



Uplands Monitoring at Fort Bowie NHS

Importance

Generating more than 99.9% of Earth's biomass, plants are the primary producers of life on our planet. Vegetation represents much of the biological foundation of terrestrial ecosystems, and it comprises or interacts with all primary structural and functional components of these systems. Vegetation dynamics can indicate the integrity of ecological processes, productivity trends, and ecosystem interactions that can otherwise be difficult to monitor. In the Sonoran Desert and Apache Highlands ecoregions, vegetation composition, distribution, and production are highly influenced by factors that include soil texture, mineralogy depth, and landform type. As such, a fundamental understanding of soils and landforms is essential for evaluating vegetation patterns and processes.

Monitoring Effort

The overall goal of the Sonoran Desert Network (SODN) terrestrial vegetation and soils ("uplands") monitoring program is to detect broad-scale changes in vegetation and soils within the context of changes in other ecological drivers, stressors, processes, and resources of interest.

Specific, measurable objectives for uplands monitoring at Fort Bowie National Historic Site (NHS) are to determine the status of and detect trends, over five-year intervals, in:

1. Terrestrial *vegetation cover* for common ($\geq 10\%$ absolute canopy cover) perennial species, including non-native plants, and all plant lifeforms.
2. Terrestrial *vegetation frequency* of uncommon ($< 10\%$ absolute canopy cover) perennial species, including non-native plants.
3. Terrestrial *soil cover* by substrate classes (e.g., bare soil, litter, vegetation, biological soil crust, rock fragments of several size classes) that influence resistance to erosion.
4. Terrestrial *soil stability* of surface aggregates by stability class (1–6).

Status and Management Concerns

In September 2010, SODN published a report summarizing the results of the first season of uplands monitoring at Fort Bowie National Historic Site (NHS), in southeastern Arizona (Hubbard et al. 2010). The report focused on current status, with



Fort Bowie National Historic Site.

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trend evaluations to commence after the next sampling period in 2013. Ten permanent field-monitoring sites were established and sampled in 2008. Results revealed the presence of diverse, complex semi-desert grassland and savanna communities, in which all major vegetation lifeforms were well represented (see figure, next page).

Exotic species

Two exotic species, Lehmann lovegrass (*Eragrostis lehmanniana*) and stinkgrass (*Eragrostis cilianensis*), were found on 100% and 69% of the sites, respectively, but at relatively low cover ($< 3.3\%$). Both species are common in the park, but are not currently outcompeting (nor dominating) native flora, as is common in other semi-desert grasslands in the American Southwest. Russian thistle (*Salsola kali*) and redstem storksbill (*Erodium cicutarium*), both non-native and potentially invasive species, were detected at one monitoring site.

Mesquite invasion

Preventing mesquite invasion and subsequent conversion of grassland to shrubland has been a management priority at Fort Bowie NHS for the last few decades. Mesquite (*Prosopis* sp.) and other shrubs were found to be common (found at 85% and 100% of our sites, respectively) but not dominant ($< 2\%$ and 4% cover, respectively). Mesquite seedlings were nearly twice as abundant (3%) as adult plants, but were still well below any commonly recognized management thresholds (e.g., 20% cover). Repeat photography indicates that mesquite cover in adjacent riparian systems has increased over the past century.

Erosion

Upland areas of the park appear to be well-protected from soil erosion, although a few sites had reduced soil stability and showed evidence of rill development from overland flow. Due to high cover of vegetation and leaf litter and an abundance of surface rocks and gravels, less than 1% of the soil surface was unprotected. However, loss of leaf litter and vegetation following fire or prolonged drought could dramatically decrease the “armored” soil surface. As soil erosion has important consequences for natural and cultural resources at Fort Bowie NHS, this is an important consideration.

