



Integrated Riparian Monitoring

Importance

Riparian ecosystems are potentially sensitive indicators of landscape-level change because they are linked to both aquatic and upland systems, perform important ecological functions, and are biologically diverse. Riparian systems face a number of anthropogenic threats, including stream-flow damming or diversion, channel-stabilization structures, invasive exotic species, livestock grazing, timber harvesting, agricultural clearing, groundwater pumping, and trail creation. These disturbances can alter watershed conditions and directly or indirectly influence downstream riparian ecosystems. Developing credible, efficient monitoring approaches will help in assessing riparian-system health and provide early warning of system degradation.

Long-term Monitoring

Integrated riparian monitoring involves the collection of both biological and physical measures. The NCPN monitors vegetation, hydrology, and geomorphology in wadeable streams at four units; and big rivers at another four units (see box).

For wadeable streams, repeat sampling of permanent transects tracks changes in the cover and species composition of riparian vegetation, including the relative abundance of native and non-native species. Measures of physical drivers, including stream flow, alluvial groundwater dynamics, and changes in channel form, are used to assess whether observed changes are primarily the result of natural variability or anthropogenic stressors.

For big rivers, the NCPN is working with the U.S. Geological Survey (USGS) and Utah State University to implement riparian monitoring in a hierarchical fashion. We will conduct intensive annual or bi-annual monitoring of vegetation and geomorphology at a select few sentinel sites; use rapid-assessment techniques to monitor a broader area using a rotational panel; and utilize decadal remote sensing data (dependent on securing additional funding or using existing NCPN protocols).

Information gathered from this protocol will provide park managers with (1) a baseline against which to gauge the long-term status and trends of riparian resources relative to natural processes and anthropogenic stressors; and (2) information for evaluating the effectiveness of management interventions aimed at protecting or restoring these ecosystems.

Status and Trends

Wadeable streams: In 2010, the NCPN initiated monitoring at Armstrong Canyon in Natural Bridges NM and Courthouse Wash, in Arches NP. Two reaches were established in each park



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Installing a well on the East Fork of the Virgin River, Zion NP.

unit, and vegetation was monitored at each reach. Vegetation was also sampled at the three established reaches on the Fremont River in Capitol Reef NP and on two reaches of the East Fork of the Virgin River in Zion NP. An NCPN crew installed hydrologic monitoring equipment at one reach each in Arches and Zion NPs. Additional surveying is scheduled for 2011 in Arches NP, Natural Bridges NM, and Zion NP; vegetation will be sampled at all four parks.

Big rivers: In 2010, the NCPN and USGS collected pilot data from five sentinel sites along the Yampa and Green rivers at Dinosaur NM. In 2011, efforts at Dinosaur were expanded to pilot implementation of the rapid-assessment techniques and efforts to capture the effects of the unusually high flows of spring 2011. We also developed a hydraulic model and implemented the first year of monitoring at the East Portal on the Gunnison River at Black Canyon of the Gunnison NP.

Contacts

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Network park units where integrated riparian systems are monitored

Wadeable Streams

Arches NP
Capitol Reef NP
Natural Bridges NM
Zion NP

Big Rivers

Black Canyon of the Gunnison NP
Canyonlands NP
Curecanti NRA
Dinosaur NM

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

Action Shots: What Are We Doing Out There?

In wadeable streams at four NCPN park units, network staff are working to understand the links between the physical drivers of hydrology and geomorphology with vegetation by conducting monitoring that uses a variety of instrumentation. Here's how we do it.

