

Northern Colorado Plateau Network

Monitoring Brief

National Park Service
U.S. Department of the Interior

Inventory & Monitoring Program



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Big Rivers Monitoring

Importance

In several Northern Colorado Plateau Network (NCPN) units, big rivers and riparian zones provide lush contrast to the surrounding desert environment. These systems provide habitat for federally listed terrestrial and aquatic species, are intimately intertwined with unique geologic features cited in enabling legislation, and are major recreational destinations. However, as demands for Colorado River water increase, water development projects have altered streamflow in virtually all systems within the river's drainage. In most cases, stream flows—and peak flows—have been reduced, leading to channel simplification. Channel simplification can result in a number of negative impacts, including channel narrowing, reduced diversity and scale of geomorphic surfaces and associated habitats, disconnection of the river from its floodplain, and changes to riparian vegetation and biodiversity. In response to these concerns, the NCPN has implemented a big rivers monitoring program.

Process and Use

The NCPN has designed a hypothesis-driven, multi-scale monitoring protocol. The protocol links frequent, field-based rapid assessments; existing independent datasets; and infrequent, quantitative evaluations of broad-scale changes using remotely sensed data.

We hypothesize that under anticipated climate change and increasing human demands, streamflow regimes will shift in response to (1) more droughts and bigger floods in some places, and (2) more droughts and fewer, smaller floods in others because of water resource development. These shifts may lead to channel simplification through vegetation encroachment, stabilization of formerly active channel deposits, and the creation of new floodplain surfaces due to lateral and vertical deposition of alluvial sediments.

To test that hypothesis, we are:

- Monitoring intensely at sentinel sites selected for their sensitivity to channel simplification,
- Conducting rapid assessments of sites hypothesized to be very sensitive, sensitive, and insensitive to channel simplification, and
- Using remote sensing to detect large-scale, riverwide changes.

Early detection and quantification of the channel simplification process would allow National Park Service managers to (1) work cooperatively with water users to identify and possi-



Field crew on the Gunnison River, Black Canyon of the Gunnison NP.

bly mitigate the effects of human-caused depletions of water resources, and (2) identify reaches sensitive to narrowing so that management actions might be implemented in an efficient, cost-effective manner.

Status and Trends

In 2014, the NCPN completed the first year of monitoring at Canyonlands NP, restored monitoring at Curecanti NRA (previously halted due to federal budget sequestration), and continued monitoring at Dinosaur NM and Black Canyon of the Gunnison NP. An instantaneous peak flow of 9,650 cfs (cubic feet per second) was recorded at Black Canyon of the Gunnison NP this year, which was the highest flow recorded since 1995. Initial results indicated that these flows cleared some monitoring sites of colluvium (loose sediments) that had accumulated from side canyons. Work at Dinosaur NM showed that invasive plant species, including tamarisk (*Tamarix* spp.), were 2–3 times more prevalent on the regulated Green River than on the wild Yampa River.

Contact

Dusty Perkins, dustin_w_perkins@nps.gov

Network park units where big rivers are monitored

Black Canyon of the Gunnison NP
Canyonlands NP

Curecanti NRA
Dinosaur NM

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

How We Do It: Big Rivers Surveying

Katrina Lund peers through the cross-hairs again, then picks up her radio. “A little more to the left with those topmost branches,” she tells the man behind the bush. A grunt and a stretch, the rustling of leaves, bending of branches, and Katrina checks again. “Got it!”

Land surveying began with ancient efforts to develop the land and divide it for purposes of taxation. Today, however, surveying is as much an element of building natural-resource databases as it is in building structures. The NCPN uses surveying to create topographic maps of its big-river sentinel sites and to correlate the resulting elevational data with other components of the project, such as vegetation and hydrology monitoring.

Upon arrival at a sentinel site, members of a 7–12 person field crew identify the hydrologic zones that represent the active channel, inactive floodplain, and active floodplain. Then they place pinflags into the ground to mark plots for vegetation monitoring. Katrina (inset, right) and her “rod crew” then “shoot” the location of each pinflag.



