SUMMARY REPORT FOR THE SAN JUAN RIVER BASIN RECOVERY IMPLEMENTATION PROGRAM HABITAT MONITORING WORKSHOP JANUARY 11–12, 2012

Prepared for

U.S. FISH AND WILDLIFE SERVICE
SAN JUAN RIVER RECOVERY IMPLEMENTATION PROGRAM
2105 Osuna Road NE
Albuquerque, NM 87113

On behalf of

U.S. BUREAU OF RECLAMATION
125 South State Street
Salt Lake City, UT 84138

Prepared by

SWCA ENVIRONMENTAL CONSULTANTS
5647 Jefferson Street NE
Albuquerque, NM 87109
Phone: (505) 254-1115; Fax: (505) 254-1116
www.swca.com

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ACRONYMS AND ABBREVIATIONS LIST

cfs	cubic feet per second
GPS	global positioning system
Program	San Juan River Recovery Implementation Program
SJR	San Juan River
TSS	total suspended solids
USFWS	U.S. Fish and Wildlife Service

1.0 INTRODUCTION

PURPOSE OF WORKSHOP

The purpose of the workshop was to review and evaluate data and results related to San Juan River Basin Recovery Implementation Program (Program) habitat monitoring protocols. The habitat monitoring protocols support *Recovery Element 2-Protection, Management, and Augmentation of Habitat* of the Program's Long Range Plan. The primary focus of the workshop was to review and determine if testing the assumptions and hypotheses provided in the monitoring protocols could be conducted with the data and results that have been collected by the program thus far. Workshop participants were focused on:

- Reviewing assumptions and hypotheses behind the habitat monitoring protocols
- Reviewing data and results of habitat-flow monitoring that have been collected to identify and describe habitat-fish-flows relationships
- Evaluating if the habitat-flow data tests the assumptions and hypotheses that are presented in the habitat monitoring protocols. The evaluation of the protocols will occur in the context of whether:
    - the data adequately can be used to test the hypotheses;
    - the hypotheses follow from the stated assumptions; and
    - the assumptions and hypotheses are still appropriate given the results
- Assessing if the results can be used to evaluate the flow recommendations and if there are other or additional habitat protocols needed so that the results can be used to evaluate the flow recommendations
- Developing and populating a "habitat-flow evaluation scorecard"

The information gained from this workshop will be used in subsequent workshops that focus on evaluating and revising the current flow recommendations.

FOUNDATIONAL ASSUMPTIONS GOING INTO THE WORKSHOP

Habitat-Flow Monitoring Assumptions

- Modification of physical attributes of the San Juan River (SJR) (see management actions) will elicit measurable responses in habitat availability
- Spawning and nursery habitat requirements of Colorado pikeminnow (*Ptychocheilus lucius*) are known
- Spawning and nursery habitat requirements of razorback sucker (*Xyrauchen texanus*) are known
- Mapping of key habitat and geomorphic features by interpretation of aerial photography is comparable to field mapping of these parameters after calibration

Habitat-Flow Monitoring Hypotheses

- Channel complexity and backwater habitat availability are maintained by implementation of the flow recommendations (no decreasing trend in either)

- Channel complexity and backwater habitat availability are positively correlated to the duration, magnitude, and frequency of high-flow spring runoff
- Channel complexity and backwater habitat availability are positively correlated to physical habitat modification
- Availability of spawning habitat for endangered fish recovery is positively correlated with management actions
- Water temperature in the critical habitat is adversely affected by management actions

The goal of the two-day workshop was to review habitat data that has been collected by the Program with the intent of using the review to determine additional monitoring needs and inform decisions regarding future flow recommendations for the SJR. This report is intended to summarize the discussions and recommendations that were made during the workshop. Table 1 provides a list of workshop attendees and their professional affiliations.

Table 1. List of Attendees for the Non-native Fish Workshop (January 11–12, 2012)

Organization	Attendee(s)
American Southwest Ichthyological Research	Howard Brandenburg Michael Farrington Steve Platania
BIO-WEST	Paul Holden
Bureau of Indian Affairs	Michael Howe
Bureau of Reclamation	Mark McKinstry Ryan Christianson Katrina Grantz Kristine Blikenstaff
Colorado Water Conservation Board	Michelle Garrison
Colorado State University/TNC	Brian Bledsoe
Ecosystem Research Institute	Vince Lamarra Keith Lawrence Justin Barker Dan Lamarra
Habitech, Inc.	Tom Wesche
Keller-Bliesner Engineering	Shawn Stout
Miller Ecological Consultants	Bill Miller
Navajo Nation	James Morel John Leeper (consultant)
New Mexico Department of Game and Fish	Eliza Gilbert Kirk Patton
New Mexico Interstate Stream Commission	Kevin Flanigan
SWCA Environmental Consultants	Eric Gonzales
Southwestern Water Conservation Board	Carrie Lile
The Nature Conservancy	Patrick McCarthy Joan Sanderson
U.S. Fish and Wildlife Service	Jim Brooks David Campbell Jason Davis Scott Durst Dale Ryden Sharon Whitmore Steve Cullinan
U.S. Forest Service	Mel Warren
U.S. Geological Society	Chris Conrad Bruce Moring
University of Colorado	John Pitlick
University of New Mexico	Steve Ross

1.1 WORKSHOP OVERVIEW

Jim Brooks of the U.S. Fish and Wildlife Service (USFWS) was the workshop's facilitator and presented an overview of the workshop's intent. The group had two primary tools for assessing the habitat work that has been collected to date: 1) list of questions that should drive the meeting and 2) the evaluation scorecard. The focus of the workshop was to address these questions to the group's satisfaction. Although the flow recommendations for the SJR were not the topic of this workshop, the habitat questions will eventually lead to modifying these flow recommendations.

Why should habitat be monitored? Initially, the program believed that if the natural hydrograph was reproduced through flow management, the SJR would provide the necessary habitat for the native Colorado River fishes that reside there, including the endangered Colorado pikeminnow and razorback sucker. This has not proven true and is analogous with the "field of dreams" hypothesis, i.e., if managers mimic the natural hydrograph, the SJR will provide the necessary habitat for the endangered Colorado River fishes.

Brooks discussed the outstanding question or issue of what the appropriate scale is for monitoring habitat in the SJR. He explained that it is easier to measure habitat than fish habitat use; therefore, the appropriate scale for monitoring needs to be determined so that results between habitat and fisheries monitoring are comparable. Brooks and the USFWS feel that current monitoring approaches are equivalent to "the tail wagging the dog," i.e., the two data sets are not comparable but should be and this should be a primary focus of the workshop. These two monitoring programs should be brought together so that management actions and effects on fish can be elucidated for the SJR. A major goal of this workshop is to clarify a series of question from the peer reviewers so that they can be addressed.

