Rocky Mountain Network
RESOURCE BRIEF

National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science
Rocky Mountain Inventory & Monitoring Program

The Influence of Human Disturbance on Upland and Wetland Vegetation

The Rocky Mountain Inventory and Monitoring Network (ROMN) monitors vegetation in two ecosystem types in Florissant Fossil Beds National Monument (FLFO): uplands and wetlands. Monitoring includes soils, and in wetlands, ground water hydrology. Given the differences in methods to best understand these two systems, ROMN treats them as separate field efforts. However, in this brief we summarize both.

Why Monitor Vegetation Communities in Florissant?

Vegetation communities are responsive to biological and physical changes due to natural events and anthropogenic disturbances in their environment. We can learn about the overall condition of parks through vegetation monitoring over the long term. Vegetation supports ecosystem processes through primary production, nutrient cycling (e.g., carbon, nitrogen), and altering microclimates (small pockets where vegetation canopies impact temperatures, moisture, wind, etc.). We include soil and ground water hydrology monitoring as these support vegetation and help determine the nature and quality of vegetation communities. Human and natural disturbances have a significant influence on vegetation communities and are a major component of monitoring. To best understand the response of vegetation over the long term, all of these factors are included in ROMN monitoring.

How ROMN Monitors Uplands

Thirty-two long-term monitoring sites were established in grassland and forest habitat in the park using a spatially balanced probability survey design. Beginning in 2010, sites were visited following a panel structure over four years, with a smaller subset visited every year to determine interannual variation. Metrics such as vegetation cover and native species richness, as well as soil chemistry parameters like total carbon and nitrogen content, provide a snapshot of conditions at sites sampled in any given year, as well as changes over time. The ROMN upland monitoring protocol derives its field methods from the USDA Agricultural Research Service and the USDA Forest Service's Forest Inventory and Analysis program. ROMN crews use a modified version of a human disturbance index (HDI) developed by the Colorado Natural Heritage Program to monitor disturbance at the sites in three categories: buffer/landscape, hydrology, and physical.

How ROMN Monitors Wetlands

We used a nonrandom sentinel site-based approach to monitoring at FLFO, given the relatively small size and limited number of wetlands within the monument. In consultation with monument staff, we selected three FLFO sentinel site wetland complexes in 2009–2010 in areas where long-term changes in key drivers like hydrology would be meaningfully characterized by monitoring, and where issues, such as high levels of anthropogenic disturbance, were known to occur.

White River coraldrops (*Besseya plantaginea*), found at ROMN upland sites (left), and moss gentian (*Chondrophylla aquatica*), found at ROMN wetland sites (right), are more likely to be found in pristine habitats.

The sites include a wet meadow complex near the Maytag or Red Barn, a fen (or peatland) and wet meadow complex adjacent to the historic Hornbeck Ranch, and a riparian wetland accessible from the Barksdale picnic area. We monitor vegetation at each site to generate metrics such as Shannon's diversity index and percent cover of nonnative species. All sites contain a groundwater monitoring well, with at least one per complex instrumented with a water table height logger. The ROMN wetland ecological integrity protocol is based on similar work by the Colorado Natural Heritage Program. Disturbance data required for the HDI are also collected in wetlands.

Select Monitoring Highlights

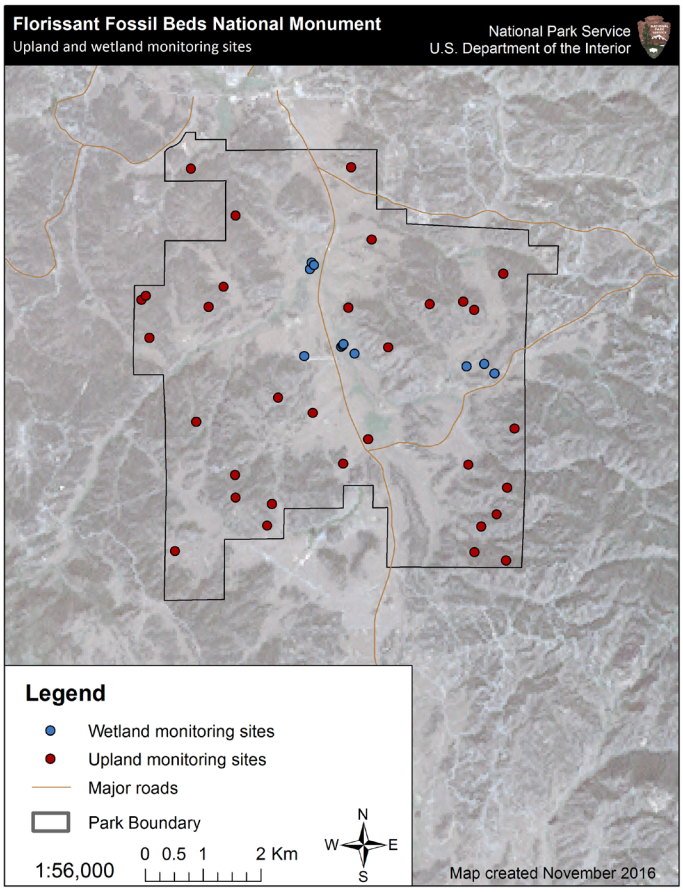
We examined the relationship between HDI values and floristic quality via coefficients of conservatism (C-scores). Lower HDI scores, on a scale of 0 to 100, indicate less disturbance. C-scores, ranging from 0 to 10, indicate the likelihood of a particular species occurring in a "pristine" habitat and are assigned to plant species on a statewide