Surface and Groundwater Dynamics

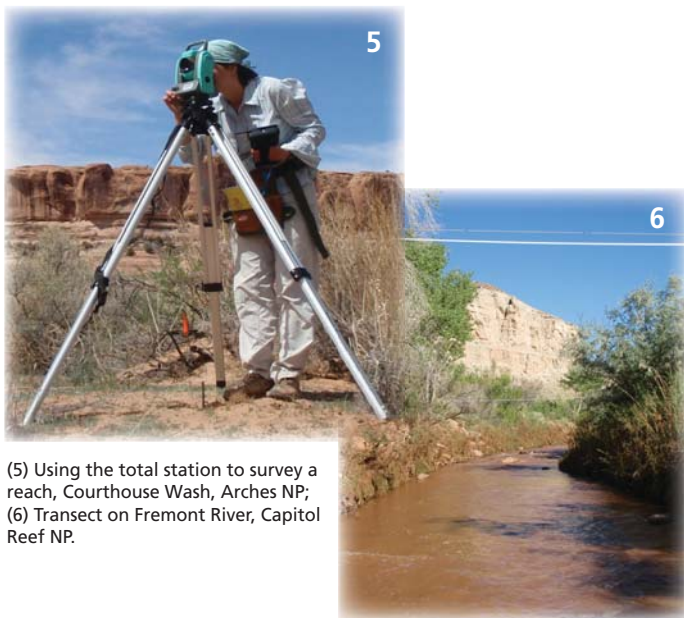
After staff hike to a site (1) and install the instrumentation (2), stream stage and groundwater elevations are measured in one instream well and one or two riparian piezometers (3) installed along one of the cross-section transects at a reach. Each well or piezometer contains a pressure transducer that records data at 15- or 30-minute intervals. Data from hydrologic monitoring equipment are downloaded (4) and manual water level and flow measurements are recorded during quarterly site visits.



(1) Hiking to well installation site and (2) Installing a well, East Fork of the Virgin River, Zion NP.



(3) Riparian piezometer, Courthouse Wash, Arches NP; (4) Field data-download.



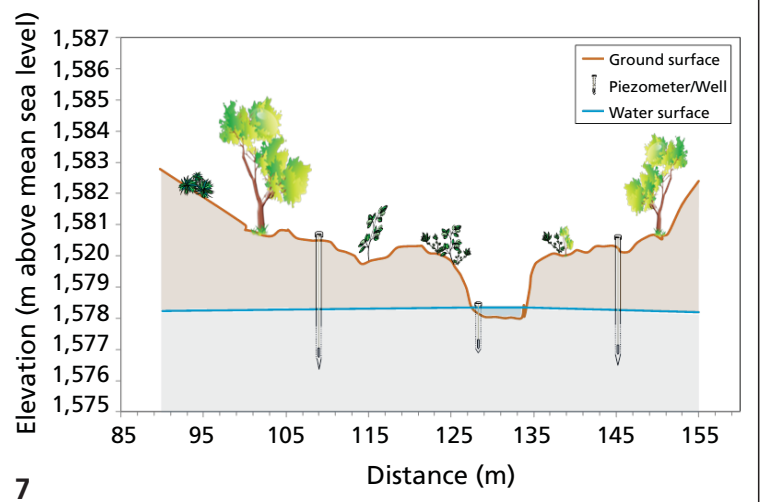
(5) Using the total station to survey a reach, Courthouse Wash, Arches NP; (6) Transect on Fremont River, Capitol Reef NP.

Geomorphology Surveys

Stream-channel surveys, one of the primary measurements of geomorphology, are performed at each reach using a total station (5). Permanent instrument set-up and reference locations are established. At each cross-section transect where riparian vegetation (6) is measured, survey points are recorded at 1-m intervals and at any significant slope-break points to provide a reasonably accurate depiction of topography. The thalweg, or lowest point along the stream channel, is surveyed throughout the reach at 1-m intervals to capture important channel features. Locations of transect headpins and hydrologic monitoring equipment are also recorded in the survey.

Integrating the Data

Using the data from the survey, a drawing of the channel cross-section is created that shows the elevation at each point along the cross-section and the location of the well and piezometers (7). Using the data downloaded from the pressure transducers, the stream stage and the average, minimum, and maximum level of the groundwater in the piezometers are determined. This information is overlain on the cross-section drawing to interpolate the depth to groundwater at different points along the channel cross-section. At the reach in Figure 7, the groundwater elevation can be seen sloping away from the stream, a typical pattern for aridland streams that "lose" water into surrounding soils. In the future, vegetation data will be added into the analysis to look for patterns in species occurrence and cover relative to groundwater elevation.



(7) Average depth to groundwater on the Fremont River, Capitol Reef NP.