Scott Durst from the USFWS then provided an overview of the scorecard approach that the group will use to determine if current monitoring data can be used to assess the assumptions and hypotheses related to the flow recommendations for the SJR. He explained that the scorecard is intended to provide an anchor that will be revisited throughout the workshop and filled in collaboratively with the group. The specific purpose of each flow recommendation is listed on the scorecard. This will enable the group to determine if the current habitat monitoring data can be used to assess if flow recommendations are serving their intended purposes and/or determine the effectiveness of some of the flow recommendation purposes. Durst explained that the habitat protocols portion of scorecard lays out the assumptions, hypotheses, and objectives behind the habitat monitoring. This system will allow the group to assess if the current habitat monitoring approach can be used to assess the hypotheses/objectives and the flow recommendations.

1.1.1 COMMENTS AND QUESTIONS MADE DURING THE WORKSHOP INTRODUCTION

- When we meet the actual flow recommendations do we meet the intended objectives?
- Does habitat respond to flow and, if it does, do we see the expected fish response?

Discussion: It is difficult to illicit what management actions are actually affecting the fish, which is a core premise of the workshop. How management is affecting fish habitat and how the fish are responding to changes in habitat in the SJR needs to be determined.

2.0 OVERVIEW OF THE HABITAT PROGRAM IN THE SAN JUAN RIVER

Vince Lamarra provided an overview of habitat data collected from the SJR in the last 20 years. His presentation put the SJR into perspective to determine the limitations within the system. Reaches in the SJR vary from 16 to 30 miles, and their current conditions are dependent on a series of antecedent conditions, i.e., the river is in its current state because of what has happened during the previous time period. The SJR maintains a fairly constant gradient until Lake Powell with only some areas that are flat. This is important to know because during high flows there is not much available floodplain habitat in the SJR.

Lamarra then discussed how reaches in the SJR were delineated. Reach definitions were developed by looking at habitat variables, including riparian vegetation, channel type, etc. From the definitions, eight separate reaches were delineated in the SJR between Lake Powell upstream to Navajo Dam.

- Reach 1 is the downstream-most reach and under the influence of Lake Powell. The reach is at lower elevations and the channel is held in place by bedrock. Typical habitats include low-gradient sand bottom, with sand shoals dominating. Backwater habitats are on sandbars or dry washes. The backwater areas formed in washes tend to be cut off from the main channel and require runoff through washes to open them back up. Access between backwaters and the main channel in this reach are ephemeral in nature.
- Reach 2 is the canyon reach. It is linear in nature, canyon bound, steep sided, and narrow. This area of the SJR is a high-gradient reach that is riffle dominated.
- Reach 3 is a debris field that is multi-channeled with a reasonable gradient. This reach has high sinuosity and is low gradient with multiple channels and abundant but unstable backwaters. The reach has exhibited the largest loss of backwater habitat of all reaches.
- Reach 4 is a transition between sandy Reach 3 and cobble-dominated Reach 5. There is clean substrate at some locations. This reach has many braided channels.
- Reach 5 is a multi-channeled reach with stable backwaters and cobble habitats dominating. This reach has some stable backwaters and substrate is dominated by cobble substrate.
- Reach 6 goes into the town of Farmington and is where the Animas River enters the SJR. The reach is mostly single channeled, with a cobble gravel substrate. There are four diversion dams within the reach.
- Reach 7 is mostly a single channel with banks stabilized by dikes. The dominant substrate in the reach is characterized as embedded cobble. Water in the reach is reasonably clear. Overall the reach is heavily channelized.
- Reach 8 is heavily influenced by Navajo Dam. This reach is a single channel, with clean gravel/cobble substrate. There are no large secondary channels in this reach.

Reaches 1 through 6 are critical habitat for endangered fishes in the SJR. Lamarra emphasized that antecedent flow conditions of the SJR are gradually diminishing in the SJR. Annual flow has steadily decreased since habitat monitoring began. Annual decreases in flow will have an effect on resetting the habitat in the SJR.

2.1 BUREAU OF RECLAMATION REMOTE MONITORING 1991–1992

Lamarra continued with his presentation and discussed the types of habitat data that were collected from the SJR using an aerial mapping approach that was done via video interpretation for river miles 68 to 154. The aerial photography was used to delineate seven major habitat types: main channel, side channel, flow-through side channel, backwaters, flooded sand bars, sand bars, and islands.

2.1.1 COMMENTS AND QUESTIONS MADE DURING THE REMOTE MONITORING PRESENTATION

- Using this approach, is the amount of habitat being mapped accurate with these data? Answer: The wetted area is, but the accuracy of individual habitat types is unknown. At high flows (8,000 cubic feet per second [cfs]), water is distributed bank to bank, reducing the amount of backwater habitat. Habitat may increase again at flows in excess of 10,000 cfs, but this is unknown.
- Does saltcedar (*Tamarix* sp.) or non-native vegetation encroachment increase or correlate with flow reductions in the SJR?
- Does videography data accurately depict the amount of habitat available at a fine scale? Could we be missing vegetated backwaters during extremely high flows? This could account for the reduction of backwater habitats at flows ~8,000 cfs.

  A major point of these analyses is that an eight-fold increase in discharge in the SJR only amounts to a two-fold increase in the amount of wetted habitat.

2.2 RESEARCH PERIOD (HABITAT – FLOW RELATIONSHIPS)

During the next portion of his presentation, Lamarra explained the approach used for ground mapping in the SJR. The ground habitat mapping approach used airborne video. Still images were captured, printed on sheets (five to seven images per mile), and then habitats mapped. These habitats were then digitized in ArcGIS so that habitat areas could be calculated. Field mapping occurred at similar flows as were present when the river was flown (typically within a week) and the video images were collected. River miles were divided into two or three teams who each mapped their assigned section over a four- or five-day period. Sites were accessed via rafts. Mapped habitats were assigned to one of 35 categories and field verification of the major habitat types was done by collecting depth, velocity, and substrate information for each.

2.2.1 COMMENTS AND QUESTIONS MADE DURING THE RESEARCH PERIOD PRESENTATION

- It seems like there could be a lot of variability between teams; how did you control for that? Staff was consistent throughout the project and we are confident the data were collected consistently. Initially, the crews worked closely together to ensure that they were calling out habitats the same.
- How different is the field mapping from the digital videography mapping? We do not know for sure. We do know that digital video technology has improved dramatically since the early 1990s and would likely result in a substantial improvement and be closer to the actual field mapping.