basis by the Heritage Program. Lower C-scores indicate species that are generalists and are able to grow in both degraded and high-quality habitats, whereas higher scores indicate species restricted to high-quality or pristine conditions.

Draft analyses suggest an inverse relationship between HDI and mean cover-weighted C-scores of native species ($R^2 = 0.209$, $p = 0.0027$). Sites with a higher level of human disturbance had lower native plant mean C-scores (Figure 1).

The mean C-score for plants was 5.72 in uplands and 4.74 in wetlands, suggesting that many monitoring sites in FLFO may be impacted. However, several taxa of higher conservation value were recorded, including marsh felwort (*Lomatogonium rotatum*), northern sweet-grass (*Hierochloë hirta*), and moss gentian (*Chondrophylla aquatica*) in wetlands and Pacific anemone (*Anemone multifida*), Parry's oatgrass (*Danthonia parryi*), and White River coraldrops (*Besseya plantaginea*) in the uplands. Moreover, deep layers of peat occurred in some of the wetland fen sites (in particular the Hornbeck Ranch site), suggesting a more intact former wetland condition in the monument. All data presented here are preliminary and subject to further quality control.

Continued monitoring by ROMN will help solidify these preliminary results for upland and wetland vegetation, soils, and ground water hydrology.



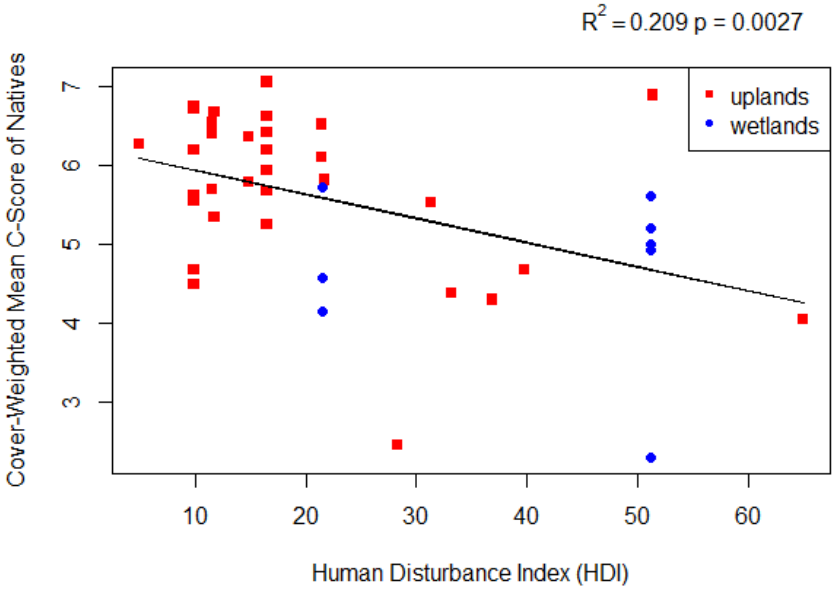


Figure 1. There is an inverse relationship between the human disturbance index (HDI) and the cover-weighted mean C-Score of native plants at wetland (blue) and upland (red) plots ($p = 0.0027$, $R^2 = 0.209$). Wetland data are from 2010. Upland data span from 2010 to 2015 to represent all sites because only a portion of sites are visited each year.

More Information

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About ROMN

The Rocky Mountain Network is one of 32 vital signs monitoring networks across the National Park Service. It monitors status and trends in upland vegetation and soils, wetlands, streams, alpine vegetation, and other systems at six parks throughout Montana and Colorado.