

# NATIONAL BURN SEVERITY MAPPING PROJECT<sup>1</sup>

*Using satellite and field data to understand fire's effect on the landscape*

<http://burnseverity.cr.usgs.gov>

## NPS BURN SEVERITY ATLAS PROJECT

### **Project Definition:**

In 2001, through funding from Joint Fire Science, USGS researchers and NPS fire ecology staff started to validate Normalized Burn Ratio (NBR), a burn-area mapping algorithm, for its robust and consistent performance under different conditions of ecosystems, fire histories and vegetation effects over time. The validation was based on Landsat Thematic Mapper (TM) imagery and field data collected using Composite Burn Index (CBI), a field tool for burn-severity rating and correlating field data with TM burn maps. This validation effort complemented The National Burn Severity Mapping Project, a joint project that The National Park Service and USGS initiated in 2001. This project uses the TM imagery and NBR to map most NPS fires over 300 acres. The results from both The National Burn Severity Mapping Project and the accuracy assessment have been positive. The burn severity mapping products has been effectively distributed to NPS fire staff and they are using the results.

With increased demands for accountability, in terms of quantifying areas treated for fuels reduction, and emphasis being placed on landscape scale planning and assessing landscape condition, land managers and researchers need to have the means to accurately capture complex changes to the land that fire causes. While ocular estimates of small-scale disturbances and treatments (less than 300 acres) can accurately be made this type of estimate is inaccurate on a larger scale. Remote sensing is not only cost effective, but with the Landsat archive, the potential exists to quantify disturbances and treatments greater than 300 acres back to the early 1970's. These results can provide fundamental information for fire management: it gives managers the ability to compare results of different treatments and disturbances over time at the local, regional, and national level.

The primary goal of this project is to provide fire staff, land managers, and researcher with comprehensive burn severity information covering three decades to use for fire operations, fire and land management planning, fire regime condition class determination, and modeling. Burn severity atlases will be developed using TM imagery and the NBR burn-area mapping algorithm. Other techniques will be used for the Landsat MSS data collected prior to 1983. This will be a joint NPS and USGS effort with collaboration from the Sierra Nevada Fire and Fuels Monitoring Project. With success, this project can be applied to other agencies or adopted nationally.

---

<sup>1</sup> We define burn severity as the degree of environmental change caused by fire, the effect of fire on ecological communities comprising the landscape. The focus is on meso-scale first-order fire effects, incorporating all spatial variability averaged within a 30-meter pixel, and compositing effects over all ecological strata of the area. GIS and statistical products of this program delineate the final fire perimeter and provide information on the whole burn and large regions of burning that is more thorough than any other tool currently used by federal land management agencies. The data helps to define lasting impacts and environmental responses from fire, and to prepare for long-term management of burned areas. Because many fires cannot be closely monitored while active, post-fire evaluations also yield insight into fire behavior across varying topography and vegetation, thus contributing to basic research and modeling.

### Scope of Work:

The National Burn Severity Mapping Project will develop burn severity atlases that cover the past 20 years for at least ten NPS units. Where feasible we will use Landsat 3 data to map fires from the 1970's. The resolution of Landsat 3 data is lower and a different remote sensing algorithm will be used to generate severity maps. Also, as practical, we will use Corona satellite data to digitize burn perimeters from fires from the 1960s and within the perimeter attempt to identify unburned areas. Atlases can include cooperators' fires if the local park can provide location data.

### Potential Atlas Sites

The sites selected for this project are based on a number of considerations: completed recent burn mapping data sets, regional NPS priorities, whether the park is a FPA prototype park, extended fire histories, and ecological region. From the list below we are proposing to complete severity atlases for at least ten of the priority 1 parks. NPS units not included on the list may be completed if regional or national staff identify them as a priority.

The list of potential parks below includes fire years, all years with one fire greater than 300 acres from 1972 to 2001.