- What was the smallest habitat unit mapped? The smallest was 2 × 2 meters. Because of the issue with scale on our maps, the size of smaller features may be easily overestimated. The scale of the mapping would best be considered macro-habitat features.
- It is important to remember that backwater habitats in the SJR are small and ephemeral.
- How does the amount of backwater habitat in the SJR compare with other portions of the Colorado River? Backwater habitats make up very little habitat in the SJR relative to other portions of the Colorado River.
- The highest backwater data point observed on the SJR was 1995. Since this year, backwater habitats have been steadily decreasing.
- There is a high degree of variability for the amount of backwater habitat at 1,000 cfs. Why is this? The system resets, but what is the system resetting factor? It appears floods of high magnitude and duration can reset the system, increasing backwater habitats.
- Why is there so much variability in backwater habitat area over time in the SJR and what are the possible causes of this variability?
- How does seasonal availability of habitat factor into the habitat analysis? From a fish perspective, they would have to utilize different backwater habitats at different flows.
- Why were the sampling times, fall or late in the year, chosen? The intent was to get a compromise between small fish monitoring and large fish monitoring programs.
- After the big flows of 1995, a loss of backwater habitat and gain of backwaters between surveys was highlighted; why is that? The difference results from flows at mapping that affected the amount of backwater habitat.
- The point was made that all the flow recommendations affect less than 6% of the habitat in the river.
- Slackwater habitat in the SJR does not change much. This is important because Colorado pikeminnow utilize these habitats. The stability of these habitats may be an important attribute of this habitat feature.
- What are the effects of vegetation changes from native to non-native vegetation on the debris piles? Many of the debris piles are actually made up of Russian olive (*Elaeagnus angustifolia*). What effect does loosing cottonwoods (*Populus* sp.) have on habitat quality or recruitment of debris/large woody debris to the system?

3.0 GEOMORPHIC INVESTIGATIONS

During this section of his presentation, Lamarra explained how the habitat data can be used and how it can be integrated with geomorphic data. He focused his analysis for this section on backwater habitats.

3.1 ACROSS STREAM TRANSECTS AND SUBSTRATE CHANGES

Habitat mapping data were taken and overlapped with other habitat data with close dates to determine how habitat amounts fluctuate. This was done in specific locations to see if changes occurred. Lamarra also emphasized that backwater habitats in the SJR have different formation

mechanisms depending on the upper and lower river and should be analyzed separately. Highlights of the curve fitting analysis and backwater formation are briefly summarized below:

- Backwater area vs. peak runoff – no relationship.
- Backwater area vs. days above 10,000 cfs – no relationship
- Backwater area vs. days above 8,000 cfs – no relationship
- Backwater area vs. days above 5,000 cfs – significant relationship
- Backwater area vs. days above 2,500 cfs – significant relationship

3.1.1 Comments and Questions Made during the Across Stream Transects and Substrate Changes Presentation

- Why is there so much variability in backwater habitat area over time in the SJR? What are the possible causes of this variability, and are we always going to see this type of variability?
- Are we putting too much importance on backwater habitats in the SJR?
- Why was habitat lost between 1995 and 1998? Backwaters are ephemeral in nature in the lower part of the river and are very dependent on antecedent conditions.
- Total backwater habitat is highly variable in Reaches 1 and 2. Backwaters associated with washes tend to form when flows increase. Backwaters associated with sandbars tend to decrease with flow increases. Backwaters have different formation mechanisms. We need to figure out how to manage this from a flow standpoint.
- In Reaches 3 through 8, backwater habitats tend to be associated with the entrance (embayment) and exit (backwater) of a dry secondary channel, as well as the main channel cobble/sand bars. Habitat has decreased in Reaches 3 through 6 since 1995.
- Are high water years important for backwater formation? Will non-native vegetation encroachment and bank armoring prevent reformation of backwater habitats?
- The data indicate that total volume of runoff has an effect on backwater formation.
- Why are canyon backwater features not recognized in upper reaches? These areas tend to be prevalent in these reaches during high flows. Some of these backwaters may be off the maps that are currently being used. Answer: mapping was done only twice during high flows. More high-flow mapping may need to be done. Should high flow mapping be conducted and, if so, how often?

3.2 Secondary Channel Surveys

3.2.1 Comments and Questions Made during the Secondary Channel Surveys Presentation

- Because areas of backwaters are small in the SJR, managing at this fine of a scale would be difficult. Can small secondary channels function in some capacity as backwaters or low-velocity habitats? Answer: Fine-scale habitat attributes cannot be mapped from the office; it needs to be done from the ground.
- How could the system be managed for Colorado pikeminnow or use flow management to do so? Answer: Flow recommendations are needed that work for both species, razorback

sucker and Colorado pikeminnow. Modifying Navajo Dam for temperature control would open up more habitat. In terms of flows, we would want to deliberately inundate the bottom portion of the river then turn off the flow. With this approach, we may be able to pulse water to maintain canyon backwaters by breaking down their berms.

- Do we really know what the species need for spawning and rearing habitat? Are their requirements the same in the SJR as in the other portions of the Colorado River?
- How much of the vegetation was removed during high flow in 1995? Lamarra replied that is a good question and the habitat mapping data can be used to determine this. Brooks said the river is now armored with a wall of Russian olive, which has increased substantially in the past 20 years.
- What effects have flows out of Navajo Dam had on the SJR since 1995?

4.0 HABITAT QUALITY

Keith Lawrence presented on what habitats are suitable for endangered SJR fishes and how productive different habitat types are. He looked at habitat productivity of riffles, runs, and backwater habitats. He also evaluated the spatial and temporal distribution and the physical and biological parameters of backwater habitats in the SJR in relation to flow. Comparisons were made with other regional rivers (Green, Colorado) to determine if physical and biological parameters in the SJR are the same as in other portions of the Colorado River basin.

4.1 HIGHLIGHTS, COMMENTS, AND QUESTIONS PROPOSED DURING THE HABITAT QUALITY PRESENTATION

Results were first presented and comparisons were made among backwater habitats in the Colorado, San Juan, and Green rivers.

- Depth of backwater habitats in the SJR averaged about 0.3 m. Colorado River backwater habitats were deeper and averaged about 0.80 m. Green River backwater habitats were about 0.40 m deep or intermediate between the Colorado and San Juan rivers.
- Total suspended solids (TSS) were greater in the SJR than the Colorado River.
- Periphyton in the SJR was greatest when flows are stable or during floods. The San Juan and Green rivers had similar periphyton concentrations, while the Colorado River had higher concentrations than the SJR.
- Detrital load was higher in the SJR and the Colorado River than the Green River.
- Invertebrate biomass did not differ among all three rivers. There was not much food or productivity in backwater habitats, which is likely because these habitats are ephemeral.
- SJR backwater habitats were shallower and more turbid than backwaters in the Colorado River.

