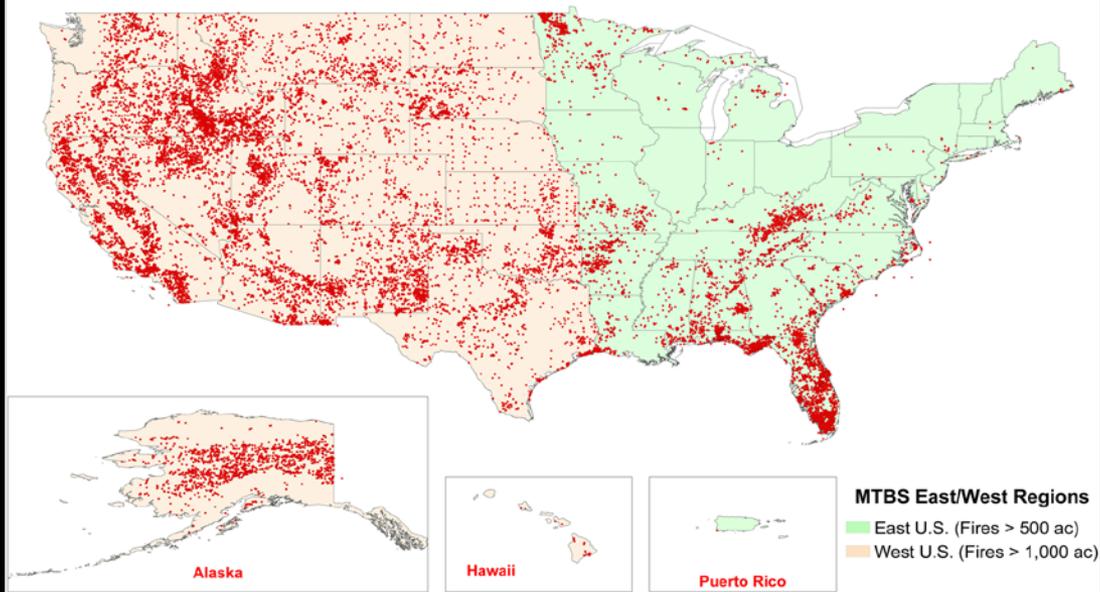


Monitoring Trends in Burn Severity (MTBS)

<http://www.mtbs.gov>

Consistently map the burned areas and associated severity of large fires on all lands in the United States from 1984 to 2010

Fire Occurrence Locations Provided By Federal, State Agencies and Other Organizations (1984-2008)



Monitoring Trends in Burn Severity (MTBS)

Online MTBS Data Summaries

Step 1. Select Database and Reporting Period
Step 2. Select Area of Interest and Summary Tables
Step 3. Review Query Logic
Step 4. Display Results

Burn Severity (default selection) | Burn Severity by Lifeform | Burn Severity by Ownership

Graph by:
 State
 Year

California
Oregon

Legend

- Unburned to Low
- Low
- Moderate
- High
- Increased Greenness

View Table | View Graph

New Search | Download

Ownership | Acres

Ownership	Acres
BLM	1,438
Non-Government	2,077
RPS	0
Other Federal	0
State/County	0
USFS	21,156
USFWS	0

User Guide

Forest Service: USGS, USFS, RSAC, MTBS

Jointly implemented by USFS and USGS

• Geospatial data distributed through web-based portals



Burn Severity (default selection)

Burn Severity by Lifeform

Burn Severity by Ownership

Graph by:

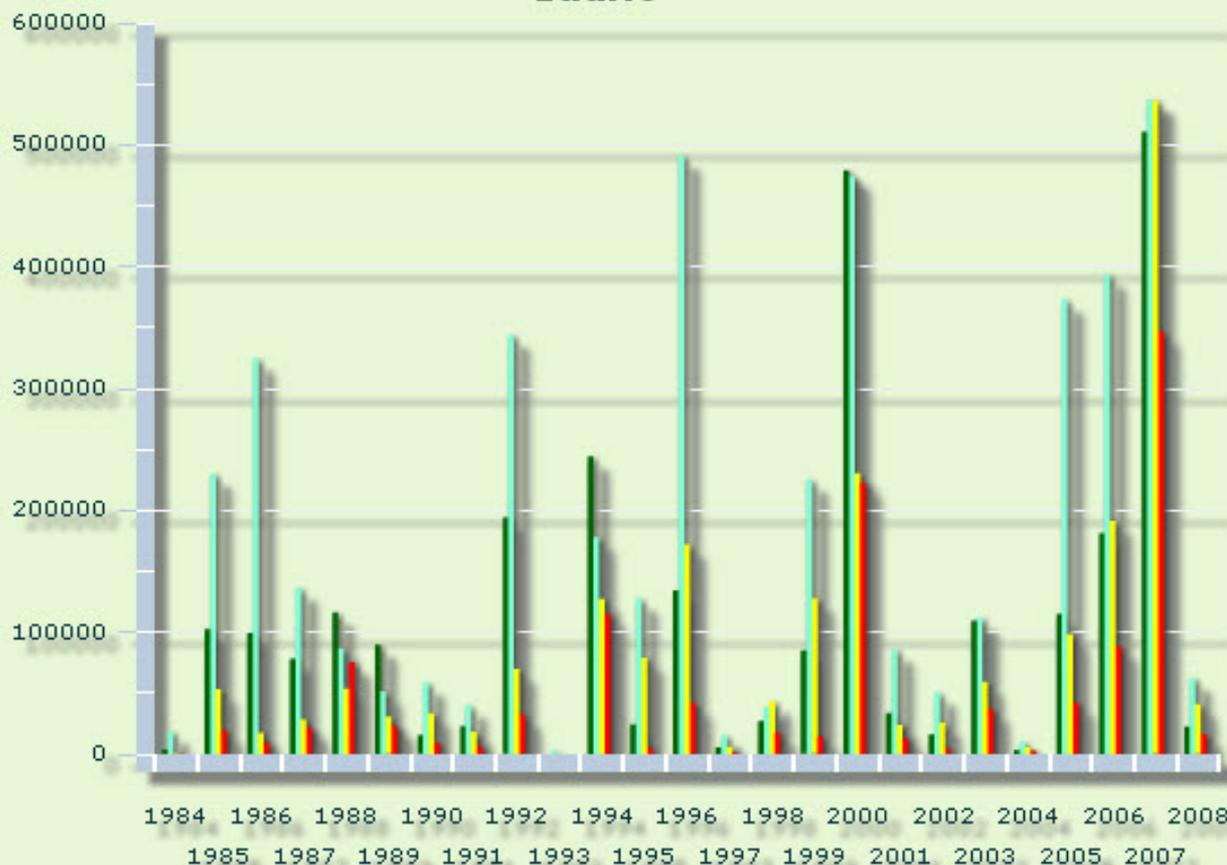
- State
- Year

Idaho

Legend

-  Unburned to Low
-  Low
-  Moderate
-  High
-  Increased Greenness

Idaho



 View Table