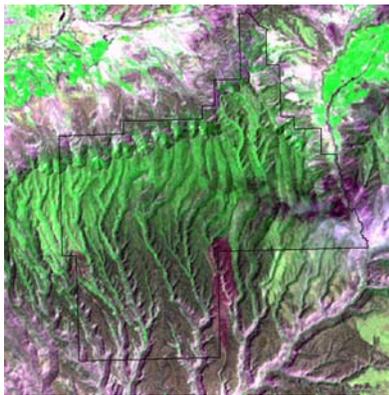
Potential Atlas Parks	# of Fire Years	Region	Priorities	Status	Lead
Denali	13	AKRO	1		NBSMP*
Yukon Charley	8	AKRO	1		NBSMP
Glacier	8	IMRO	1	80% Complete	NBSMP/USGS-BRD
Grand Canyon	16	IMRO	1		NBSMP
Grand Teton/BT	13	IMRO	1		NBSMP
Mesa Verde	6	IMRO	1	80% Complete	NBSMP/USGS-EROS
Yellowstone	10	IMRO	1		NBSMP
Buffalo	11	MWRO	1		NBSMP
Wind Cave	15	MWRO	1		NBSMP
Shenandoah	12	NERO	1		NBSMP
Lassen Volcanos	9	PWRO	1		NBSMP/SNFFM**
Sequoia Kings	26	PWRO	1		NBSMP/SNFFM
Yosemite	21	PWRO	1		NBSMP/SNFFM
Everglades	30	SERO	1		NBSMP
Great Smokey MT	11	SERO	1		NBSMP
Bandelier	7	IMRO	2		
Dinosaur	16	IMRO	2		
Saguaro	7	IMRO	2		
Zion	9	IMRO	2		
Badlands	2	MWRO	2		
Ozarks	11	MWRO	2		
Voyaguers	4	MWRO	2		
Olympic	3	PWRO	2		
Santa Monica Mts	9	PWRO	2		
Big South Fork	3	SERO	2		
Cape Canaveral	9	SERO	2		
Little River	4	SERO	2		

\*NBSMP = National Burn Severity Mapping Project

\*\*SNFFM = Sierra Nevada Fire and Fuels Monitoring

### Example 1

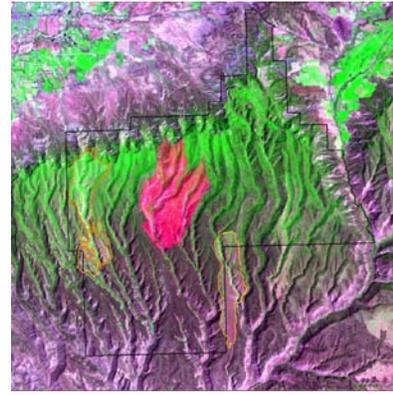
Mesa Verde National Park historical fires mapped with Landsat Multi-Spectral Scanner (MSS), Thematic Mapper (TM), and Enhanced Thematic Mapper Plus (ETM+) sensors. Black line marks the Park boundary. Shades of red indicate areas of burns, whereas shades of green correspond to growing vegetation, whether forest, woodland, or irrigated agriculture. Shades of purple/magenta are indicative of sagebrush with strong soil reflectance. The product is developed at the USGS EROS Data Center, with assistance provided by the National Park Service personnel.



