Assessment of Geomorphic Impacts of Vegetation Removal on the Colorado River

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ABSTRACT

The introduction of tamarisk (*Tamarix* spp.) to the riparian zones adjacent to the Colorado River and many of its tributaries in the southwestern US has contributed to increased stability of the river channels. The increased stabilization and salinization of riparian zones and increased total water consumption of tamarisk stands create a significant impact in the Colorado River drainage basin on the main stem and many tributaries. Tamarisk impacts on the Colorado River and its tributaries have led to removal efforts and the release of the tamarisk leaf beetle (*Diorhabda carinulata*) as a biological control agent. Bank erosion following high flows in 2011 in areas where vegetation removal had occurred suggests that recent efforts at removal of tamarisk could contribute to increased bank erosion and increased channel mobility.

The purpose of this study is to assess changes in channel mobility following tamarisk removal along a 51-km reach of the Colorado River in western Colorado via GIS analysis of repeat aerial photos of the channel and side channels in areas where removal has been accomplished and field surveying of cross sections in two reaches of the Colorado River where tamarisk removal is planned with the intention of continued annual monitoring to measure cross-section geometry changes.

During the summer of 2013 the initial field surveying of the river channel was accomplished at the two field sites identified for tamarisk and Russian olive (TRO) removal during the winter 2013/14: Franklin Island, near Corn Lake State Park and Walker State Wildlife Area (Walker SWA). A total of ten cross sections were surveyed at the two sites with survey-grade GPS to map the pre-removal channel bathymetry. Topographic survey of the riparian zones will be accomplished with aerial LIDAR following removal of invasive riparian vegetation. The removal sites will be resurveyed following the next near-bankfull streamflow.

GIS analysis of the entire 51-km reach, including the main channel and side channels, will assess channel mobility in removal and non-removal areas via measurement of changes in the non-vegetated active channel from pre-removal and post-removal aerial photos. The "active channel" of the Colorado River active channel is defined as the area of no or sparse vegetation cleared by the river, and does not include vegetated islands or mechanically cleared areas. Channel change analysis has been completed for the north bank of the channel between 2007 and 2012. Areas of significant channel change were identified and classified as removal areas, non-removal areas, or adjacent to removal areas based on GIS data from the Tamarisk Coalition (2013). Initial results do not indicate significant difference in sizes of eroded areas in removal or non-removal sites.

BACKGROUND

In the Grand Valley in western Colorado along the Colorado river, about 2,700 acres (~1,000 hectares) of riparian land area are estimated to have tamarisk present, with about 1,200 acres (~480 hectares) of that land having more than 50% tamarisk coverage.

The Tamarisk Coalition has mapped land area adjacent to the Colorado River in the Grand Valley from Palisade to Loma, where tamarisk and Russian Olive (TRO) removal efforts have been undertaken. About 175 acres of land have undergone some kind of TRO removal efforts (Figure 1).

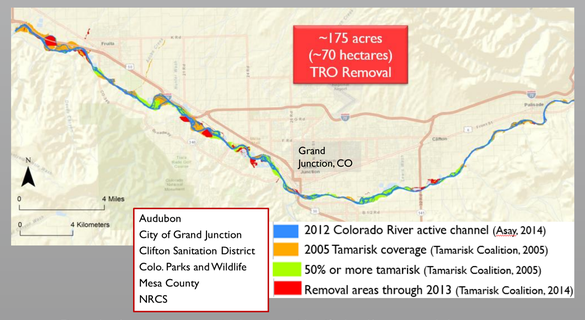


Figure 1 – Areas where tamarisk have been identified and/or removed along the Colorado River in the Grand Valley, CO

FIELD SURVEY 2013/2014

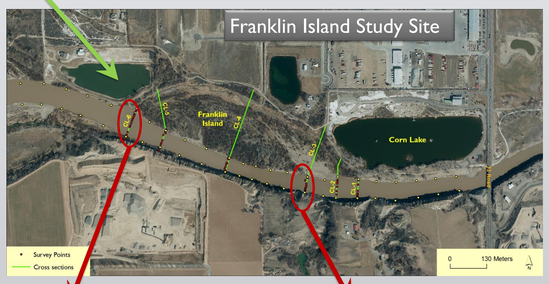
2013 Field Survey

- Identified two field sites where TRO removal was planned
- Surveyed ten cross-sections (Table 1) using survey-grade GPS for baseline channel morphology pre-TRO removal
- Six of the section were re-survey of Colorado Division of Wildlife 1999 (Anderson 2002) channel survey for fish habitat modeling
- Franklin Island sections were compared with 1999 survey (Figure 2)

Table 1. Cross-section data

	Walker SWA	Franklin Island
Reach Length (m)	711	850
Average section length (m)	101	76
Average distance between cross sections (m)	237	170

Trimble Survey-grade GPS w/ Real-Time Virtual Reference Network (RTVRN)



2014 Field Survey

- High flows in 2014 required re-survey of pre-removal bathymetry
- Re-surveyed ten cross-sections.