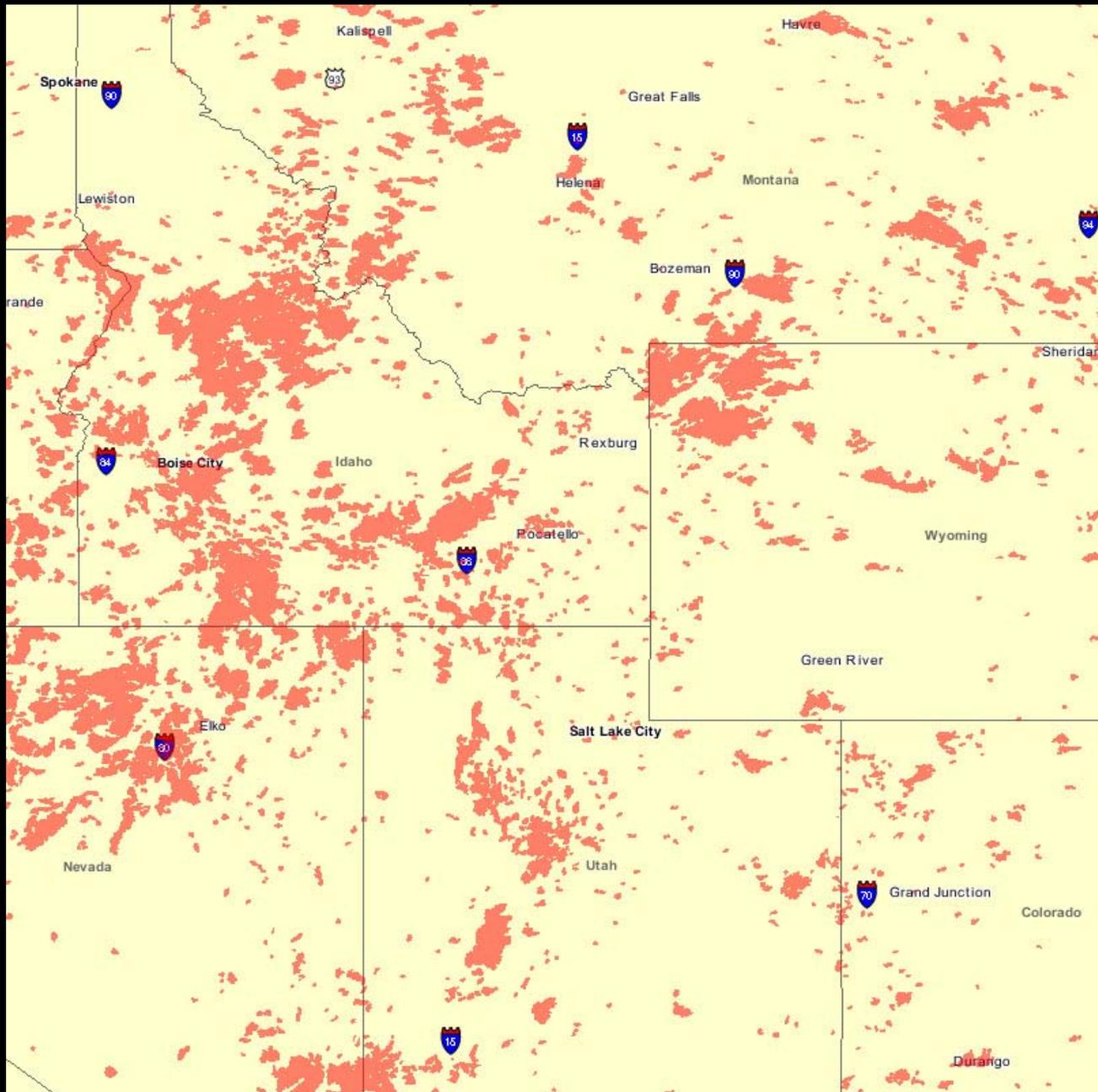
 View Graph

User Guide

 New Search

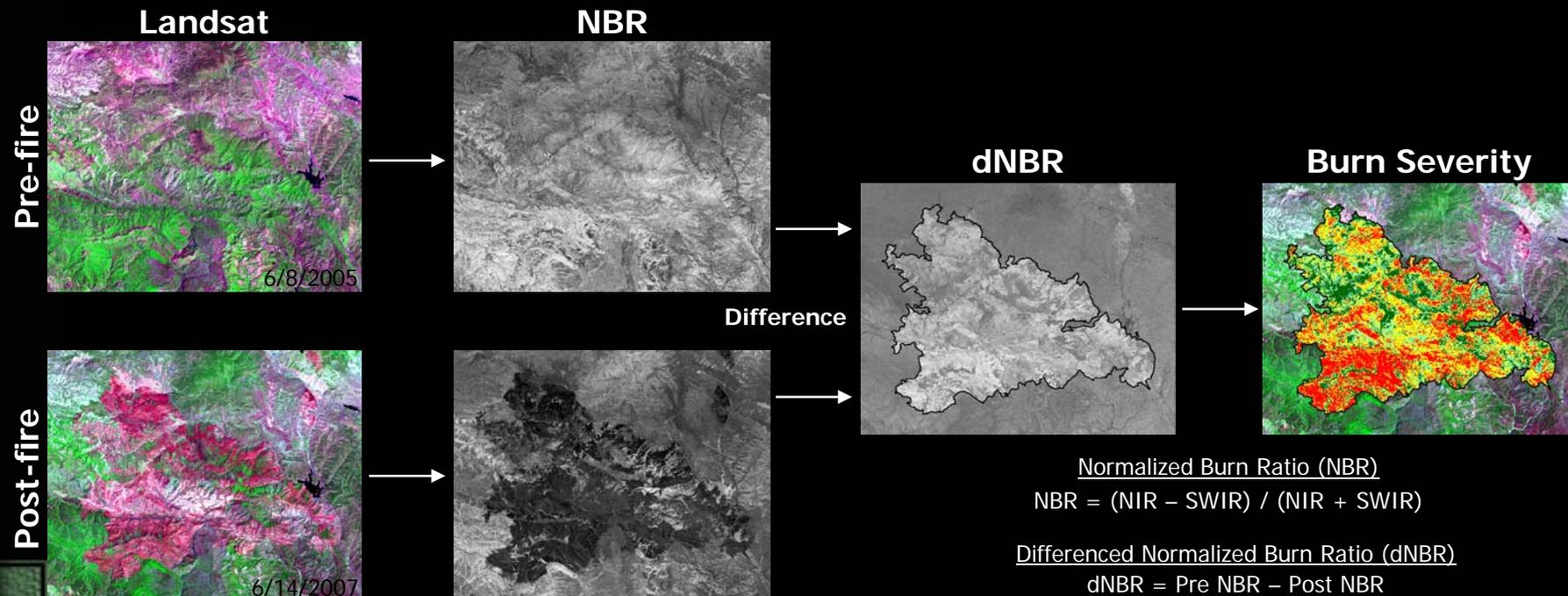
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Data Processing Overview