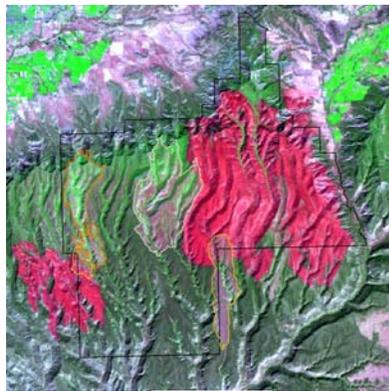
1973



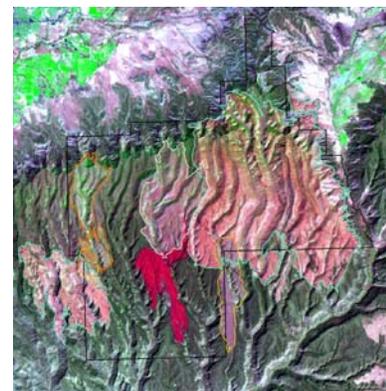
1990



1997



2000



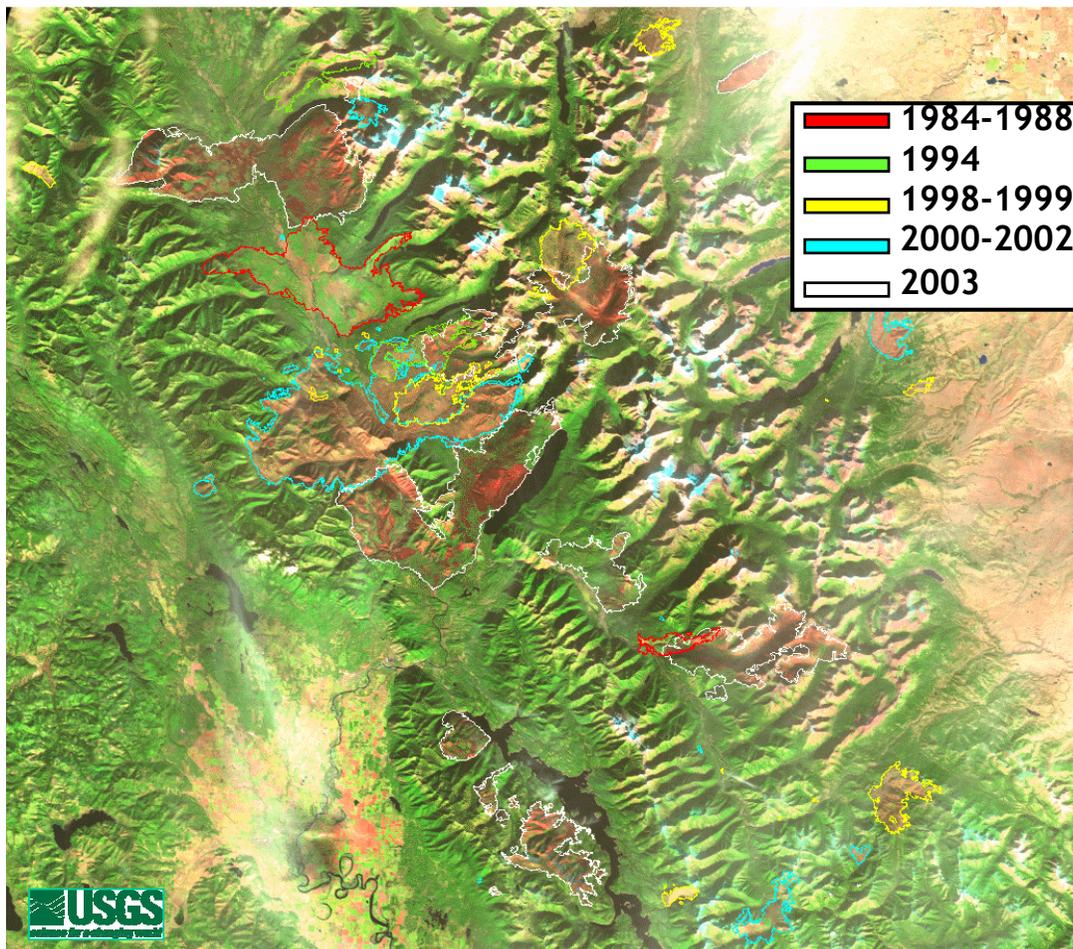
2002

A fire atlas is a valuable tool for land managers and scientists:

- Planning and prioritization of hazardous fuel reduction.
- Impact assessment and monitoring of ecosystem restoration efforts and effects
- Understanding future fire behaviors
- Enhancing firefighting safety by identifying safe zones (previous burns)
- Mapping and modeling CO<sub>2</sub> emissions and dynamics
- Assessing fuels treatment

