



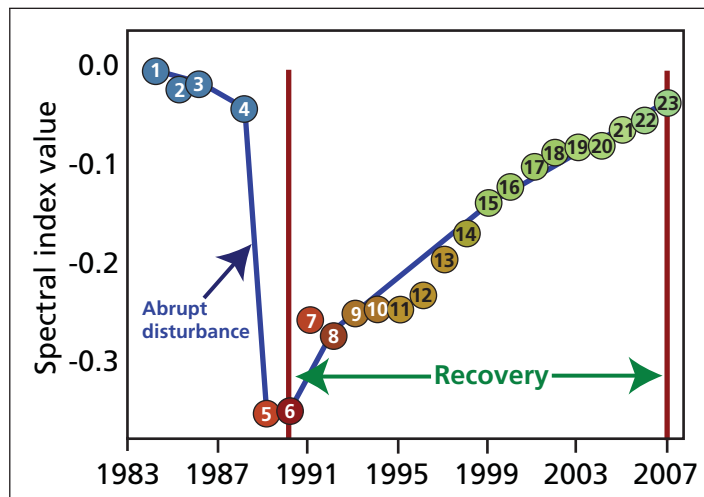
Land Cover Monitoring

Importance

The types and distribution of vegetation across the landscape are fundamentally important to the natural diversity of ecosystems and species. The configuration and connectivity of land-cover types helps to determine habitat availability, energy and water flow, and animal movements. Large changes in landscape structure can occur in response to natural and human-caused disturbances that can impact native vegetation and the processes and fauna that depend on it.

Long-term Monitoring

Landscape-scale vegetation changes can be detected by evaluating imagery that represents conditions across many years. New image analysis techniques, developed at Oregon State University, now make it possible to determine spatial extent, rate, direction, duration, and relative magnitude of vegetation change using a time series of annual, remotely sensed images from Landsat satellites. These new techniques were designed to minimize the potential for confusing long-term change with seasonal and annual phenological change, which are driven



Spectral index showing landscape disturbance and recovery over time.

by short-term weather variations. Detectable changes include both rapid and gradual change due to fire and drought stress, as well as growth and recovery processes. Being able to visualize and quantify these types of change across large landscapes offers land managers insight to processes that may be caused by climate change, plant disease, encroachment, or land management over long periods of time (see next page).

Management Implications

Data collected under this protocol will provide park managers the ability to detect large-scale disturbances in backcountry areas, as well as information on land-use activities along park boundaries and their potential impacts to park resources, which will aid in formulating management strategies.

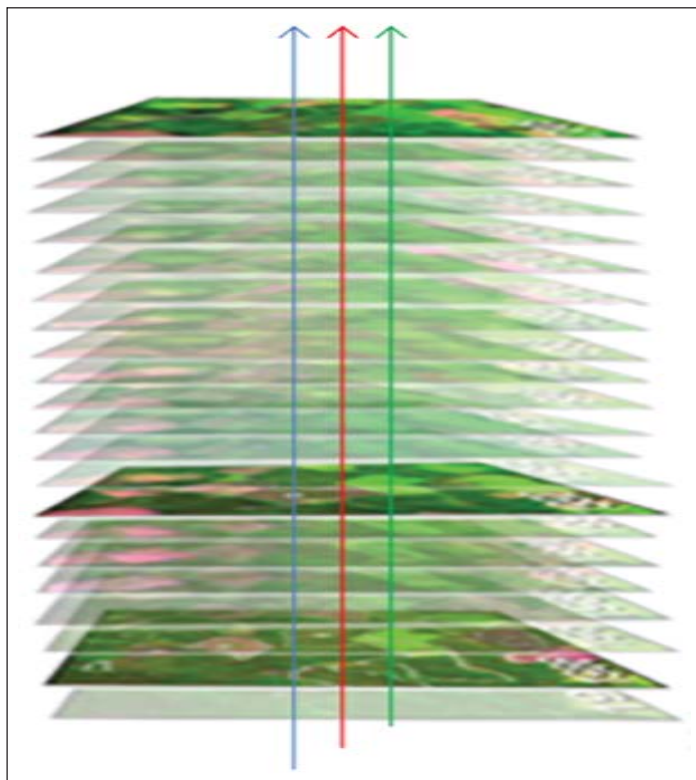
Contact

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Network park units where land cover will be monitored

Arches NP	Dinosaur NM
Black Canyon of the Gunnison NP	Fossil Butte NM
Bryce Canyon NP	Golden Spike NHS
Canyonlands NP	Hovenweep NM
Capitol Reef NP	Natural Bridges NM
Cedar Breaks NM	Pipe Spring NM
Colorado NM	Timpanogos Cave NM
Curecanti NRA	Zion NP

NP = National Park; NM = National Monument;
NRA = National Recreation Area; NHS = National Historic Site



During analysis, Landsat images from mid-summer are stacked, one image per year. Pixel values are then plotted through time, and a linear trend is fit through the line segments (see figure at above right).

