Channel Movement, Error Analysis, and Impacts for Neighboring Landowners: A Lower Bear River, UT Case Study

Russell Babb, Kellie Shawn, Todd Brown, Ayman AlAfifi, Dr. David Rosenberg
RussellBabb756@gmail.com

The Bear River Fellowship Program
NSF Grant # 1149297
UWRL Utah Water Research Laboratory
2016 Spring Runoff Conference

ABSTRACT

We set out to answer the questions how is the Bear River channel moving and changing from year to year and how does that movement affect the surrounding landscape? Neighboring land owners and managers posed these questions to us during a multi-day river trip we took in August 2015 on the Bear River between the Utah-Idaho border and Amalga. During the trip, we collected hydrological, topologic, and vegetative data at two sites just above and below the confluence of the Bear and Cub rivers and a third site about 8 miles upstream in the Bear River Bottoms management area. At each site, we measured water level, stream flow, river bank and bed topology, plus delineated riparian zones using an Acoustic Doppler Current Profiler (ADCP), transom surveying equipment, and a Garmin GPS unit. We pooled these observations from August 2015 with similar measurements prior undergraduate Bear River Fellow researchers made in 2012 and 2013. The resulting cross sectional views at each research site through time show bank movement of up to 5 feet over two years. An error analysis of ADCP measurements of channel bed depth show an average error of 0.4 feet. In addition to providing information for local land owners and managers, this research experience in the Bear River Fellows Program also gave us hands-on experience in collecting, synthesizing, and analyzing environmental and ecological data.

OBJECTIVES

- Observe and identify changes that occurred in the three establish research sites
- Determine the error of river depth reading taken by the ADCP
- Determine the impacts of river movement on local landowners
- Develop graphs to represent the change that happened between August 2013 and August 2015

METHODS

1. Set up transect cross sections on established study site. Repeated for Morton, Cub, and Bear-Cub Confluence sites.
2. Collected water flow along with river depth using the ADCP by dragging the ADCP across the river following transect line (Figure 1)
3. Recorded 4 transects to measure errors in cross sectional measurements
4. Surveyed cross sections of the river banks and riparian zones using Transom Survey Equipment (Picture 2) and Garmin GPS
5. Exported data from ADCP WinRiver II software and analyzed data in Excel
6. Measured errors in river depth readings by interpolating and graphing multiple transects at each site
7. Repeated for all three sites for 2015 and 2013 years

Figure 1: Acoustic Doppler Current Profiler (ADCP) taking readings

Figure 2: Being trained on how to use Transom Survey Equipment

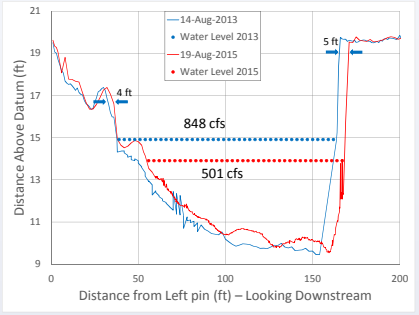


Figure 3: Morton Site comparing 2013 cross section survey to 2015 survey. Arrows indicate changes in cross section.

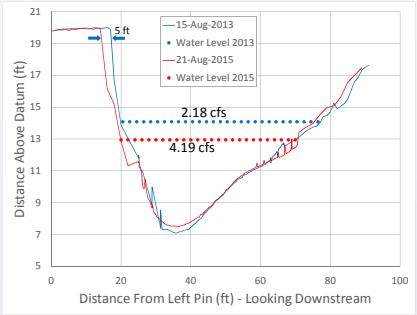
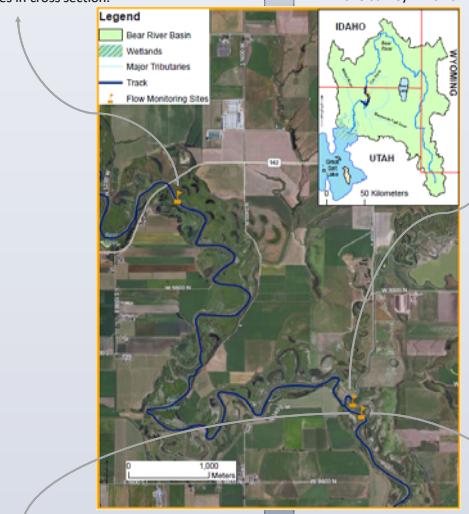