The same study was conducted on riffles and run habitats and comparisons were made between the Colorado, San Juan, and Green rivers.

- No difference was seen in periphyton concentrations between riffles and runs. Periphyton concentrations were much higher in the SJR than in the Colorado River. In

the Colorado River varied spatially from upstream to downstream. This trend was not observed in the SJR.

- Detritus increased from downstream to upstream in the SJR. The same trend was observed in the Colorado River, but overall detrital load was greater in the SJR than in the Colorado River.
- Invertebrate biomass increased from downstream to upstream reaches in both the Colorado and San Juan rivers. Riffles had more invertebrate biomass than runs in the San Juan River. The same trend was observed in the Colorado River. Invertebrate biomass was similar between the SJR and the Colorado River in riffles and runs.

Lawrence discussed his observations of condition of SJR fishes and how it varies temporally and spatially throughout the river.

- Fish condition (Fultons) for flannelmouth sucker (*Catostomus latipinnis*) increases from downstream to upstream during the fall in the SJR. Spring conditions for flannelmouth sucker only increased during 1994 and 1996 from downstream to upstream. Both of these years followed the largest floods since the monitoring began (i.e., 1993 and 1995).
- Flannelmouth sucker condition seems to responds negatively to high discharges or the number of storm event days in October and February. Bluehead sucker (*Catostomus discobolus*) condition does not.
- Upstream reaches of the SJR are likely more productive because there is more detrital and organic matter in riffles and runs. The upper SJR is very important to native fish due to higher productivity and paucity of non-native fishes.
- Do we need to improve access to the upper SJR? We need to ensure that fish have easy access to the upper SJR. The Animas River has good fish habitat and some Colorado pikeminnow are being collected in the river.
- How can access be improved to the upper SJR?
- Does fish monitoring need to be extended to the upper SJR? The Animas River? Some data exist in the Animas River and native fish occur there at high densities, so perhaps monitoring should be extended to include the Animas River.

5.0 ATTEMPTS TO INTEGRATE HABITAT DATA WITH FISHERIES DATA

Lamarra presented on initial attempts to integrate the habitat monitoring data with the fisheries monitoring data. The objectives of this portion of the presentation were to determine if the fisheries monitoring data could be used with the habitat monitoring data. He analyzed the 2003 and 2004 data to determine if relationships could be established.

5.1 ANNUAL ADULT MONITORING DATA AND SYSTEMATIC MACROHABITAT DATA COLLECTIONS (REGRESSION AND PRINCIPAL COMPONENTS ANALYSIS)

The following variables were used in the analysis: habitat type, fish group, and general habitat groups. General and habitat type analysis were conducted separately. The researchers then compared fish catch per unit effort data with habitat area data. At the fine level, island and

cobble habitats had the greatest fish abundance. These habitats are the most productive habitats in the SJR. At the course level, cobble shoals and slackwater habitats had the greatest fish abundance. Islands per mile was significantly correlated with fish abundance.

5.2 STANDALONE MICROHABITAT INVESTIGATIONS (COMPLEX REACH STUDIES)

Dr. Paul Holden presented results from a detailed reach and habitat use/association perspective. He discussed how habitat can be related to endangered fish. Thirty-four reaches qualified for surveys and from these, two reaches were randomly selected for detailed habitat monitoring. A global positioning system (GPS) unit was used to collect data for 2-D modeling. These data were compared between the regular mapping and differences were noted. From Holden's presentation, several questions regarding the life history of endangered SJR fishes emerged and are summarized in the next section.

5.2.1 HIGHLIGHTS, COMMENTS, AND QUESTIONS PROPOSED DURING THE STANDALONE MICROHABITAT INVESTIGATIONS PRESENTATION

- How can we relate habitat to endangered fish?
- Early stocking showed that Colorado pikeminnow were growing rapidly compared to other places. Why?
- Should habitat mapping be done at a finer scale than is currently being done? We may need to do so because fish sampling is occurring at a finer scale than the current habitat monitoring.
- What is the appropriate scale for habitat mapping?
- What is the appropriate scale for fisheries monitoring?
- Should small seines be used in conjunction with large seines to be able to differentiate microhabitat features and fish response?
- Should fisheries monitoring and habitat monitoring be conducted simultaneously?
- Detailed habitat mapping provided nearly a three-fold increase in resolution.
- Colorado pikeminnow use multiple habitats in the SJR.
- Is small pikeminnow (total length <100 mm) habitat utilization the same in the SJR the same as in other portions of the Colorado River?
- Is large pikeminnow (total length >100 mm) habitat utilization the same in the SJR the same as in other portions of the Colorado River?
- Do large and small pikeminnow utilize the same habitats?
- Do larval pikeminnow and larval razorback suckers utilize the same habitats?
- Models cannot accurately predict backwater locations or abundance except by water surface inspection.
- Is looking at complex reaches an alternative to river-wide mapping?
- Fish habitat relationships are difficult to establish. More work needs to be done for razorback sucker.
- How often should river-wide mapping be conducted?
- Should photo interpretation of habitat be validated with river-wide monitoring?

- Do razorback sucker juveniles utilize the same habitats as adults?
- How well do velocity profiles match with 2-D model predicted velocities?
- What scale should 2-D model grids be?
- How well do 2-D model predicted low-velocity habitats correlate to fish distribution?
- Are there things we can do from a management perspective to increase hydraulic retention?
- How important is habitat complexity or spatial availability of habitats for fish in the SJR?
- Is the current fish distribution data in the SJR affected by capture probability?

6.0 LESSONS LEARNED AND CURRENT PROGRAM

6.1 HIGHLIGHTS, COMMENTS, AND QUESTIONS REGARDING HABITAT CREATION AND LOSS

- How do island complexes evolve over time? Why have many been able to persist even with the encroachment of non-native vegetation?
- Can island count be used as an index of habitat complexity? Lamarra said because islands produce more edge, forcing channel braids that result in a greater amount of habitat complexity, it could be used.
- Has the number of islands increased or remained stable? Lamarra said it looks like they are stable and may even be increasing.
- Have flows observed since the Program started been examined to see how habitat complexity changes/responds? Lamarra said it can be done because we have data since 1993.
- Is the river long enough for all life stages of endangered fishes in the SJR?