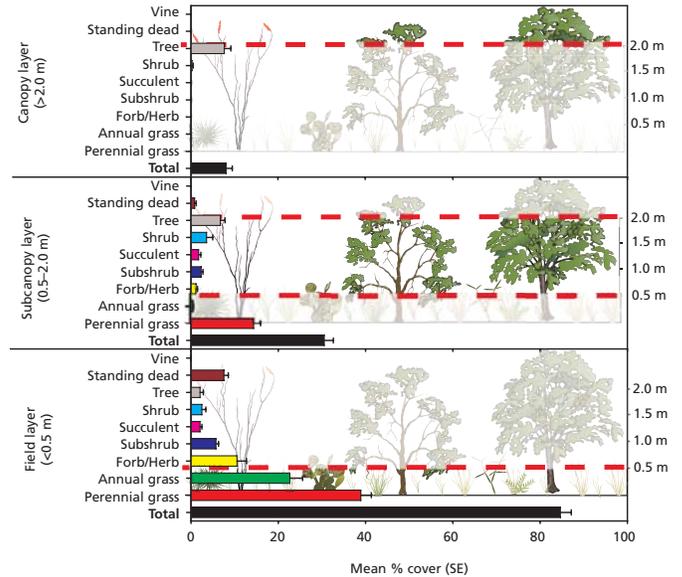
Management Assessment Points

To achieve the National Park Service’s core mission of resource protection, resource management and monitoring must be explicitly linked. Management assessment points, which are “pre-selected points along a continuum of resource-indicator values where scientists and managers have agreed to stop and assess the status or trend of a resource relative to program goals, natural variation, or potential concerns,” can serve as a bridge between science and management (Bennetts et al. 2007). Management assessment points are intended to serve as a potential early warning system encouraging scientists and managers to pause, review available information, and consider options. They do not define strict management or ecological thresholds, inevitably result in management actions, or reflect any legal or regulatory standard.

In Hubbard et al. (2010), SODN proposed eight assessment points for uplands at Fort Bowie NHS, based on the ecological literature and network staff’s knowledge of park ecosystems and management goals. Those proposed assessment points, intended as a starting point for discussion, are summarized in the table below.

Terrestrial vegetation and soils monitoring data in the context of proposed management assessment points, Fort Bowie NHS, 2008.

Issue	Management assessment point
Erosion hazard	1 Bare ground cover is >30%
	2 Percentage of surface soil aggregates in “very stable” (6) class is <20%
Site stability	3 Foliar cover of perennial grasses in field layer is <25%
	4 Proportion of foliar grass cover (%) of annuals in field layer is >33%
Shrub encroachment	5 Shrub foliar cover is >35% (field & subcanopy) a,b
Mesquite invasion	6 Mesquite (<i>Prosopis</i> sp.) foliar cover is >20% (field & subcanopy) a,b
Exotic plant dispersal	7 Extent (plot frequency) of invasive exotic plants in any layer is >20%
Exotic plant invasion	8 Proportion of foliar plant cover (%) contributed from exotic plants in field layer (etc.) is >10% (field, subcanopy, canopy) a,b,c



Lifeform cover in terrestrial vegetation monitoring plots at Fort Bowie NHS, 2008. The greatest cover and frequency occurred in the “field” layer.

Most indicators did not approach these assessment points in 2008, but some plots had values that suggested the potential for site-specific issues. In addition, there were two parkwide exceptions, shown in red. However, the actual value for #7 (exotic plant dispersal) fell within 10% of the assessment point and was supported by less statistical power than the others.

Conclusions

Hubbard et al. (2010) concluded that the terrestrial vegetation and soils in uplands of Fort Bowie NHS are well within the historic range of natural variability. Current park conditions compare very favorably with most semi-desert grasslands and savannas in the ecoregion, of which 85% are estimated to be degraded. It is recommended that park managers exercise continued vigilance toward potential invasions of exotic plants and mesquite, as well as erosion. Restoring natural fire regimes through wildland fire use or prescribed fire, as advocated by current and former park staff, is also critical to the future health of the system.

Contact

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[Bennetts, R. E., J. E. Gross, K. Cahill, C. L. McIntyre, B. B. Bingham, J. A. Hubbard, L. Cameron, and S. L. Carter. 2007. Linking monitoring to management and planning: Assessments points as a generalized approach. The George Wright Forum 24\(2\):59–77.](#)

[Hubbard, J. A., S. Studd, and C. McIntyre. 2010. Terrestrial vegetation and soils monitoring at Fort Bowie National Historic Site: 2008 status report. Natural Resource Technical Report NPS/SODN/NRTR—2010/368. National Park Service, Fort Collins, Colorado.](#)



For more information

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