



Stream Ecological Integrity, Little Bighorn Battlefield NM

Streams are fundamental components of every park in the Rocky Mountain Network (ROMN). They support a broad spectrum of ecological services including hydrologic cycling, nutrient processing, and wildlife habitat as well as recreation, fisheries, and cultural context. Streams are sensitive to stresses such as excessive sediment and nutrient inputs, withdrawal for agricultural use, and climate change, making them ideal for long-term monitoring of ecological health. The general objectives of stream ecological integrity monitoring are to document the status and long-term trends in condition of streams and rivers in a park, and to use this information to help understand why stream conditions may have changed.

The following is a summary of results from pilot monitoring of Stream Ecological Integrity (SEI) of the Little Bighorn River at Little Bighorn Battlefield National Monument (LIBI) from 2007-2010.

Methods

The SEI protocol includes a broad spectrum of indicators to help evaluate the ecological integrity of the Little Bighorn River at LIBI. Core indicators include multiple measures of water and sediment physiochemistry (nutrients, metals, temperature); physical habitat (substrate composition, riparian cover, channel geomorphology); and community-level assays of two important biological assemblages: macroinvertebrates and algae. The latter provide an integrated aspect for assessing ecological integrity, because these organisms respond to environmental conditions over time and space. We include measures of drivers (or stressors) and ecological responses, so that we may better understand the linkages among them and help parks apply these results to resource management. SEI methods are documented in a protocol and are largely derived from well-established and existing protocols developed by ROMN partners, including the Environmental Protection Agency (EPA), the U.S. Geological Survey (USGS), and the Montana Department of Environmental Quality (MT DEQ). The application of standardized protocols across ROMN and partner stream monitoring sites facilitates the comparison of streams and rivers within an ecoregion. SEI data were analyzed following well-established methods. Biological response was emphasized, because the presence and health of populations of key taxa are indicative of overall stream health.

We interpret results using a variety of assessment mechanisms, including regulatory criteria and other thresholds, among them reference values derived from state and federal monitoring reference sites in the Northern Great Plains ecoregion. Because SEI monitoring is not regulatory in nature, we can consider thresholds that may have more of an ecological basis or relevance to a specific LIBI resource management need.



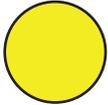
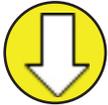
NPS, B. SCHWEIGER

The Little Bighorn River in the Little Bighorn Battlefield National Monument during the fall of 2007. The top of the SEI sample reach begins on the left side of this image and extends around the large bend for 1.2 kilometers. Stream flow is from the left side of the image.

Results

In general, the Little Bighorn River and its riparian corridor were largely intact and medium to high in quality. A few areas of concern include some evidence of excessive fine substrates in littoral or shoreline areas, and some non-reference aspects of the riparian corridor with some invasive plants of concern. The weight of biological evidence suggests a non-reference biological condition; however, the available biological metrics may not be well suited to the Little Bighorn and we generally have low to medium confidence in this interpretation (in other areas we have greater confidence in our assessment). The long-term trend in stream temperature suggests rising water temperature and reduced total flow—or a deteriorating condition (but the period of record is short). With this combination of results, we determine the overall condition is “Intermediate” (Caution).

The following summary table describes each SEI indicator and measure and symbolizes the status, trend, and level of confidence. This information is a considerable simplification of the detail in the full report and should be used with caution.