Too much jargon? Here’s how it works. There are two human components to a big rivers survey: The surveyor, who operates the survey equipment (called a total station) and orchestrates the survey operation, and the rod crew. The rod

crew usually consists of 2–4 people, each equipped with a height-adjustable rod topped with a reflector prism. The surveyor (Katrina) sets up the total station at a given point, then directs the rod crew to stand at certain locations. Katrina sights in the prism in the total station, then pushes a button that shoots a laser out to the prism. The laser hits the prism and comes back, and the total station calculates a set of xyz coordinates associated with the site of the prism (northing, easting, and elevation), as well as the distance between the prism and the total station.

At each visit to a given site, Katrina shoots the same set of control points, then shoots the pinflags set up during that particular visit. By calibrating the results of the pinflag points (which vary by visit) with the control points (which remain consistent across visits), NCPN staff can map changes in deposition and erosion over time, as reflected in elevation changes.

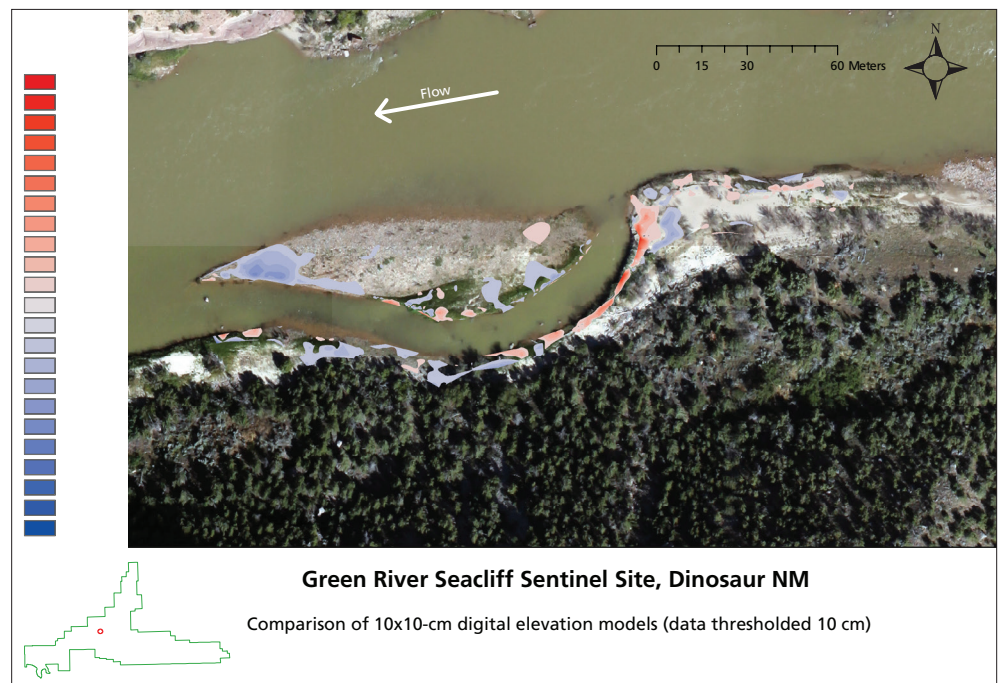
It should come as no surprise that surveying is “all about keeping the errors low.” Katrina needs to know the exact height of the rod at each shot or the measurements (which need to be precise within 2–3 centimeters) will be off and the topographic map will be wrong. (Remember that scene in *Raiders of the Lost Ark* when Indiana Jones real-



After sighting in the prism, the total station (left) shoots a laser and then returns data about the precise location of the prism (circled). (Note: In this photo, the side of the total station that would normally face the prism is facing the photographer, instead.)

izes the enemy couldn’t find the Well of Souls because their rod was the wrong height? The same principle is at work here.)

By combining the survey results for elevation with vegetation data and information on hydrologic stage and discharge, it’s possible to determine how the dynamics of vegetation and geomorphology at a sentinel site are changing and might continue to change. For instance, we might learn that Plot A, at 3,000 feet, was scoured of 20% of vegetation since the previous sampling period, and inundated with water for 20 days—while only 5% of vegetation was scoured at Plot B, at 3,010 feet, which only had water on it for 10 days. With this combination of survey and vegetation data, we can track the value of natural flows as well as large floods in the natural resetting process. This process is essential to river health, and having information about it can help with flow management on regulated rivers.



Green River Seacliff Sentinel Site, Dinosaur NM

Comparison of 10x10-cm digital elevation models (data thresholded 10 cm)

Map of elevational changes at a sentinel site on the Green River, 2011–2012.