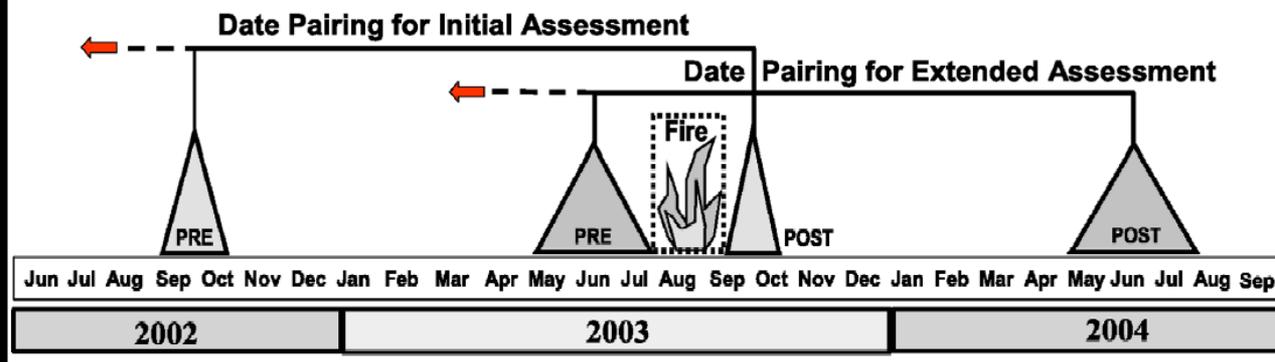
- Compile a single MTBS fire occurrence database (FOD) from existing data sources
- Based on FOD and prescribed assessment strategy, select pre and post-fire Landsat scenes
- Landsat TM/ETM+ data ordered and acquired from EROS
- Analysts perform necessary image pre-processing, image differencing, burned scar delineation and threshold dNBR images into burn severity classes
- Metadata, map products, burn severity data analysis and summary, and reporting



MTBS Assessment Strategy

- Based on fire type
 - Extended Assessment (EA)
 - Severity based on post-fire assessment at peak of green of next growing season
 - Forests/shrublands
 - Initial Assessment (IA)
 - Severity based on immediate post-fire assessment
 - Grasslands/shrublands
 - “Single Scene” Assessment
 - Lack of suitable pre-fire imagery or other factors; use post-fire NBR
 - Conducted on a limited basis (EAs and IAs)

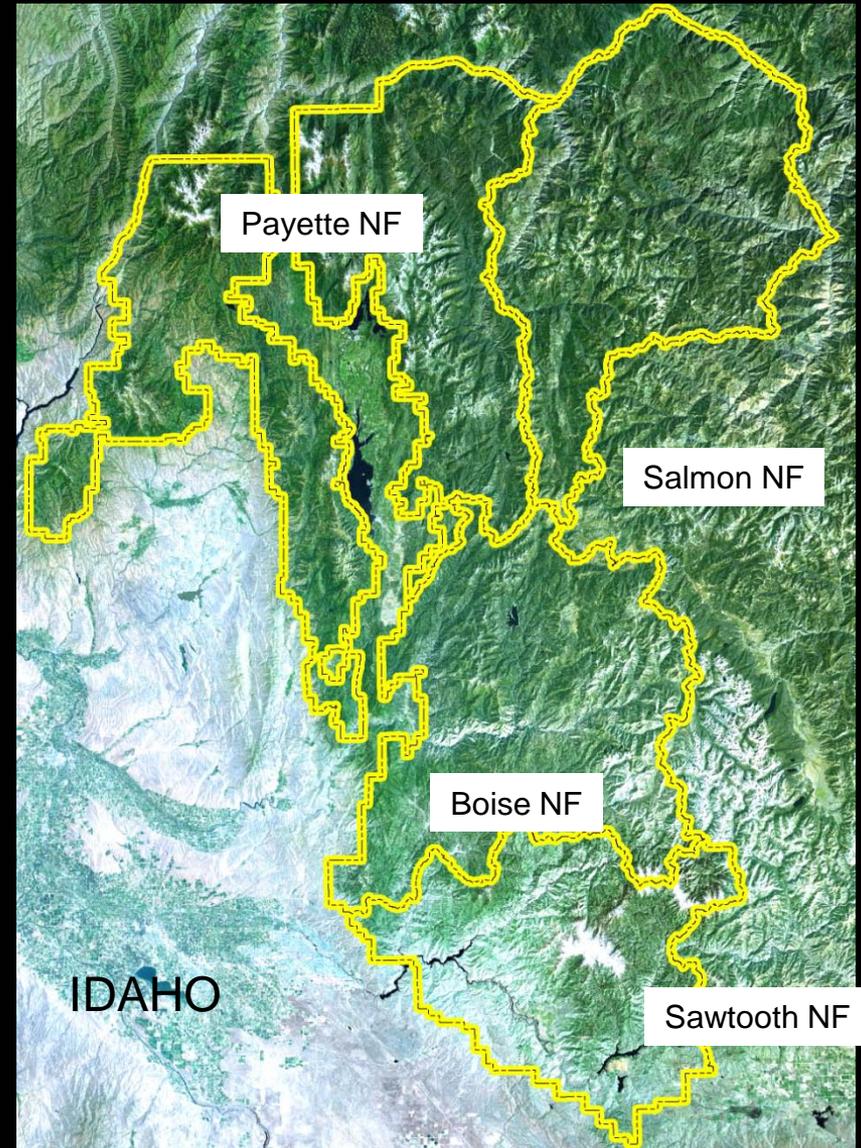
Landsat Acquisition Scenarios Relative to Time of Fire.