Vegetation Change, as Seen from Above

At Capitol Reef National Park, Landsat analysis provides useful insight to landscape changes in the Cathedral and Hartnet grazing allotments (Figure 1), which are also the subject of the NCPN's integrated uplands monitoring program at that park. We are seeking to determine if remote sensing imagery collected since 1985 can reveal trends in vegetation biomass across different grazing allotments.

In terms of biogeography, these two allotments are largely similar. They share the same ecological site (deep grassland soils), are similar in elevation and aspect, and experience generally the same weather. One difference between them is land use: although cattle grazing previously occurred on both allotments, it was phased out from the Cathedral allotment from 1988 to 2000, but continues in the Hartnet allotment. During the scoping with park staff that occurs before the NCPN initiates monitoring in a park, managers expressed interest in (1) how current grazing affects upland ecosystems and (2) how plants and soil respond when livestock grazing stops. At Capitol Reef NP, the NCPN upland monitoring effort is dedicated to investigat-

ing these issues, and information gathered from satellite and ground-based protocols will be integrated with data collected during uplands monitoring for better understanding.

Any findings from remote sensing will likely need to be combined with data from the on-the-ground vegetation monitoring and other NCPN monitoring for us to determine powerful explanatory conclusions. For instance, if a trend is found in greenness, vegetation monitoring may tell us which vegetation species increased, which of those increased the most over time, and whether there are variations within each allotment, such as soil type and grazing pressure, that may explain the spatial pattern and magnitudes of vegetation increase. Vegetation monitoring, in conjunction with climate and land-condition monitoring, may also reveal what caused the increase in vegetation. Integrating the results of this project with results from our other monitoring efforts should help to answer these questions and further our understanding of the ecosystem processes occurring at these sites. Being able to determine the cause of change in park resources, and to map the extent and magnitude of that change, will help park staff to better understand and manage these areas.

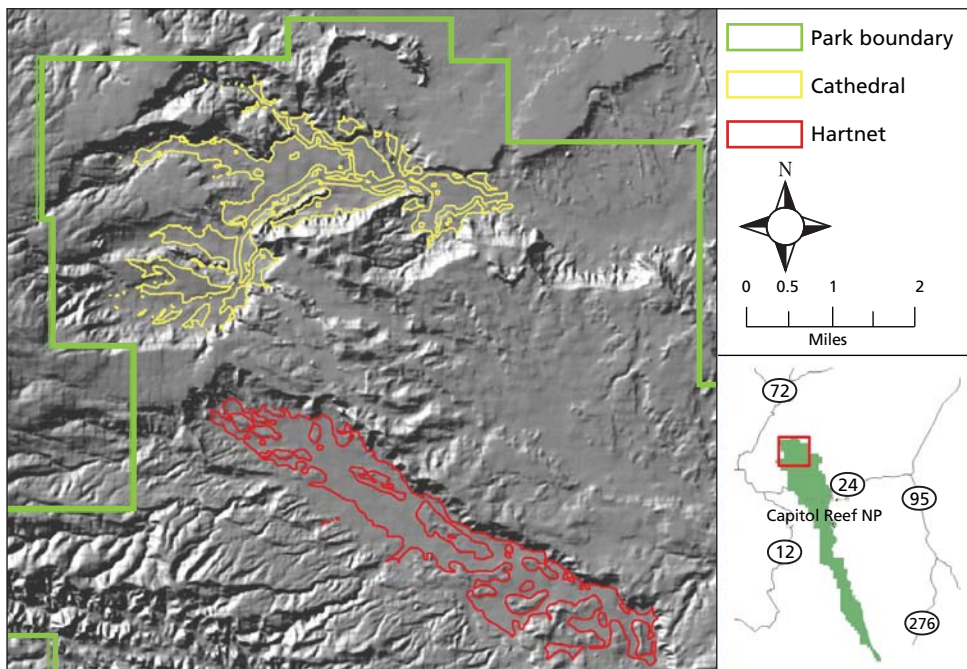


Figure 1. Cathedral and Hartnet allotments, Capitol Reef NP.



Cathedral (top) and Hartnet (bottom) allotments, Capitol Reef NP.