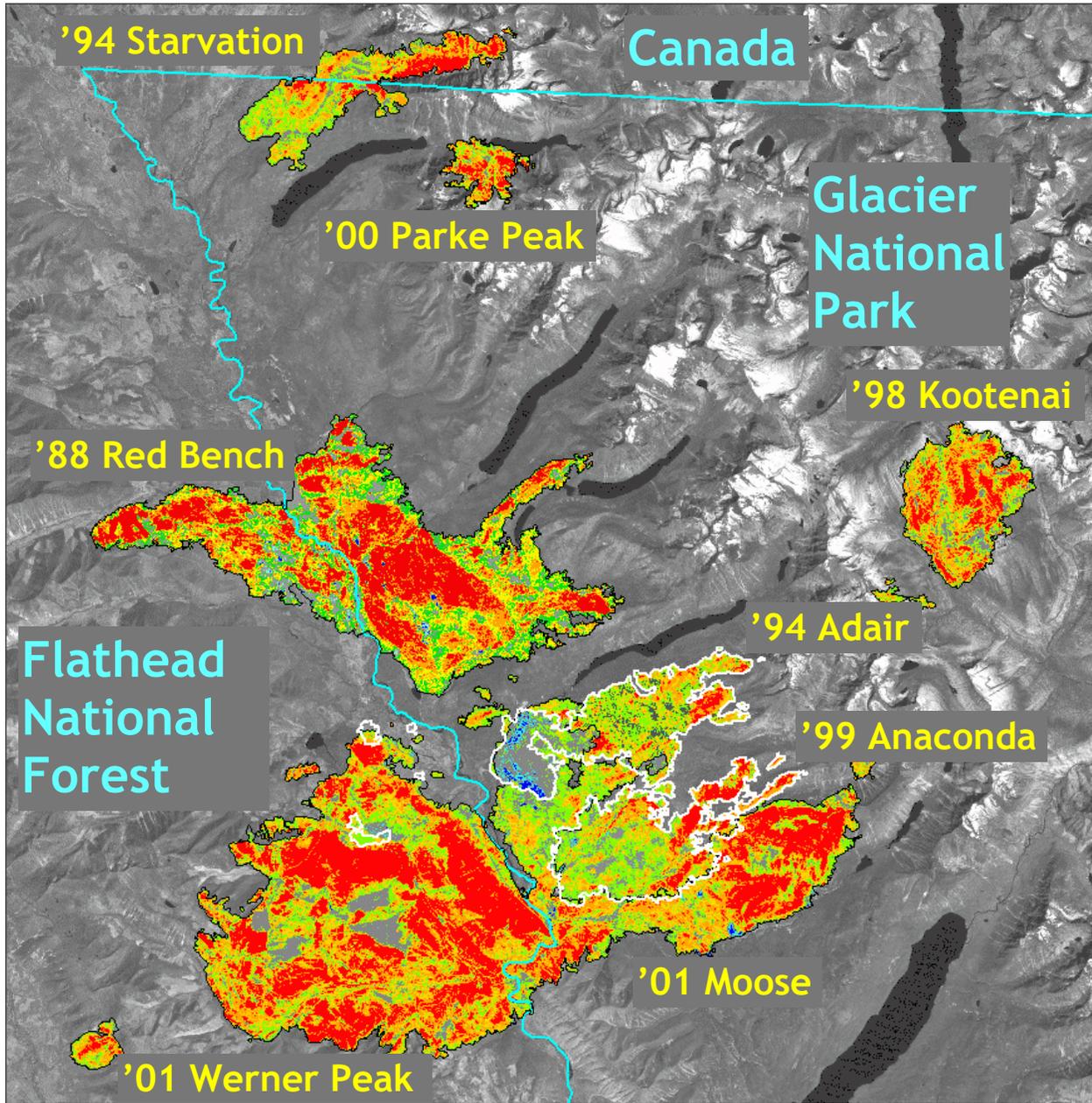
**Example 2**

Fire History of Glacier National Park and adjacent Flathead National Forest from 1984 to 2003