7.0 REVIEW OF HYDROLOGY OF THE BASIN POST FLOW RECOMMENDATIONS

Ryan Christianson used a version of the scorecard to determine how well the flow recommendations out of Navajo Dam have been met. All the flow recommendations were only met during 1995, 1997, and 2005. No flow recommendations were met in 2002. The 2,500-cfs flow target was met during all years but 2002. The 5,000-cfs flow target was met in 1993–1995, 1997– 1999, 2001, 2005, 2007, and 2008.

7.1 HIGHLIGHTS COMMENTS AND QUESTIONS REGARDING HYDROLOGY OF THE BASIN POST FLOW RECOMMENDATIONS

- Can flow recommendations be evaluated if they are not met?
- There is a limited window when you can release large amounts of water from Navajo Dam. We need about one or two weeks to schedule releases. This is difficult because runoff forecasts are only accurate for about 14 days.
- What are the appropriate ramping and reduction rates for flows out of Navajo Dam?

- Can ramping rates affect native fish survival in the SJR?

8.0 ASSUMPTIONS OF HABITAT MONITORING

During day two, the group spent the majority of the workshop assessing and modifying the habitat monitoring assumptions and the flow recommendations for the SJR. Below are a list of the assumptions and the discussions that took place.

1. **Assumption 1 - Modification of physical attributes will elicit measureable responses.**
    - Brooks to the workgroup: What do we mean by this?
    - Can be both flow and physical modification, i.e., habitat restoration. Do we expect to see a response? Yes, but it may be immeasurable and can be negative. This assumption should be retained but modified.

From this discussion, Assumption 1 was modified as follows:

"Environmental releases from Navajo Dam will improve habitat characteristics important to the endangered fish."

2. **Assumption 2 - Spawning and nursery habitat requirements are known.**
    - These are not completely known, but given enough time, characteristics can be quantified.
    - American Southwest Ichthyological Research staff: We have a good idea for nursery habitats in the SJR. We have a specific for habitat but do not know exact details about biology.
    - Bill Miller: Where do you find the fish? Do we have enough of that habitat to keep the populations self-sustaining?
    - Mark McKinstry: Recovery is based on past data collections in other rivers. We never had a clear picture of how the river is used by endangered SJR fishes.
    - Others: Data exist after the construction of Navajo Dam that showed many pikeminnow of various life stages. Less is known about razorback sucker. Is this a good assumption? Is it correct?
    - We know habitat characteristics not sure that we know requirements.
    - Lamarra: Is the habitat in the SJR ideal habitat for the fish? Or do they just occur where we find them because that's the available habitat?
    - Should this assumption be restated in the context of each species by life stage?
    - Brooks: Should this assumption be restated as "spawning and nursery habitat required for recovery in the SJR are not sufficiently known?"
    - Lamarra: We know where pikeminnow spawn in the river but we don't know how much of this spawning habitat is available.
    - Howard Brandenburg: We don't know where razorback spawn, but we do know that we collect their protolarvae from upstream to downstream sites.

- Dale Ryden: We have evidence of habitats occupied by pikeminnow during spawning from radio telemetry data. Our data also indicate that razorback suckers can spawn in a wider variety of habitats than the pikeminnow.
- Ryden: We need to learn how to monitor for juvenile razorback suckers. We don't know anything about the juvenile life stage for this species. This is a huge unknown that needs to be addressed for this species.
- Lawrence: We don't know much about habitat because we can't find the larvae, or does this mean the habitat is not present in the SJR?
- Miller: Can we actually measure biological response? We should focus on physical response since the biology has many confounding factors.
- Lamarra: Do we have the current technology to even construct appropriate habitats for fish in the SJR? Is our monitoring program for habitat in sufficient enough detail to track management actions on habitat? Have we been doing it? No. Can we do it: Yes. Is our program technology sufficient enough to track changes?
- Brian Bledsoe: It may be important to make a distinction between tracking a response and observing a response.

From this discussion, Assumption 2 was modified into two separate assumptions for each species:

<u>Modified Assumption 2</u> –

- Razorback sucker nursery and spawning habitat characteristic can be quantified.
- Colorado pikeminnow nursery and spawning habitat characteristics can be quantified.

3. **Assumption 3 - Aerial and field mapping of key habitats and geomorphic features are comparable**.

    - Lamarra: One or two sites per reach may be sufficient enough to track management actions.
    - McKinstry: Should river-wide mapping be conducted every year or we should we focus on important areas instead?
    - Bledsoe: Assumption 3 is focused on methodology; should it be tied into the first two assumptions?

From these discussions the workgroup came up the following revised habitat monitoring assumption:

<u>Modified Assumption 3</u> –

- Aerial and field mapping of key habitats and geomorphic features of the entire floodplain are both critical components to characterizing system responses to management actions.

After the revised assumptions were derived, the workgroup continued with its discussion regarding habitat monitoring and following key questions and assumptions as they relate to the habitat monitoring.

- David Campbell: Part of our monitoring should target key locations for spawning endangered fish.
- Miller: Should these assumptions be extended to the entire fish community?
- Brooks: Do these assumptions also cover other native fish species?
- Assumption - When habitats are improved for Colorado pikeminnow and razorback sucker, habitats are improved for the entire native fish community.
- Do we need to monitor for non-native fish response to management actions? Assumption - Our current monitoring program quantifies non-native fish habitat.
- How does riparian vegetation distribution relate to habitat availability for endangered SJR fishes? Assumption: Non-native vegetation encroachment adversely affects natural processes and management actions to improve habitat.
- Assumption: Current water quality conditions affect habitats (temperature, contaminants, TSS, etc.).
- Steve Ross: Should habitat be considered in terms of static and dynamic habitat? Does good water quality automatically equate to suitable habitat if geomorphic features are not suitable?
- There is a separate monitoring program for water quality in the SJR. This monitoring program needs to be evaluated in the context of other monitoring programs.
- We need to monitor management actions from the [River Ecosystem Restoration Initiative] RERI project to restore side channel and backwater habitats.
- Assumption: There is enough habitat/river length in the SJR to recover these species.

The afternoon of January 12 began with further discussion regarding habitat monitoring Assumption 1. Brooks explained that the workgroup had thus far discussed hypotheses while figuring out the assumptions. Now the workgroup needed to go back and come up with hypotheses for the assumptions. The workgroup was then led into a discussion regarding habitat monitoring Assumption 1, as modified.

Assumption 1 - Environmental releases from Navajo Dam will improve habitat characteristic important to endangered SJR fish. The following are four hypotheses associated this assumption:

1. Channel complexity and backwater habitat availability are maintained by flow recommendations.
2. Channel complexity and backwater habitat availability are correlated to duration, magnitude, and frequency of spring runoff.
3. Channel complexity and backwater habitat availability are correlated to physical habitat modification.
4. Water temperature is adversely affected by management actions.