Existing Vegetation Mid-Level Mapping

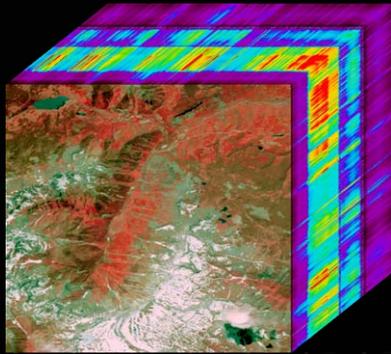
Current projects include:

- Boise/Payette:
 - 5 million acres
 - 5 Landsat path/rows x 3 dates
- Caribou Targhee:
 - 3 million acres
 - 6 Landsat path/rows x 3 dates
- Sawtooth:
 - million acres
 - 5 Landsat path/rows x 3 dates
- Salmon Challis:
 - 4.3 million acres
 - 5 Landsat path/rows x 3 dates



Existing Vegetation Mid-Level Mapping

- Process relies on Landsat imagery
- Develop information based on national standards for mid-level mapping
- Dominance type, canopy cover, size



Input image-cube



Field & PI training sites



```
See5 [Release 1.19] Tue Mar 02 17:35:24 2004

Options
  10 boosting trials
  Probability thresholds

Class specified by attribute 'Rip-NonRip'
Read 1762 cases (55 attributes) from rip01_4_seef5.data
----- Trial 0: -----
Decision tree:
sr_dq3a_m0_10a_tnt_img <= 98 (104 5):
  ... sr_cn_b4_img >= 82 (81 5):
    ... sr_wetness10a_clip_img <= 122 (129 5): 0 (45/3)
    ... sr_wetness10a_clip_img >= 130 (129 5): 1 (19)
  ... sr_cn_b4_img <= 91 (81 5):
    ... sr_strdistance_img > 3 (2 5): 0 (980/3)
    ... sr_cn_tcag_b2_img <= 129 (145 5): 0 (36/2)
    ... sr_cn_tcag_b2_img >= 153 (145 5): 1 (3)
  ... sr_dq3a_m0_10a_tnt_img <= 108 (104 5):
    ... sr_cn_mdvi_img <= 50 (53 5):
      ... sr_slope10a_pct_clip_img <= 6 (7): 1 (5)
      ... sr_slope10a_pct_clip_img >= 8 (7):
        ... sr_off_tcag_b2_img <= 116 (115 5): 1 (4/1)
        ... sr_off_tcag_b2_img >= 115 (115 5):
          ... sr_dq3a_m0_10a_tnt_img >= 91 (89 5): 0 (62)
          ... sr_dq3a_m0_10a_tnt_img <= 88 (89 5):
            ... sr_dq3a_m0_10a_tnt_img <= 200 (217 5): 1 (2)
            ... sr_dq3a_m0_10a_tnt_img >= 230 (217 5): 0 (2)
        ... sr_cn_mdvi_img >= 62 (53 5):
          ... sr_strdistance_img <= 3 (3 5):
            ... sr_off_b6_img <= 82 (82 5): 1 (487)
            ... sr_off_b6_img >= 89 (82 5):
              ... sr_cn_pca_b3_img <= 153 (155): 1 (21)
              ... sr_cn_pca_b3_img >= 157 (155): 0 (5/1)
            ... sr_strdistance_img >= 4 (3 5):
              ... sr_dem10a_img <= 1798 (1901): 1 (49/2)
              ... sr_dem10a_img >= 1903 (1901):
                ... sr_dq3a_m0_10a_texture_img >= 134 (132 5): 1 (6)
                ... sr_dq3a_m0_10a_texture_img <= 131 (132 5):
                  ... sr_growday_img <= 2629 (2631): 0 (30)
                  ... sr_growday_img >= 2632 (2631):
                    ... sr_93_mdvi_img <= 151 (155 5): 0 (3)
                    ... sr_93_mdvi_img >= 160 (155 5): 1 (3)
```

