



Landscape Dynamics

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

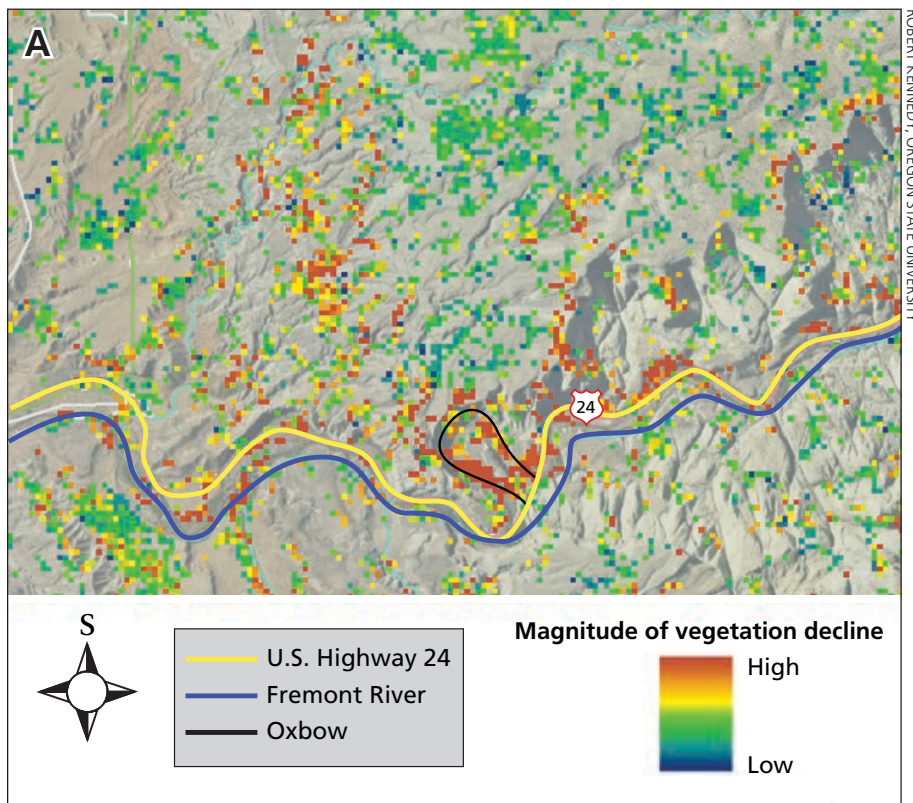
seasonal and annual phenological change, which are driven by short-term weather variations. Detectable changes include both rapid and gradual change due to fire and drought stress, as well as growth and recovery processes. Being able to visualize and quantify these types of change across large landscapes 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 Figure A and 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

David Thoma, dave_thoma@nps.gov



Land surface phenology is monitored in all NCPN park units:

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

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

Landsat map of long-term declines in vegetation vigor between 1986 and 2009 along the Fremont River oxbow (delineated with black line), Capitol Reef National Park. See page 2 for story.