The following points/questions were made by workshop participants regarding habitat monitoring Assumption 1:

- McKinstry: Compared to some systems we do a good job of mimicking the natural hydrograph in the SJR.
- Brooks: What hypothesis do we need to specifically state now to move forward with the fish and habitat monitoring programs?
- Ross: High spring flows improve nursery habitat for the razorback sucker.
- Lamarra: We do not know threshold flow in the SJR; what are the target flows to improve/maintain habitat? Is it duration? Is it flow magnitude? Is it ramping rate? Is it a combination of all three?
- Miller: To get actual spawning substrates, high flows are necessary for reworking bars and are [necessary parts] of maintaining spawning habitat.

9.0 FLOW RECOMMENDATIONS FOR THE SAN JUAN RIVER

The current flow hypotheses have been used as the basis for the flow recommendation in the SJR:

1. **Flow Recommendation 1 - Flows greater than 10,000 cfs for ≥5 days in 20% of the years will:**
    - Provide out-of-bank flow.
    - Generate new cobble sources; we need out of bank flow to generate new cobble sources.
    - Change channel configuration to provide channel diversity and complexity; this may only work with manual removal of non-native vegetation.
    - Provide nutrient loading to improve habitat productivity.

The following questions/comments were made with regard to Flow Recommendation 1:

- Does our current monitoring capture if flows >10,000 cfs for ≥5 days in 20% of the years achieve the stated purposes?
- Is 10,000 cfs enough to obtain the desired physical response in the SJR?
- Are these flows sufficient to maintain the floodplain and main channel connectivity? If not, what would the necessary flows be?
- Brooks: Biology ties into the physical questions. What physical responses are necessary for providing habitat for SJR endangered fishes?
- Miller: Does our current habitat monitoring protocol capture the purposes of the flow recommendations?

From these discussions the following flow hypothesis was proposed and questions regarding the utility of the current habitat monitoring approach for addressing this hypothesis were discussed. The following is a list of key questions/points made during the discussion:

- **Hypothesis 1. Flows greater than 10,000 cfs will provide out-of-bank flow along the majority of the SJR reaches.**
    - Are we monitoring for out-of-bank flows? Some data are available.
    - Should additional assessments be made? Yes. We may use HEC-RAS modeling to assess overbank flows in the SJR. We may also need to determine zones or areas where sediment transport varies, i.e., how sheer stress in bed varies throughout the SJR.
    - Can you see overbank flows from videography? Can you record while the SJR is peaking? This could be addressed by sending out a crew during high-flow events to ground map overbanking or you can send a crew out to survey the high water marks after high flows.
    - Do key components of past work that are not captured in the current program need to be revisited and will this be sufficient to assess Hypothesis 1?
    - We do not have a good understanding of out-of-bank flow. Do fish respond better in reaches with more out-of-bank flow? The SJR is a detrital-based system. Most energy in the SJR comes from terrestrial sources. Out-of-bank flows increase with discharge. We cannot fine tune flow management above 10,000 cfs in the SJR because of channel constraints.
    - If you get more out-of-bank flow do you get more productivity? Is this productivity greater in reaches with more out-of-bank flows? How do fish respond in reaches with more out-of-bank flows?
    - Do we have evidence to support the 10,000 cfs flow recommendation?
    - Are we monitoring for cobble generation? Some data are available. Do we need additional assessments of cobble generation? Yes.
    - Are we monitoring for changes in channel configuration? No. Videography data and cross section ground mapping can also be used. This can be measured with existing data sets. Existing data can be used to assess changes in channel configuration.
    - Can channel change be assumed to increase the amount of cobble generation?
    - Are we monitoring nutrient loading and fish response after floods? Monitoring does not currently assess this. Nutrient loading is assumed to increase with overbank flows.

The discussion continued focusing on other current flow recommendations for the SJR.

2. **Flow Recommendation 2 - Flows greater than 8,000 cfs for greater than or equal to 10 days in 33% of the years.**
    - Are we monitoring to determine of channel cross sections are maintained by flows? Yes, periodically. Do we need to continue monitoring? We should monitor at least every five years.
    - Are we monitoring for cobble movement and building that is suitable for spawning? No. Should we monitor? Yes, but not yet. At what scale and what frequency?
    - Are we monitoring to see if these flows are providing larval habitat? Yes and no. Do we need to? Yes. We need to provide immediate and antecedent conditions. We can use existing data to evaluate. We have four data points to conduct this analysis.

3. **Flow Recommendation 3 - Flows greater than 5,000 cfs for 21 days in 50% of the years.**
    - Are we monitoring for clean backwaters? No. Should we monitor? No.
    - Are we monitoring to determine if low-velocity habitats are being maintained? Yes. Do we need to continue to do this? No.
    - Are we monitoring to see if nursery habitat is maximized at these flows? No. Do we need to monitor? Yes. What do we need to monitor?

4. **Flow Recommendation 4 - Flow greater than 2,500 cfs for greater than or equal to 10 days in 80% of years.**
    - Are we monitoring for cobble movement on spawning bars? No. Do we need to monitor? Yes.
    - Does cobble move at 2,500 cfs and where are the cobble bars?
    - Does 2,500 cfs move cobble on spawning bars regardless of how much sediment is in the system? How would we monitor this? By assessing spawning gravels/cobbles?
    - Ryden: This flow recommendation does not seem to be meeting the intended purposes. Evidence indicates that these flows don't move cobbles.
    - Are we monitoring for cobble cleaning? No. Do we need to monitor? Yes.
    - Does this flow recommendation trigger Colorado pikeminnow spawning? No. Do we need to monitor? Yes.
    - Are sufficient habitats provided at these flows for Colorado pikeminnow spawning?
    - Do these flows provide the correct hydraulic conditions for spawning of endangered SJR fishes?

5. **Flow Recommendation 5 - Manage the hydrograph to mimic peak flows.**
    - Are we monitoring to see if the hydrograph is similarly timed to the actual hydrograph? Yes. Do we need to monitor this? Yes.

6. **Flow Recommendation 6 - Provide 500- to 1,000-cfs base flows.**
    - Are we monitoring to see if this flow recommendation provides nursery habitat? Yes. Should we monitor? Yes.
    - We need to develop measurable hypotheses for this flow recommendation.
    - What percentage of nursery habitat is maintained by this flow recommendation?
    - Do we have the data to determine how much backwater habitat there is?