Data mining develops decision-trees to classify veg

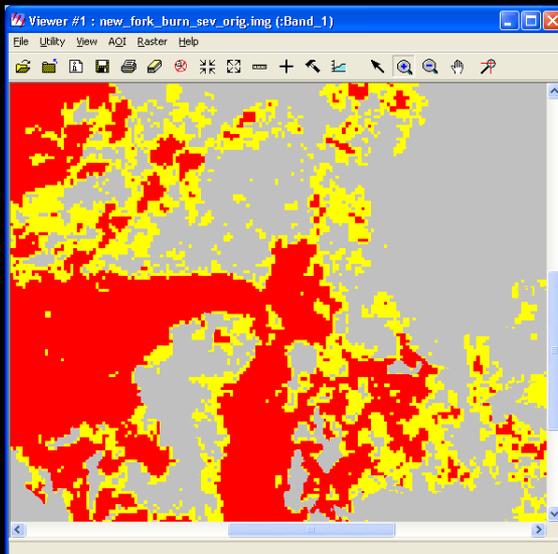


Applied to image-cube to classify & label segments

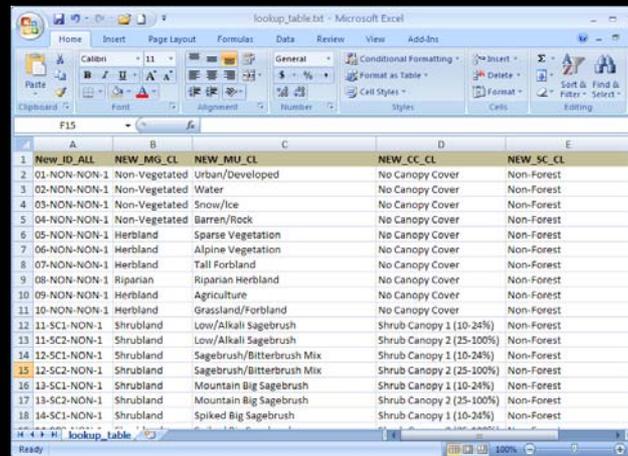


Map Updates for Mid-Level Mapping

- Updating mid-level maps
 - Humboldt-Toiyabe NF, NV
 - ~150 Landsat images used (1998-2009)
 - Bridger-Teton NF, WY
 - 10 Landsat images used (2001-2009)

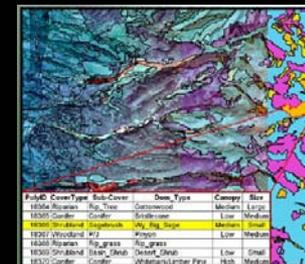


1. Disturbance maps derived from Landsat – fire, conifer mortality, harvest, etc.

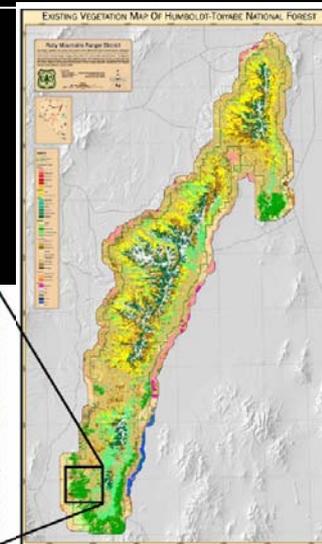


NEW_ID_ALL	NEW_IMG_CL	NEW_MU_CL	NEW_CC_CL	NEW_SC_CL
01-NON-NON-1	Non-Vegetated	Urban/Developed	No Canopy Cover	Non-Forest
02-NON-NON-1	Non-Vegetated	Water	No Canopy Cover	Non-Forest
03-NON-NON-1	Non-Vegetated	Snow/Ice	No Canopy Cover	Non-Forest
04-NON-NON-1	Non-Vegetated	Barren/Rock	No Canopy Cover	Non-Forest
05-NON-NON-1	Herbland	Sparse Vegetation	No Canopy Cover	Non-Forest
06-NON-NON-1	Herbland	Alpine Vegetation	No Canopy Cover	Non-Forest
07-NON-NON-1	Herbland	Tall Forbland	No Canopy Cover	Non-Forest
08-NON-NON-1	Riparian	Riparian Herbland	No Canopy Cover	Non-Forest
09-NON-NON-1	Herbland	Agriculture	No Canopy Cover	Non-Forest
10-NON-NON-1	Herbland	Grassland/Forbland	No Canopy Cover	Non-Forest
11-SC1-NON-1	Shrubland	Low/Alkali Sagebrush	Shrub Canopy 1 (10-24%)	Non-Forest
11-SC2-NON-1	Shrubland	Low/Alkali Sagebrush	Shrub Canopy 2 (25-100%)	Non-Forest
14-SC1-NON-1	Shrubland	Sagebrush/Bitterbrush Mix	Shrub Canopy 1 (10-24%)	Non-Forest
15-SC2-NON-1	Shrubland	Sagebrush/Bitterbrush Mix	Shrub Canopy 2 (25-100%)	Non-Forest
16-SC1-NON-1	Shrubland	Mountain Big Sagebrush	Shrub Canopy 1 (10-24%)	Non-Forest
17-SC2-NON-1	Shrubland	Mountain Big Sagebrush	Shrub Canopy 2 (25-100%)	Non-Forest
18-SC1-NON-1	Shrubland	Spiked Big Sagebrush	Shrub Canopy 1 (10-24%)	Non-Forest