Vital Sign (Example Indicators)	Summary Condition Table Description	Symbol
Overall ecological integrity	The ecological integrity of the Little Bighorn from 2007 to 2010 was largely intact and of medium to higher quality. Results were somewhat mixed, with high quality water physiochemistry and physical habitat, but the weight of biological evidence suggests a non-reference biological condition. However, the available biological metrics may not be well suited to the Little Bighorn and in general we have low to medium confidence in this interpretation (in other areas we have greater confidence in our assessment). We lack data to assess the overall trend in condition.	
Water physiochemistry (nutrients, major ions, metals)	Nutrients, major ions, and metals concentrations were all acceptable with few exceedances of State of Montana water quality criteria for aquatic life (or human health). Maximum (but not median) sulfate concentrations were higher than at ecoregion reference sites. While patterns are mixed, the long-term trend in several water physiochemistry parameters may be improving. We have medium confidence in our assessment of major ions, nutrients, metals at LIBI.	
Water <i>in situ</i> chemistry (pH, conductivity, DO, temperature)	All of the core NPS parameters were in an acceptable reference range. Dissolved oxygen needs more careful monitoring. The long-term trend in stream temperature suggests rising water temperature—or a deteriorating condition (but the period of record is short). We have medium confidence in our assessment of <i>in situ</i> parameters at LIBI.	
Sediment chemistry (metals)	Most metals were present in low concentrations and did not exceed informal consensus-based sediment criteria. We suspect the source of most metals is natural. We lack data to assess trends in metal concentrations. We have lower confidence in our assessment of sediment chemistry at LIBI given the lack of clearly relevant criteria.	
Habitat, in-stream and riparian (complexity, cover, disturbance)	In-stream habitat was generally in a reference state with a fairly complex bottom profile and sufficient woody debris. However, there was more filamentous algae cover than ideal, riparian vegetation cover was patchy, especially on the west or non-park bank, and some adjacent potential stressors in the floodplain were more common than in ecoregion reference sites (even with the fairly intact riparian corridor on the park side). Invasive plants were fairly common, and some occurred with higher frequency than in ecoregion reference sites. We need more data to confirm these conclusions and assess trend.	
Habitat, sediment (size, stability)	Fine substrates in the Little Bighorn channel were less prevalent than in ecoregion reference sites. Bed sediments were also slightly less mobile than expected. If we restrict data to just littoral areas, however, the cover of fines is high and may explain reduced biological condition. However, the channel bedform and these sediment dynamics are probably not relevant in ongoing natural processes like bank sloughing of concern to the park. We need more data to confirm these patterns and to assess trend.	
Habitat, stream flow (amount and timing)	Stream flow during 2007 to 2010 relative to the period of record suggest SEI monitoring occurred in variable but largely average water years. Long-term USGS gauge data suggests a shift in timing of peak flows to later in the summer, and a small but marginally significant decrease in total annual flow We have lower confidence in our assessment of stream flow at LIBI given the distance to the gauge near Hardin.	
Biological communities, macroinvertebrates (MMI and RIVPACS metrics)	Patterns across macroinvertebrate metrics were complex. The weight of evidence suggests that there was a non-reference community present. Littoral fine sediment may be the primary cause behind a degraded condition but it is not clear if the level of fine sediments at LIBI are natural or are caused by anthropogenic activities in the watershed. We lack data to assess trends. We have lower confidence in our assessment of benthos communities at LIBI due to possible imprecision in some macroinvertebrate models developed for warm water or plains rivers like the Little Bighorn.	
Biological communities, diatoms (increaser metrics)	Like macroinvertebrates, most diatom metrics suggested a degraded conditions in the river, especially in response to sediment and nutrients. Diatoms are the base of the food chain and the lack of an intact diatom community may be one of the reasons why we also see lower quality macroinvertebrate assemblages. We lack data to assess trends. We have lower confidence in our assessment of benthos communities at LIBI due to possible imprecision in some diatom models developed for warm water or plains rivers like the Little Bighorn.	
Aquatic invasives (presence)	No aquatic invasive species were found, although the New Zealand mudsnail is in the Bighorn River watershed and likely on the move. SEI monitoring will watch closely for these and other invasive species over the coming years. We have medium confidence in our assessment of aquatic invasives at LIBI.	

Red=significant concern/nonreference, Yellow=caution/intermediate, Green=good condition/reference

Thick border=high confidence, dashed border=low confidence

Arrows: up=improving trend, down=decreasing trend; flat=stable trend; empty=unknown trend due to insufficient data