7. **Flow Recommendation 7 – 5,000-fs spike flood control release.**
    - Are we monitoring to determine if sediment is flushed from low-velocity habitat? No. Do we need to monitor this? No.
    - Are monitoring to determine if the flow recommendation will suppress small-bodied fish? Yes. Do we need to monitor this? Yes, with fish monitoring.

10.0 ASSUMPTIONS OF HABITAT MONITORING - FINAL DISCUSSION

After reviewing the flow recommendations, the group then revisited the habitat monitoring assumptions to determine if Assumptions 2 and 3 were addressed by looking at the flow recommendations. In particular the work group wanted to assess if current monitoring programs were structured so that the expected response was measured. Below is a list of the modified assumptions for habitat monitoring and key points/questions provided by the workgroup.

Modified Assumption 2:

- Razorback sucker nursery and spawning habitat characteristic can be quantified
- Colorado pikeminnow nursery and spawning habitat characteristics can be quantified
- Do we know enough about the following to guide management actions? Each characteristic was categorized as low, medium, or high depending on how confident the workgroup believed the current monitoring data could be used to answer each of the following categories:
    - Razorback sucker spawning habitat characteristics - high
    - How much habitat is needed - low
    - Biology of larvae - medium
    - Razorback sucker nursery habitat characteristics - high for larvae; unknown for juveniles
    - How much habitat is needed - low
    - Biology of juveniles - unknown
    - Colorado pikeminnow spawning habitat characteristics - high
    - How much habitat is needed - low
    - Biology of larvae - low
    - Colorado pikeminnow nursery habitat characteristics - medium for larvae; high for juveniles
    - How much habitat is needed - low
    - Biology of juveniles - medium

Key questions and points discussed by the workgroup with regard to habitat monitoring Assumption 2:

- Brandenburg: What about persistence of nursery habitats? Should this be part of habitat monitoring or something more focused? Should this be considered separately from regular habitat monitoring?
- Lamarra: [We] need to target specific times. There is a short window to do this. [We] could place pressure transducers in backwater habitats to determine how many days these habitats are wetted. We don't currently know this but this should be monitored in some fashion.
- How important do you think persistence of these habitats is? These habitats should persist for at least two months, persistence is likely important.
- Brooks: Should persistence of these habitats be monitored?

- Brandenburg: These habitats are important and the benefit they provide to SJR fishes would likely increase the longer they persist.
- Lawrence: Is it possible that larvae are drifting into the backwaters?
- Brandenburg: Backwater persistence should be based on the development rate of fishes. [We] may need a longer backwater persistence time for Colorado pikeminnow and less persistence time for razorback sucker.
- Miller: What was the duration of historic flows above a certain level? This could provide us with an idea of how long backwaters in canyon reaches persisted prior to impoundment of the SJR.
- Brooks: How are we defining nursery habitat? We have yet to do this. We can't monitor this if we done know what we are defining [as] this type of habitat.
- How is nursery habitat defined in the SJR for the Colorado pikeminnow and razorback sucker?
- Lamarra: At 3,000 cfs you start losing backwater habitats that are in the canyon reach.
- At what point do the backwater habitats become less important for razorback sucker and more important for Colorado pikeminnow?
- Brandenburg: Reach 3 is different [than] Reach 1. In Reach 1, some backwater habitats can become closed off from flow because of their canyon bound nature. We visit all our sites and record if they are inundated, so after a few years of this we will have some idea of what each site requires for inundation.
- Brooks: Should we make a change that incorporates another method for monitoring nursery habitat? Do we need to conduct this monitoring annually?
- Brooks: I don't think you can monitor this as a function of the current habitat monitoring protocol.
- How do you know if you are gaining or loosing habitat if you don't have a benchmark to compare to?
- Brandenburg: Canyon reach backwaters can be monitored with the videography. Instream backwater habitats are more ephemeral and are always changing.

11.0 QUESTIONS ABOUT CURRENT MONITORING PROGRAMS

- McKinstry: How we can create more backwater and nursery habitat in the SJR with the management tools that we have (flow and mechanical manipulation).
- Campbell: Evidence shows we have lost side channels, which is likely due to non-native vegetation. We need to understand how channel dynamics have affected sediment transport in the SJR with particular attention on the role that non-native vegetation has on sediment transport.
- How has non-native vegetation changed the geomorphic dynamics of the SJR?
- How will mechanical habitat manipulation affect river channel dynamics? Can we mechanically manipulate habitat in the SJR to achieve desired outcomes that benefit the native fish community?

- There is an immediate need to monitor channels that were created this year to begin to assess the critical uncertainties.
- Lamarra: Focus should be on Reaches 3 and 4 to determine how long backwater habitats persist. These are the most important reaches in the river to me. I think we can develop stage discharge relationships for all of these backwater habitats.
- McKinstry: We need to prioritize what needs to be monitored.
- Backwater and side channel habitats? No need to keep monitoring runs and riffles because there is plenty of this habitat in the SJR.
- Lamarra: We may not need to worry about washes in the lower canyon but should focus on those habitats that we could actually manipulate.
- Ross: It is important to note that habitats for Colorado pikeminnow and razorback sucker are different. [We] will need to emphasize monitoring of the RERI work to assess these uncertainties.
- Campbell: We need to show that these habitats are important.
- Brooks: Some of the Biology Committee is opposed to habitat manipulation. The RERI studies could provide information that supports habitat manipulation benefits for native fish.
- Chris Conrad: [We] need to monitor a control site to compare to RERI study. Ideally, you should monitor a site that you plan on manipulating so you have before/after data at this site.
- Patrick McCarthy: Regarding RERI sites—last meeting we had discussed a trip for folks to see the sites so that folks are familiar with what these sites look like from the ground. Secondly we need to strategically survey and construct the RERI sites, setting up controls and collecting before after data.
- We can conduct a detailed study at the RERI sites. We need to make sure that cobble bars remain sediment free and loose. Backwater larval monitoring sites should be fitted with pressure transducers to determine stage discharge relationships to determine backwater habitat availability.
- How will backwater availability change over a range of SJR flows?
- In the RERI sites, an understanding what flows are achieving the low-velocity conditions in those channels should be the focus. There should also be a focus on the re-colonization of Russian olive at those sites to determine if the species removed when flooding occurs or if floods can be used to remove small Russian olive stands.
- How can resources be optimally allocated for monitoring and managing the SJR for the endangered fish? What monitoring aspects are most important?

12.0 KEY QUESTIONS FOR THE SAN JUAN RIVER WORKGROUP

The following is a list of key questions that were repeatedly brought up throughout the workshop.

- Does saltcedar or non-native vegetation encroachment/increase or correlate with flow reductions in the SJR?

