



## Wetland Ecological Integrity

### Introduction

Wetlands are important components of nearly all Rocky Mountain Network (ROMN) parks and provide many valuable ecological and socioeconomic functions. Wetlands support a disproportionate amount of biodiversity relative to their area, provide crucial hydrologic and water quality functions, may host relict populations for wetland communities and processes outside park units, and are part of visitors' experiences. Wetlands are also sensitive indicator systems for the overall ecological condition of a park or watershed. However, ROMN wetlands are vulnerable to disturbances at both the park and landscape scales. These stressors (or drivers) include shifting climate regimes, atmospheric nutrient deposition, changes in groundwater levels, stream diversion, overgrazing by native ungulates, lingering effects of historical disturbances such as grazing by domestic livestock, and invasion by exotic plants. Given the sensitivity, integrative, and imperiled aspects of wetlands, at least 5 of the ROMN's 12 high priority vital signs are incorporated into the Wetland Ecological Integrity (WEI) protocol, which is currently in development.

### Objectives

The goals of the ROMN WEI are to determine the status and trend of wetland conditions and develop reference conditions for each network park. The core monitoring objectives include the following:

1. *Determine the episodic (every 5 to 10 years) status and trend of wetlands by type (i.e., fens, wet meadows, riparian, marshes in Glacier National Park, salt flats in Great Sand Dunes National Park and Preserve) at the park scale*
2. *Determine the episodic status and trend in wetland conditions using groundwater dynamic models and wetland vegetation assemblages*
3. *Quantify seasonal, annual, and/or episodic trends at wetland "sentinel" sites using groundwater dynamics and wetland vegetation*

### Protocol Development and Status

The WEI protocol describes the long-term monitoring and assessment of ROMN wetlands and uses an integrated, comprehensive approach. To monitor conditions of wetlands, multiple measures of responses and stressors will be collected, synthesized, and compared to reference conditions. Select sentinel locations will be monitored more intensively, particularly for how change occurs relative to climate dynamics. The protocol

## LONG-TERM MONITORING PROJECT SUMMARY



Monitoring in Kawuneechee Valley, Rocky Mountain NP, 2007.

emphasizes the measurement of wetland vegetation composition and groundwater hydrology. Other site measurements include vegetation structure, ungulate herbivory, soil characteristics, water chemistry, and anthropogenic and natural disturbances. Each site has an identical plot layout centered on a water table logger which tracks groundwater hydrology.

ROMN and Colorado State University (CSU) are cooperating to develop the protocol and conduct pilot field implementation in Rocky Mountain National Park. David Cooper and Katie Driver from CSU and Billy Schweiger from the ROMN are the Principal Investigators. In 2006, the ROMN began scoping for the main content of the protocol and writing the narrative and methods. A draft of the protocol and survey design was completed in 2007. This included consultation with an expert statistician, Scott Urquhart, from CSU. After the successful completion the Rocky Mountain pilot project in 2009, the ROMN will begin WEI long-term wetland monitoring in Great Sand Dunes, Florissant Fossil Beds National Monument, and other network parks.

#### Network park units with ongoing WEI monitoring

Florissant Fossil Beds NM	Great Sand Dunes NP and Pr
Glacier NP	Rocky Mountain NP
Grant-Kohrs Ranch NHS	

**bold** indicates current monitoring; gray indicates future monitoring plans  
NHS = National Historic Site; NM = National Monument;  
NP = National Park; Pr = Preserve

## Preliminary Results

In 2007 and 2008, 150 sample events at survey sites were conducted in Rocky Mountain. The ROMN installed a total of over 30 water table loggers at some of these locations to collect continuous water table data. Several sites were revisited to estimate seasonal effects and various quality control statistics. The survey design functioned as expected and gave an unbiased sample of wetland. Results from pilot project efforts will support the first unbiased characterization of the status of wetlands in the park. These data will also be used in the development of reference conditions for wetlands in Rocky Mountain, as a baseline for trend analysis in select park sentinel wetlands, and, when the survey is repeated through time, for park-scale trend analysis.

In 2008, Rocky Mountain and CSU staff helped select new gradient sites, including a location designed to capture elevation, wetland types, and expected wetland condition. A new sentinel site was also selected in a sensitive, high altitude location where the impacts of climate change, nutrient deposition, and invasive vegetation may be able to be evaluated. New plot locations were selected within existing sentinel sites.

Data from 2007 and 2008 are still being processed. Preliminary results from vegetation data analysis suggest that the WEI protocol is well positioned for more careful analysis and that response measures will likely lead to powerful bioassessment models. Hydrology data from 2007 are also not fully analyzed, but there is a clear pattern among wetland types and a strong signal to precipitation, especially in wet meadows.

Vegetation data include 3,654 records of over 300 unique species. This represents approximately 27% of the species listed in the park, recorded from only about 4% of the park's area, and supports the importance of wetlands to park biodiversity. Staff



ROMN staff conduct sampling in Rocky Mountain NP.

recorded 35 non-vascular species, including a new moss for the Colorado flora, *Platyhypnidium riparioides*. Vegetation in the sampled sites was largely native, with the highest percentage (an average of about 13%) of non-native species recorded in riparian systems. Riparian systems were the most diverse wetland type. Fens had the highest percentage of obligate wetland vegetation and were also the most homogeneous, suggesting that these wetlands are more stable and persistent.

Collaborations continued in 2008 with CSU and the Sierra Nevada and Northeast Temperate National Park Service Inventory and Monitoring networks. The U.S. Environmental Protection Agency and Colorado Natural Heritage Program (additional collaborators) are interested in the bioassessment models the ROMN is developing and in using ROMN sites as references for eco-regional and state wetland monitoring.

## Future Plans

In 2009, the final set of survey sites will be revisited in Rocky Mountain and recurring sentinel site monitoring should occur. The ROMN will also establish and monitor a wetland sentinel site in Florissant Fossil Beds. In 2009 or 2010, ROMN will begin a full implementation of the protocol, including a site-rich survey approach at Great Sand Dunes. The ROMN will also continue sentinel site sampling in Rocky Mountain and Florissant Fossil Beds. This work will be developed with the National Park Service Water Resource Division and Great Sand Dunes staff, and assist in the administration and monitoring of water rights recently awarded to the park.

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Colorado State University and ROMN staff conduct monitoring at a sentinel site in Rocky Mountain NP, 2008.