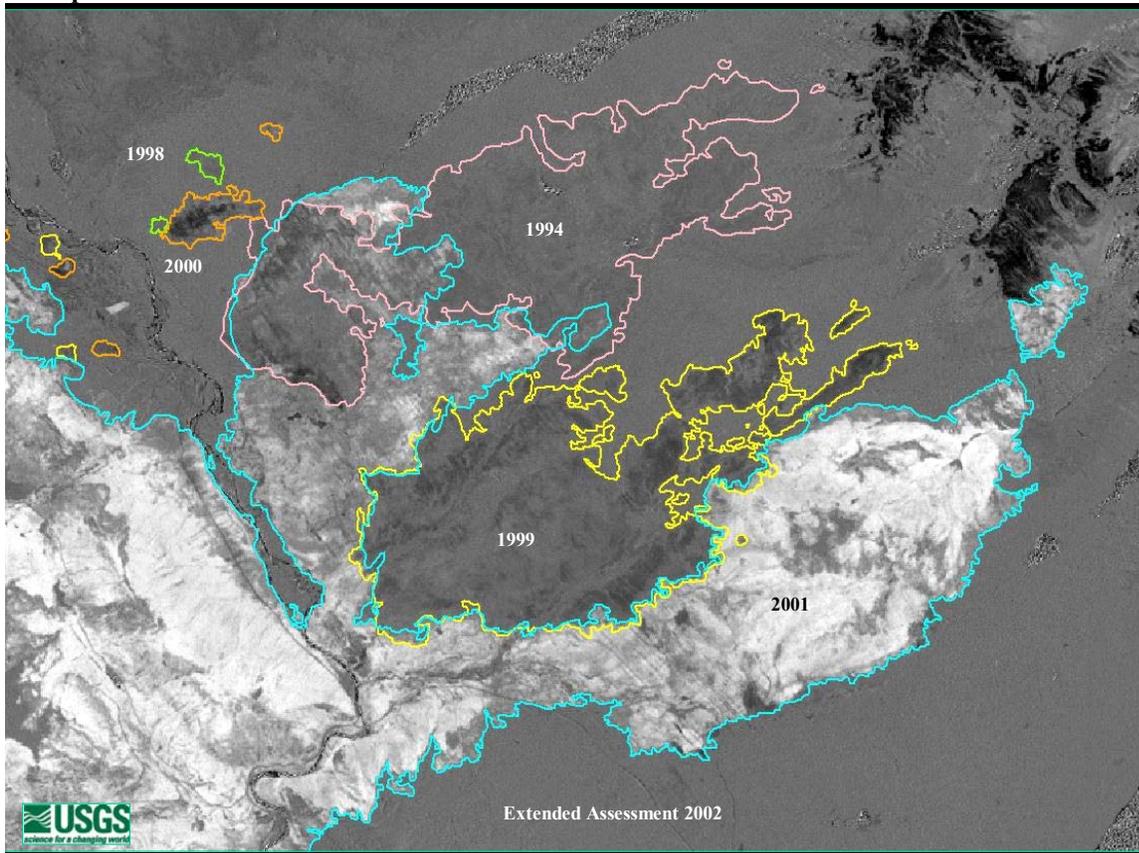


**Example 3**

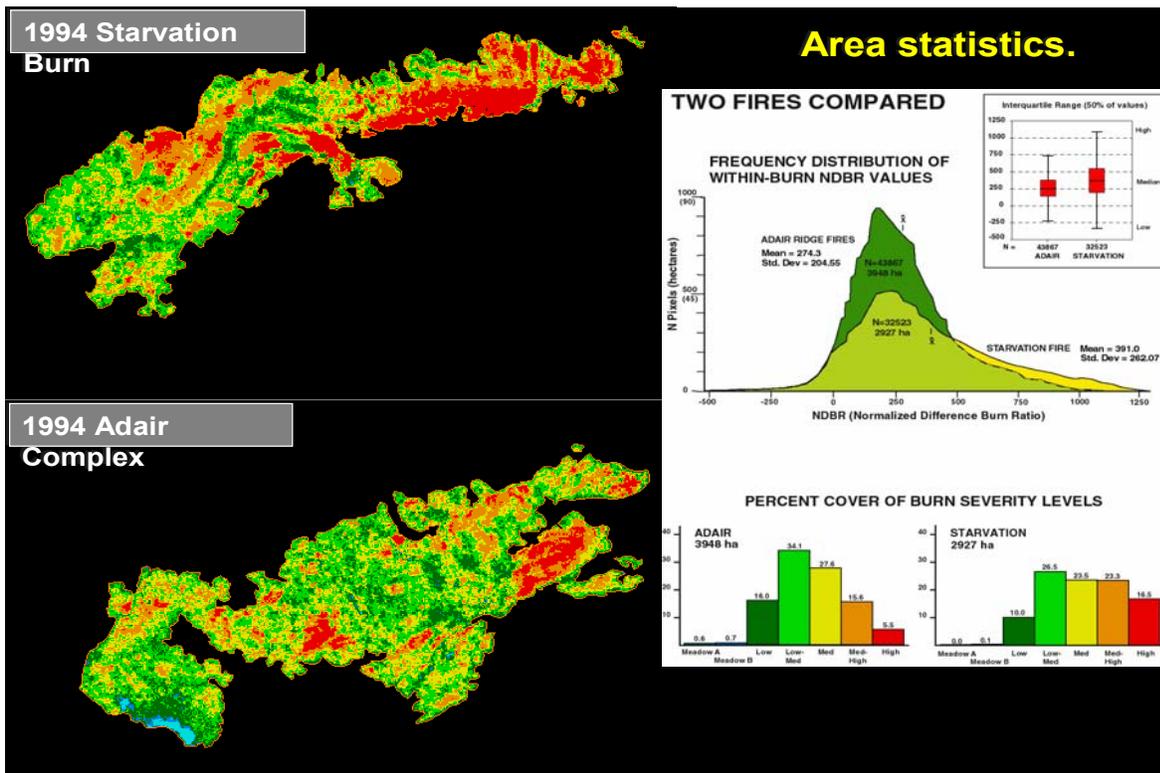
Fire severity assessments of significant fires of Glacier National from 1984 to 2001



### Example 4



The perimeters of the different fires were digitized from burn severity assessments using the dNBR burn-severity mapping algorithm. To better understand the relationship between different fires, severity maps of each fire can be used to understand how the fire impacted the vegetation and why fires may or may not burn into recent burns.



Severity assessments provided maps of the mosaic and summary statistics of Adair Complex and Starvation Fire.