- How different is the field mapping from the digital videography mapping?
- What are the effects of vegetation changes from native to non-native vegetation on the debris piles? Many of the debris piles are actually made up of Russian olive. What effect does losing cottonwoods have on habitat quality or recruitment of debris/large woody debris to the system?
- Are we putting too much importance on backwater habitats in the SJR?
- Will the non-native vegetation encroachment prevent reformation of backwater habitats even if the correct flow targets are met?
- Should high-flow mapping be conducted? If so, how often?
- Do we really know what the endangered fish species need for spawning and rearing habitat in the SJR? Are their requirements the same in the SJR as in the other portions of the Colorado River?
- Do we need to improve fish access to the upper SJR?
- How can access be improved to the upper SJR?
- Does fish monitoring need to be extended to the upper SJR? The Animas River? If so, how much and how often?
- Can we utilize the fisheries monitoring data with the habitat monitoring data?
- What is the appropriate scale for habitat mapping?
- What is the appropriate scale for fisheries monitoring? Should small seines be used in conjunction with large seines?
- Should fisheries monitoring and habitat monitoring be conducted simultaneously?
- Can flow recommendations be evaluated if they are not met?
- How does riparian vegetation distribution relate to habitat availability for endangered SJR fishes?
- Is our habitat monitoring protocol sufficiently capturing the purposes of the flow recommendations in the SJR?
- Are we monitoring to determine how much nursery habitat is available at different flows?
- Should nursery habitat persistence be monitored?
- How is nursery habitat defined in the SJR for the Colorado pikeminnow and razorback sucker?
- How has non-native vegetation changed the geomorphic dynamics of the SJR?
- Can we mechanically manipulate habitat in the SJR to achieve desired outcomes that benefit the native fish community?
- How can resources be optimally allocated for monitoring and managing the SJR for the endangered fish?
- What monitoring aspects are most important?

13.0 DISCUSSIONS REGARDING OUTSTANDING QUESTIONS RELATED TO HABITAT MONITORING

The following is a summary of discussions related to 10 outstanding habitat monitoring questions that were developed prior to the workshop with input from the peer reviewers.

1) Considering the primary purpose of the habitat monitoring is to test the efficacy of the flow recommendations (management actions), are the objectives, assumptions, and hypotheses in the habitat protocols appropriately developed? If not, what would be modified? Is the current habitat monitoring program designed to capture the effectiveness of the flow recommendations?

    - What are the current monitoring protocols? Lamarra: We are currently using past [Bureau of Reclamation] protocols. Videography is better now and we are geo-referencing the data and will map habitat from the ground about every five years depending on the committee needs. Protocols have changed and we are only doing the flight now not the ground mapping. From the air photos we will be monitoring backwaters, islands, and side channels.
    - Conrad: Monitoring is not currently set up to answer specific questions regarding how flow recommendations may be helping the fish populations or habitat. Should monitoring programs be set up to measure specific responses to specific management actions or flow recommendations?
    - Campbell: How important is it to measure riparian vegetation concurrently with other monitoring? Should vegetation changes be monitored annually, or should one comprehensive study be conducted using the past videography to compare how vegetation cover has changed since the program began?
    - It would be good to have more process understanding built into the monitoring program.
    - What would be the appropriate scale for detailed specific response monitoring? Should we key into complex areas that are known to be important to SJR fishes.
    - Conrad: Focus should be on detailed reaches; however, other areas of the river should also be considered.
    - Currently, monitoring assesses integrated effects of suite of flow recommendations. To assess each flow recommendation, monitoring needs to be set up to measure specific responses to management actions or flow recommendations.
    - Components of a comprehensive habitat monitoring:
        - Monitoring: system-wide scale – videography
        - Monitoring: management action/question specific scale - RERI sites pose immediate need
        - Integration/analysis of current habitat/fish data to answer specific questions

2) Does the habitat monitoring follow the objectives, assumptions, and hypotheses developed?

3) Are the data collected sufficient to test the hypotheses in the protocols?

4) Are there better ways to collect, analyze, and interpret current monitoring data?

5) Are all habitats important to monitor? At what scale and frequency?

6) Is it realistic to think we can manage flows to improve habitats at each of these different scales, or is it better to target particular processes or features that have a high priority?

7) Leading from the objectives of the habitat monitoring, what, if any, additional monitoring data are needed to properly evaluate flow recommendations? If additional data are needed, how frequently (seasonally, annually, biannually, etc.) should they be collected?

8) Since the primary purpose of the habitat monitoring is to test the efficacy of the flow recommendations (management action), how would you suggest that the monitoring protocols be set up?

9) For testing the efficacy of the flow recommendations (management action) what are the key habitat indicators that need to be measured annually or even seasonally? What elements could be measured without information loss at longer intervals?

10) In your opinion, considering that the prevailing hydrological conditions (e.g., record low 10-year antecedent flows) may be representative of reoccurring future conditions, what additional management actions could be used to the improve of habitat for the two target fishes?

11) Should the primary purpose of habitat monitoring be testing the flow recommendations? Are other biological data needed?

14.0 MEETING OVERVIEW AND FINAL QUESTIONS/WHERE DO WE GO FROM HERE

- Do we still want to continue monitoring the entire river or focus on specific targeted areas?
- We need to determine what is realistic for habitat monitoring while considering the flow recommendations.
- Colorado pikeminnow and razorback sucker nursery and spawning habitats need to be considered separately.
- We need to understand processes behind the habitats we are trying to restore.
- We need to monitor RERI sites (need a control, strategic placement of additional sites):
    - What flows are creating low-velocity habitats in restored channels
    - How fast is Russian olive re-colonizing restored channels
    - What flushing flows remove new Russian olive colonizers
- We need to monitor cobble bars (need to remain sediment free and loose).
- We need to monitor 15 washes/side canyons: set pressure sensors to get daily (or more frequent) water levels, relate water levels to river discharge, and develop a stage/volume relationship to get a correlation between water level and habitat area.
- We can expand monitoring upstream into the Animas River and upstream of the Animas River.

- We can conduct a historical study (not ongoing monitoring) of the expansion of Russian olive over past years and decades.
- We can conduct a historical study (not ongoing monitoring) of the migration of side channels and how it relates to high flows.
- We currently have videography and transect data. Are the transect data good enough to use for determining what we need to monitor in the future? Campbell: Data [are] survey grade and will work.
- How will information discussed at this meeting be used to restructure habitat monitoring program?
- Will this happen this year? McKinstry: We have an approved work plan that we need to follow for this year; we can change where monies are spent but we cannot ask for more money at this point.
- The group will use feedback/advice from peer reviewers to determine what monitoring components are most important and the best direction to take in restructuring the habitat monitoring program.