Vegetation Change, as Seen from Above

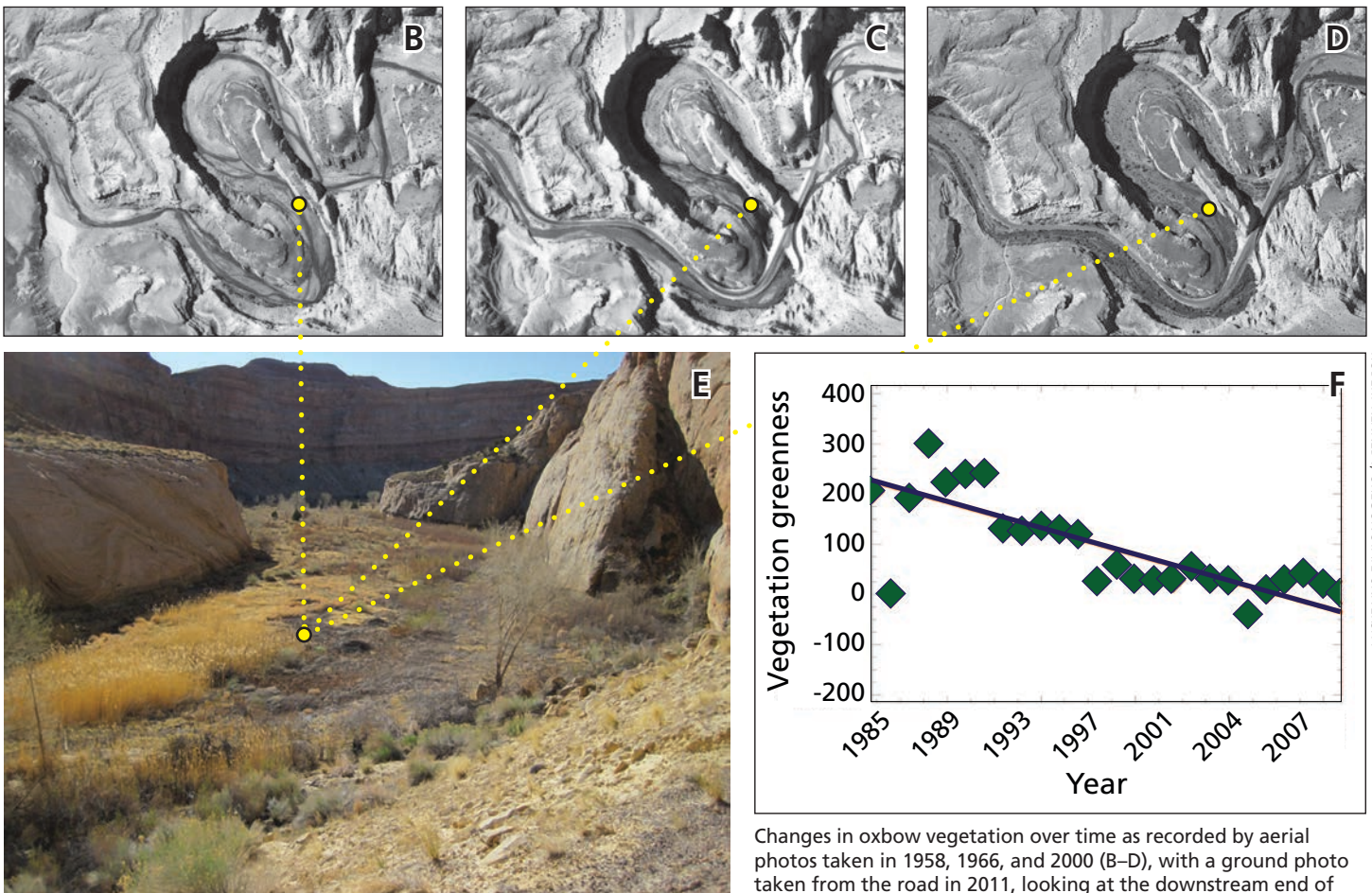
Before initiating monitoring at a park, the NCPN holds scoping meetings with park staff to identify issues of particular interest or management importance at that park. At Capitol Reef National Park, managers expressed interest in (1) the condition of vegetation in the abandoned meander of the Fremont River along U.S. Highway 24 and (2) how plants and channel morphology might respond if flow is eventually reintroduced to the oxbow during restoration efforts. To understand change, it is helpful to have a baseline condition for comparison in the future. For this reason, the NCPN established a riparian monitoring reach in the dry channel—and looked into the past using an archive of satellite imagery to understand the pace and magnitude of change that resulted in current conditions.

Before 1962, the Fremont River in the vicinity of the meander was a shallow, alluvial, braided river with little visible riparian vegetation (Figure B, from 1958). At that time, frequent flooding minimized the ability of vegetation to become established along the river banks. In 1962, as part of a road construction project, the Fremont River was diverted from its natural meander. This diversion changed the local hydrology, leaving the oxbow bend dry except at the downstream end, where subsurface flow ponded against the new road (Figure C, shown in 1966)

allowing riparian vegetation to flourish without being ravaged by frequent floods. Over time, the river cut a narrower and deeper channel and flooded less frequently. This channel incision may have cut off the subsurface flow that supplied water to the downstream end of the oxbow, resulting in the steady decline in vegetation vigor at that location (Figures D and E).

Since 1986, Landsat imagery has shown a slow and steady decline in vegetation vigor at the downstream end of the oxbow (Figure F, see Figure A). The slow rate of change may be due to channel incision and narrowing along the length of the Fremont River.

Observations such as these provide insight into processes happening long before NCPN monitoring efforts began on the ground, and they help us link observed changes to possible causes. The NCPN riparian monitoring effort is dedicated to investigating these issues, and information gathered from satellite and ground-based protocols will be integrated with data collected during riparian monitoring for better understanding in the future. 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.



Changes in oxbow vegetation over time as recorded by aerial photos taken in 1958, 1966, and 2000 (B–D), with a ground photo taken from the road in 2011, looking at the downstream end of the oxbow (E). The chart (F) tracks declining vegetation vigor for the area in the 2011 ground photo, as measured by annual Landsat satellite images.