

Northern Colorado Plateau Network

Monitoring Brief

National Park Service
U.S. Department of the Interior

Intermountain Region
Inventory & Monitoring Program



2012

Integrated Uplands Monitoring

Importance

Uplands represent the vast majority of land area in the Northern Colorado Plateau Network (NCPN), and include rock outcrops, badlands, shrublands, grasslands, woodlands, and forests. Upland vegetation provides energy to other trophic levels, habitat structure for various organisms, and is a significant component of species diversity. The ability of uplands to retain soil and nutrients, absorb and release water, and buffer high-runoff precipitation events is a major influence on riparian condition. Upland ecosystems are easily disturbed and slow to recover, yet several NCPN units contain relatively undisturbed examples of grasslands and shrublands. Historic land uses include livestock and timber production; more recently, recreational use has increased. To effectively manage uplands, the National Park Service needs to know the impacts of these uses.

Long-term Monitoring

Integrated uplands monitoring includes measuring soil stability, hydrologic function, biological soil crusts, and plant community characteristics. The NCPN uses a complex survey design to select randomized sampling plots that are visited in two consecutive years, followed by a relatively long interval between revisits (3–6 years). This design minimizes the chances that sensitive, arid-ecosystem plots will be damaged by repeated visits in successive years and is a cost-effective way to estimate the health of upland ecosystems across a large area. NCPN uplands monitoring is intended to strike a balance between increasing fundamental understanding of these systems and providing managers with early warning of undesirable change.



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Gambel oak.

Status and Trends

The NCPN initiated uplands monitoring in 2006. By the end of the 2011 field season, the network had established plots in all 10 park units where uplands are monitored. To optimize uplands monitoring and ensure that we are sampling the appropriate number of plots to detect trends, pilot sites are sampled for three consecutive years in most park units to estimate variability of ecosystem measures. In 2012, a power analysis was conducted on these data from Dinosaur NM to identify a sample size that optimizes tradeoffs between trend and status estimation and overall operational reality. A survey and revisit design has been created for the park based on this analysis. Also in 2012, data from the 2011 field season will be summarized in annual reports for Arches, Black Canyon of the Gunnison, Bryce Canyon, Canyonlands, Capitol Reef, and Zion national parks; Cedar Breaks, Dinosaur, and Timpanogos Cave national monuments; and Curecanti NRA. After at least five full years of monitoring at any park, the NCPN will perform more detailed analyses to identify trends.

Contact

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Network park units where uplands are monitored

Arches NP	Cedar Breaks NM
Black Canyon of the Gunnison NP	Curecanti NRA
Bryce Canyon NP	Dinosaur NM
Canyonlands NP	Timpanogos Cave NM
Capitol Reef NP	Zion NP

NP = National Park; NM = National Monument; NRA = National Recreation Area

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Sagebrush, Dinosaur NM.

Linking Monitoring to Management: Ecological Thresholds

One of the key purposes of the NCPN monitoring program is to provide park managers with early warning of ecosystem change. To succeed, we must first identify a range of baseline conditions and natural variation, so that actual change is recognizable. To effectively connect science to management, we must also characterize the points, or thresholds, at which ecosystem change may require action to prevent degradation or impairment, so that park managers may develop effective mitigation measures and reduce management costs.

To facilitate those goals, the NCPN is applying state-and-transition models to a series of ecological sites across several parks. An ecological site is an area classified by the types of vegetation and soils present, for instance, Semidesert Sandy Loam (fourwing saltbush), which the NCPN monitors at Arches, Canyonlands, and Capitol Reef national parks. A state-and-transition model identifies which types of vegetation may occur in a given ecological site under different types and levels of disturbance and establishes parameters for several different “states” of ecosystem health. When ecological stressors cause a site to cross a disturbance threshold, the site “transitions” from one state to another.

The USDA Natural Resources Conservation Service has developed state-and-transition models for many, but not all, ecological sites, and few include defined thresholds that describe when

an area may transition from one state into another. To help fill the gap, the U.S. Geological Survey (USGS) led a project, with the NCPN and Southern Colorado Plateau Network as partners, to develop state-and-transition models and define ecological thresholds for dominant ecological sites on the Colorado Plateau.

In the case of the Semidesert Sandy Loam ecological site, for example, four distinct states were identified using data from monitoring plots and other sources (see below). These states are defined primarily by the amount of biological soil crust, native perennial grasses, and exotic annual plants present in a site, with earlier stages being characterized by higher amounts of soil crust and native perennials.

State-and-transition models and their associated thresholds can be used to determine the overall health of park uplands, and when certain areas may be approaching an ecological threshold. Resource managers can use this information to determine if action should be taken to prevent an area from crossing a threshold. In the example shown below, the park might choose to control exotic annual plants in a State 3 grassland that has substantial cover of exotic annuals but has not yet crossed over to State 4. Once a threshold is crossed, it is difficult to transition back to a less disturbed ecological state without large inputs of restoration work and money, and in some cases this may not even be possible.

States Described for Semidesert Sandy Loam

State 1 (S1) and State 2 (S2), which are dominated by well-developed biological soil crusts and native perennial grasses, are difficult to find today, and occur most often in ungrazed relict areas historically inaccessible to cattle or sheep. The transition from S1 to S2 involves the introduction of exotic annual seeds and climate conditions that allow them to germinate and multiply. Because any amount of exotic annual seed could cause this change, no threshold was calculated for this transition.

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State 3 (S3) is characterized by the same native perennial vegetation as S1 and S2, but well-developed biological soil crusts are rare. This is the most common state of the Semidesert Sandy Loam ecological site in NCPN parks. The transition from S2 to S3 is associated with the loss of biological soil crust due to grazing-related disturbances (in this case, before the land became part of Canyonlands National Park). The thresholds for transition were predicted using biological soil crust cover, soil aggregate stability, and other measures. According to the USGS model, there is a 95% probability of transition from S2 to S3 with 7.5% biological soil crust cover.

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State 4 (S4) is characterized by exotic annual vegetation, and by lack of biological soil crust and native perennial vegetation. According to the model, the transition from S3 to S4 occurs when cover of exotic annual plants exceeds 26%. For example, the greenish vegetation in the foreground of this photo, taken at Arches National Park, is Russian thistle (*Salsola tragus*).