Future Work

- Survey riparian portions of cross sections following TRO removal during winter 14/15 with survey-grade aerial LIDAR
- Re-survey of cross sections at the Colorado River Island that were established by Dr. John Pitlick of CU-Boulder

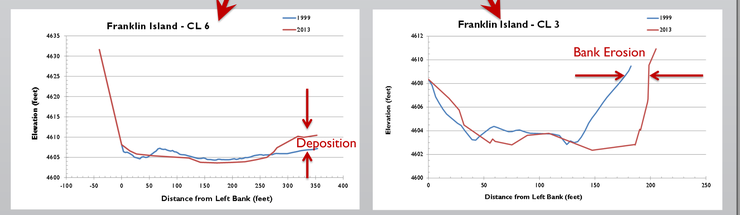


Figure 2. 2013 Field survey results illustrating channel change measured at two selected cross sections at Franklin Island. 1999 Survey Data from Anderson (2002).

GIS ANALYSIS METHODS

- Digitized north bank of "active channel" from 2007 and 2012 aerial photos (6-inch resolution full color orthophotos)
- Clipped banklines to create erosion site polygons and measured size of each erosion site (Figure 3)
- Identified vegetation removal areas, dates of removal, removal methods
- Measured and compared erosion in veg removal areas with the rest of the channel

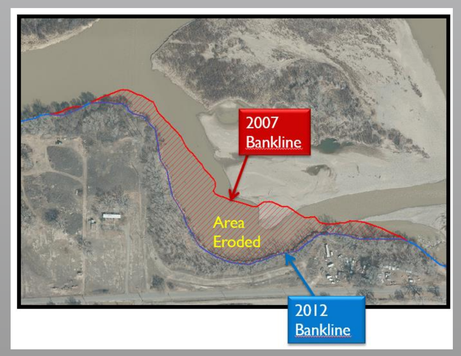


Figure 3. Exampled of an eroded area polygon.

GIS ANALYSIS PRELIMINARY RESULTS

- Identified a total of 36 eroded areas, with only 8 being in areas where vegetation removal had been performed prior to 2012 (Figure 4)
- The size and length of individual eroded areas did not differ significantly between sites with and without vegetation removal (Figures 5 & 6), but eroded sites without vegetation removal were slightly larger and longer.
- Individual sites where vegetation removal was performed exhibited very slightly wider eroded areas than sites where vegetation removal was not performed (Figures 7 & 8).

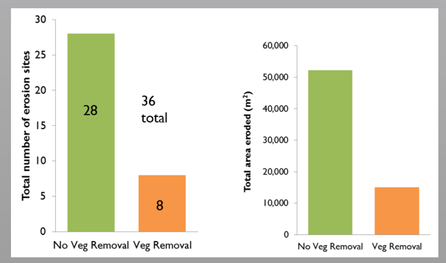


Figure 4. Distribution of erosion sites and comparison of total area eroded in vegetation removal sites vs. non-removal sites.

GIS ANALYSIS PRELIMINARY RESULTS (con'd)

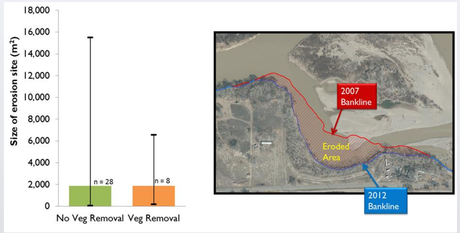


Figure 5. Comparison of area of individual erosion sites.

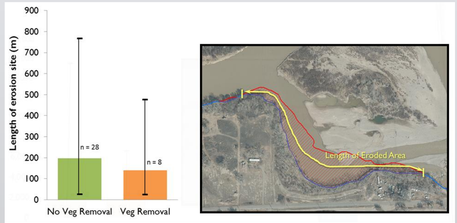


Figure 6. Comparison of length of individual erosion sites.

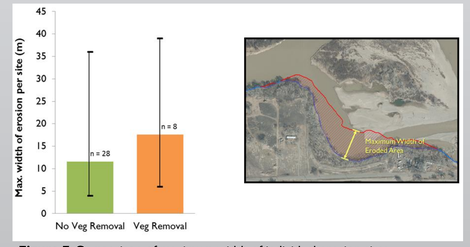


Figure 7. Comparison of maximum width of individual erosion sites.

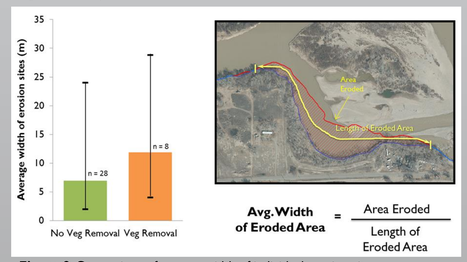


Figure 8. Comparison of average width of individual erosion sites.

REFERENCES

Anderson, R. 2002. *Riverine Fish Flow Investigations, Federal Aid Project F-289-R5*. Colorado Division of Wildlife, Fort Collins, CO.

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