Figure 5: Cub River Site comparing 2013 cross section survey to 2015 survey. Arrows indicate changes in cross section.



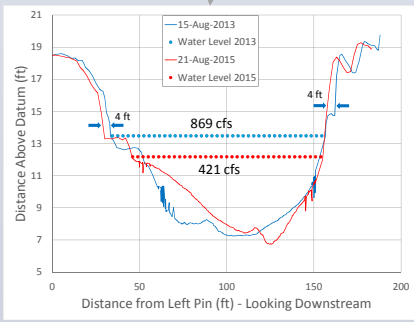


Figure 4: Bear-Cub Confluence Site comparing 2013 cross section survey to 2015 survey. Arrows indicate changes in cross section.

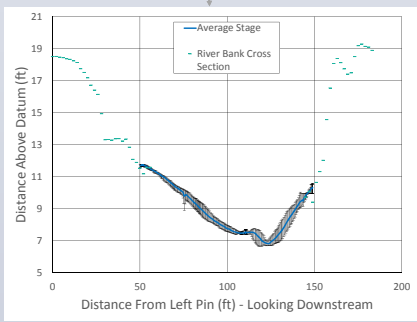


Figure 6: Bear-Cub Confluence Site Cross Sections taken 21-August-2015. Error Bars indicate the maximum and minimum values recorded at any specified location. Blue Line indicates average stage

KEY RESULTS

- Horizontal shift of cross section is visible and marked at large changes. The shift tends to be greater on the steep bank of the river. In the Cub and Morton sites we observed up to 5 ft of soil shift. In the Bear-Cub Confluence site there was up to 4 ft of soil shift.
- The cause is the river carving the channel away.
- At the Bear-Cub Confluence site, the depth to the channel bottom decreased on river-left and increased on river-right.

Ambiguities:

- Zig Zag patterns appear in the cross section (e.g., 70 ft from left pin at Morton site in August 2013, 60-70 ft. from left pin at Cub River site in August 2015) Two potential causes for the patterns are:
  1. Conflicting observations between the ransom survey equipment and ADCP (a few transom survey points were made in the water near the bank)
  2. ADCP had difficulty measuring depth to the channel bottom at some locations
- The Cub River had lower flow rates at higher stage. We hypothesize this counter intuitive result occurs because the Cub River site is located very close to the confluence of the Bear and Cub rivers and under certain conditions the Bear River influences water levels in the Cub.

Key Results of Error Analysis:

- Error bars on Figure 6 show the highest and lowest point recorded by the multiple transects the ADCP took
- The Error Bars are caused by:
  1. Human Error with pulling the ADCP across the river
  2. Mechanical error of the ADCP readings
  3. Disruptions of the river (e.g large rocks, sticks, trees etc.)

NEXT STEPS

- Share Results with local landowners and mangers
- Analyze ADCP depth to channel bottom measurements at the other sites to confirm error
- Obtain future cross sections in future years to compare erosion

CONCLUSIONS

- The cross sectional views of each research site through time have shown bank movement up to 5 feet over two years.
- The error analysis of ADCP measurements of channel bed depth show and average error of 0.4 feet.
- The Bear-Cub Confluence site channel bottom depth has decreased on river-left and increased on river-right
- Since August 2012 the Bear River Fellows Program has set up research sites and established a longitudinal study of the lower Bear River Bottoms and will continue to investigate these sites

Website: http://bearriverfellows.usu.edu/