

I. Project Title: Colorado River Embeddedness Monitoring Study

II. Principal Investigator(s):  
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III. Project Summary:

A program designed to monitor embeddedness of gravel and cobble substrates in the upper Colorado River initiated in 1999 continued in 2000, 2001, and 2002. Baseline embeddedness data was previously collected during 1996-1998 as part of another study. This monitoring program will be used to determine effects of various flow regimes on substrate condition. Substrate composition affects primary and secondary production in riverine ecosystems. Periphyton and invertebrates, the food base of the fish community, depend on rock surfaces for attachment sites; in addition, invertebrates depend on the interstitial voids among rocks for shelter and feeding sites. Because the transport, sorting and deposition of coarse and fine-grained sediments is largely determined by the flow regime, gaining a better understanding of the link between streamflow, substrate characteristics, and food availability will allow managers to more effectively manipulate flows to maintain and enhance native fish habitat.

Monitoring was conducted in two reaches of the Colorado River in the Grand Valley, near Grand Junction; this area includes the highest concentrations of Colorado pikeminnow in the Colorado River. Monitoring sites in four riffles and four runs were sampled in the 15-Mile Reach, upstream of the Gunnison River confluence, and in four riffles and four runs in the 18-Mile Reach, immediately downstream of the Gunnison River confluence. At each site, 20 embeddedness measurements are made on each sampling date. Sampling was conducted once prior to runoff in early spring, and three times during base flows of summer-fall.

IV. Study Schedule: 1999-2009

V. Relationship to RIPRAP: Coordinated Reservoirs I.A.4.c(3)(c)

VI. Accomplishment of FY 02 Tasks and Deliverables, Discussion of Initial Findings and

Shortcomings:

Tasks

1) Sample 16 embeddedness monitoring sites in the Grand Valley on four dates. This task was accomplished on schedule.

Initial findings indicate that total depth-to-embeddedness (DTE) in riffles during base flow declined significantly from 1996 to 1997 and again from 1997 to 1998, leveled off from 1998 to 1999 and then continued to decline from 1999 through 2001. This was true in both the 15- and 18-Mile Reaches. For runs, total DTE steadily declined from 1997 to 2001 in both the 15- and 18-Mile Reaches. Peak flows during this period declined from 1997 through 1999 and the low 1999 levels were repeated in 2000. In 2001, peak flows had declined again. In 2002, peak flows were the lowest on record due to an unusually low snowpack. In the 15-Mile Reach, peak flows were: 26,500 cfs in 1997, 14,400 cfs in 1998, 12,700 cfs in 1999, 14,000 cfs in 2000, 8,180 cfs in 2001 and 2,780 cfs in 2002.

In the 18-Mile Reach peak flows were: 36,800 cfs in 1997, 24,700 cfs in 1998, 17,200 cfs in 1999, 17,000 cfs in 2000, 13,000 cfs in 2001, and 4,470 cfs in 2002. Only in 1997 did the peak discharge exceed the threshold necessary for full mobilization of the bed in most areas. In 2001 and 2002, thresholds needed to initiate limited bed movement in most areas were not met. The elevated base flow levels that occurred during 1999 may have been responsible for DTE in riffles having not declined between 1998 and 1999. Riffle DTE continued to decline again in 2000 and 2001 probably because of a combination of low peak flows followed by low base flows. For runs, which constitute the majority of the habitat in the Grand Valley, peak flows that were capable of initiating limited bed movement but not full mobilization did not prevent sedimentation of cobble interstitial voids. The question of whether low DTE will level off at some point or whether rock spaces will continue to fill with low flow remains unanswered. As of the end of 2001, DTE had continued to decline: in the 18-Mile Reach relative DTE in both riffles and runs was less than one median cobble diameter. This is also the case in runs of the 15-Mile Reach. Data for 2002 have not yet been analyzed.

During the three winters of 1997-1998, 1998-1999 and 1999-2000 there was a significant amount of sedimentation of the substrate that occurred between our fall sampling effort (October) and our early spring effort (prior to runoff). During those three periods, depth-to-embeddedness significantly declined. This apparently did not occur during the winter of 2000-2001 for some unknown reason. At some sites, DTE declined while at other sites it increased; however, preliminary analyses indicate the average of all runs and of all riffles in both the 15- and 18-Mile Reaches showed no significant change over winter.

It is difficult to determine the extent to which invertebrate abundance has been negatively affected by the decline in DTE during base flows over the past 4 years. In 2001, a concurrent invertebrate sampling program at the embeddedness sites was initiated. These samples were processed in 2002. Invertebrate samples collected during 2002 have not yet been processed. Several years of invertebrate data collection will be necessary before trends, if any, can be discerned. Preliminary analysis of the summarized invertebrate data from 2001 indicate significantly higher volumes of invertebrates in riffles than in runs (as expected). Also, there is a huge amount of variability in invertebrate volumes among samples within sites and among sites. To

develop mean values per habitat per reach per sampling date, sample size will need to be increased to reduce variability about the means. Without greater sample sizes it may be impossible to discern trends from one date to the next or from one year to the next.

- VII. Recommendations: Proceed with monitoring as before except increase funding to cover collection and processing of additional Hess samples at each site.
- VIII. Project Status: Project is ongoing and on-track. Field work is scheduled to continue through 2009 and report writing and completion in 2009.
- IX. FY 2002 Budget
  - A. Funds Provided: 16,310
  - B. Funds Expended: 16,310 (\$4,320 for lab analysis has not yet been billed by contractor)
  - C. Difference: 0
  - D. Publication costs 0
- X. Status of Data Submission: Not applicable. The database manager only requires submission of fish data.
- XI. Signed: Douglas Osmundson, Fishery Biologist, Lead investigator  
12/06/02