2. Develop vegetation crosswalk to reflect disturbance class

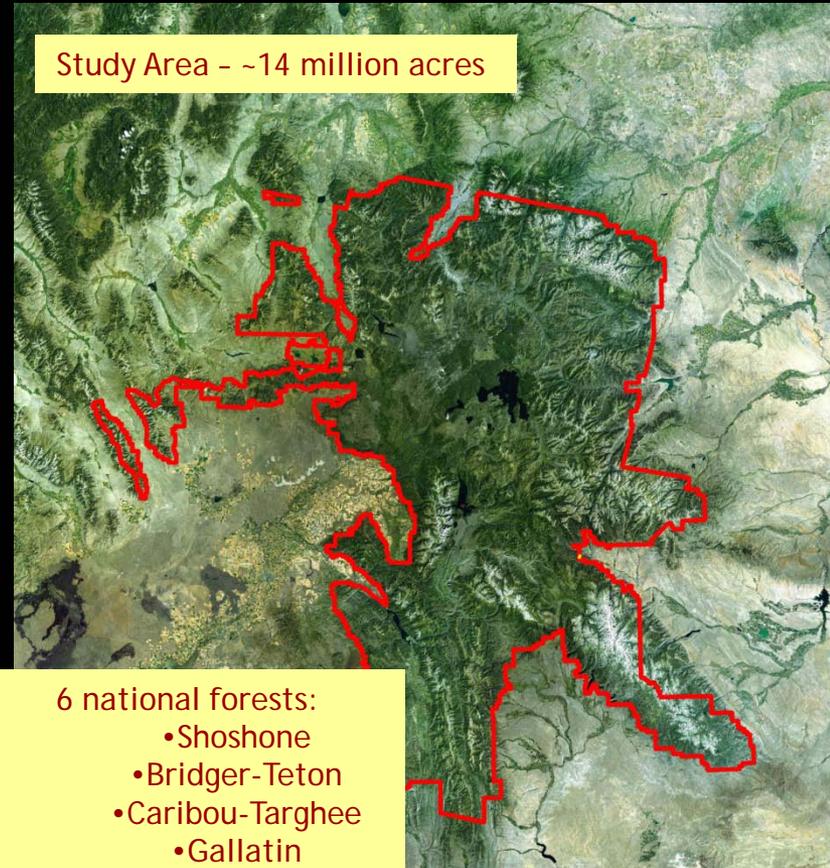


3. Integrate updates into existing vegetation map



Whitebark Pine Mortality Assessment

- Developed whitebark pine mortality map for Greater Yellowstone Area 2000-2008:
 - Used in risk assessment models
 - Aids in prioritizing restoration efforts
 - Assessing impacts of whitebark mortality on ecosystem components



- 6 national forests:
 - Shoshone
 - Bridger-Teton
 - Caribou-Targhee
 - Gallatin
 - Custer
 - Beaverhead-Deerlodge
- 2 national parks:
 - Yellowstone
 - Grand Teton

Whitebark Pine Mortality Assessment

- Landsat imagery
 - 5 path/rows
 - 2 dates, 2000 & 2007/2008
- Landfire
 - Existing vegetation type
 - Canopy closure
- USGS Whitebark pine map (S.Podruzny, C.Schwartz, R.Lawrence, L. Landenburger)
- 425 1-Hectare field plots

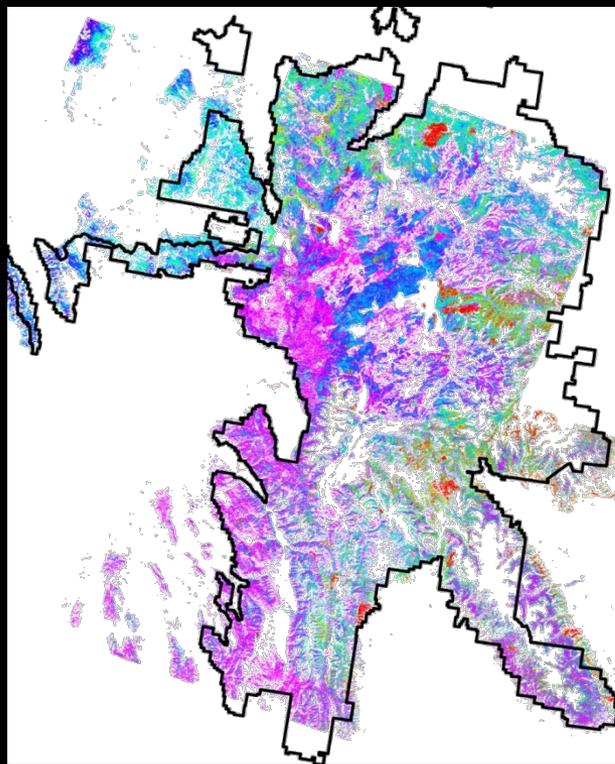


Whitebark Pine Damage Mapping Fieldsheet 2008									
Plot ID		Observers			Date, time		/ / DE, am/cm		
Observation type		On-site full	On-site fast	Off-site	Topographic		All cover %		
Fixed plot		Moved/opportunistic plot		Elevation		WbP cover		%	
Verified on plot photo		UTM N	WGS 84	Slope	ft/m	All damage		0 1 2 3 4	
GPS reading good		UTM E	UTM	Aspect	deg	WbP damage		0 1 2 3 4	
Moved		PDOP/Error				Variability		L M H	
						WbP in overstory		Y N	
						WbP in understory		Y N	
PLOT LAYOUT									
Location notes -									
SUBPLOT VISUAL ESTIMATES									
		Ctr (0)	NE (1)	SE (2)	SW (3)	NW (4)			
		Current live canopy cover, all trees (%)							
		Current live canopy cover, wbp (%)							
		Est. 2000 live canopy cover, all trees (%)							
		Est. 2000 live canopy cover, wbp (%)							
		Tree regeneration cover (%)							
		Shrub cover (%)							
		Herbaceous cover (%)							
		Unvegetated cover (%)							
		Photo codes							
		Description - forest canopy cover/total, even/uneven, species composition, tree sizes, etc.							
		Canopy sampling							
		Overstory canopy cover to nearest 10%							
		Current live		Current red/yellow		Est. 2000 live			
		5m							
		10m							
		15m							
		20m							
		25m							
		30m							
		35m							
		40m							
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		10m							
		15m							
		20m							
		25m							
		30m							
		35m							
		40m							
VISUAL CANOPY ESTIMATION GUIDE									
1% 2% 3% 5%									
7% 10% 15% 20%									
25% 30% 40% 50%									

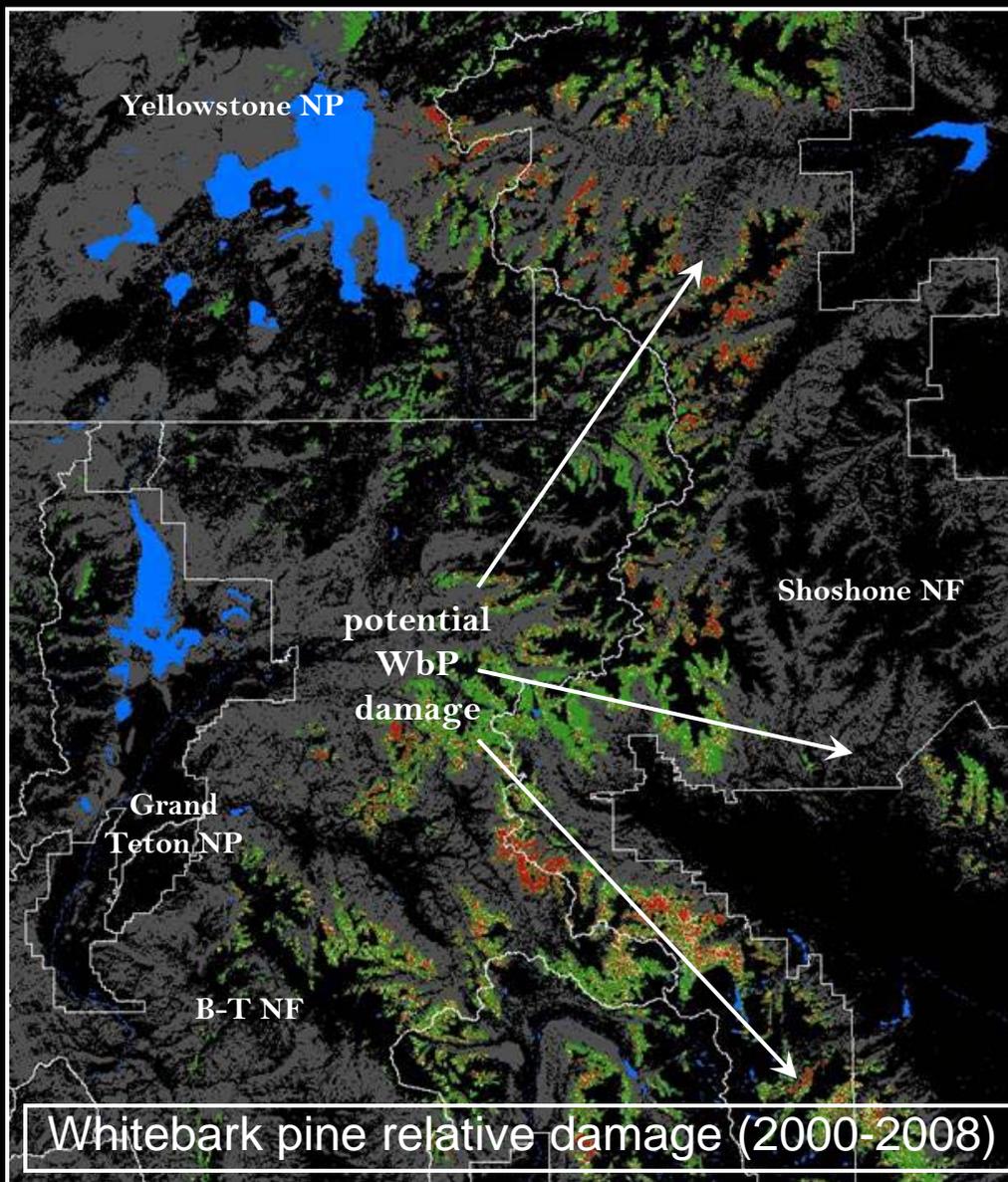


Whitebark Pine Mortality Assessment

- Products



Conifer mortality for GYA



Whitebark pine relative damage (2000-2008)



Parting Thought

Without LDCM & the NLIP,
Agencies cannot continue to assess,
monitor & manage at an adequate
level of scientific validity



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