

PVA Biology Work Group Meeting
January 28th, 2011
AAO, U.S. Bureau of Reclamation
555 Broadway Blvd. NE, Albuquerque, NM 87102

MEETING SUMMARY

Action Items:

- Gary Dean and Rich Valdez will continue discussions regarding the updates to the RiverEyes data collection protocols.
- Tetra Tech will distribute the presentations given in today's meeting.
- Jason Remshardt will correct the augmentation data through September 2010 by adding the "release location by river mile" field back into the spreadsheet and will distribute the updated data to Dr. Goodman and Dr. Miller.
- Dr. Goodman and Jason Remshardt will continue discussions on how to use the Service's monitoring data to emulate ASIR-type data.
- Dr. Goodman will distribute a list of identified "events" of significant population response at certain locations and circulate to PVA members in order to gather information on other activities taking place in proximity.
- Rich Valdez will provide Dr. Goodman with daily drying data for every reach for every year as a file or data set.
- David Gensler, Rich Valdez, Mick Porter, and Dr. Goodman will represent the PVA work group at the adaptive management work group meeting on February 1st, 2nd, and 3rd and will report back to the PVA work group at the March meeting.
- Dr. Goodman will correct the labeling on Figure 4 – the Isleta graph and San Acacia graph are reversed.

References:

- The web address for the NOAA's Interim Endangered and Threatened Species Recovery Planning guidance document Version 1.3, updated June 2010 referenced by Dr. Goodman is:
<http://www.nmfs.noaa.gov/pr/pdfs/recovery/guidance.pdf>.
- Rich Valdez recommended review of the Department of the Interior's Technical Guide on Adaptive Management, 2009: <http://www.doi.gov/initiatives/AdaptiveManagement/documents.html>.

Recommendations:

- After receiving clarification from the Program Manager, the PVA work group agreed to postpone writing and submitting a PVA/Adaptive Management integration concern letter to the EC. Instead, the issues and concerns will be raised by PVA representatives to the Adaptive Management work group at the meetings scheduled next week.
- CC and EC members will be invited to the March PVA meeting for the model presentations.
- It was suggested that the PMT liaisons could have regular planning sessions with the chairs of all the work groups in order to know expectations and roles/responsibilities and to be able to share work group perspectives as needed.
- It was recommended that there needs to be continued discussions at all levels within the Program on how all the work groups will be integrated into the adaptive management process (including biological, hydrological, technical, and structural programmatic pieces).
- There was agreement between Dr. Phil Miller (PVA modeler), Dr. Dan Goodman (PVA modeler), Rich Valdez, Mick Porter, and David Gensler that the 4 adaptive management steps with 6 bullets on advanced specification are very important to the successful development of an adaptive management plan for the Middle Rio Grande (MRG).

Requests:

- The PVA work group would like to request that the adaptive management work group meeting calendar/schedule be provided months in advance in order to better facilitate consistent PVA attendance, including participation from the PVA modelers.

Meeting Summary:

- Dave Campbell brought the meeting to order and introductions were made. The agenda was reviewed and approved with minor changes in the agenda order. The correct title of R. Valdez's presentation is "Estimates of Silvery Minnow Survivability in Isolated Pools."

- The December action items were reviewed; all but 3 were completed. Of the remaining 3 action items, 2 are on-going and the third was postponed based on discussions at the meeting. During the action item review, there were length discussions regarding concerns over the integration of the PVA models and the adaptive management (AM) plan. The original intent was for the PVA work group to draft a letter expressing the concerns to be elevated to the EC; attendees were reminded that while the Program by-laws do not explicitly prohibit a work group from elevating a document directly to the EC, if the document will require an EC decision then it will need to be vetted through the CC first (since the CC is responsible for making consensus recommendations to the EC). The Program Manager explained that the most streamlined and efficient way to get the concerns into the process is to make sure the work group's representatives to the AM work group clearly articulate the issues and suggestions at the meetings on February 1st, 2nd, and 3rd. It was eventually agreed that the letter writing would be postponed indefinitely; PVA members will voice the concerns to the AM work group participants as the first step.
- Approval of the December 6th and 7th 2010 meeting notes for finalization was not addressed.
- Dr. Goodman then presented on the formal definition of “adaptive management” as it was originally developed. He explained that the term “adaptive management” originally referred to “a technical way to optimize implementation of a process when there is uncertainty” or in other words, a way of dealing with scientific uncertainty. Dr. Goodman referenced NOAA’s Interim Endangered and Threatened Species Recovery Planning guidance document Version 1.3, updated June 2010 (<http://www.nmfs.noaa.gov/pr/pdfs/recovery/guidance.pdf>) to highlight agency guidance on the use and linkages between ESA, PVAs, recovery plans, etc. Dr. Goodman then presented the “distilled recipe” or “formula” that he and Dr. Miller agreed was the essential building blocks of AM. There are 4 main steps that are applied iteratively to get an AM cycle:
 - 1. adopting an uncertain working model that acknowledges the uncertainty;
 - 2. use the model to select actions that the model predicts will have the desired affect; all the while implementing that action
 - 3. monitoring the effects to detect whether the desired effects are materializing; if yes, then it becomes a decision point that the action is no longer a pilot project and can be produced. If the desired effects are not being materialized as predicted, then
 - 4. revise the choice of action and the model accordingly.
 - The monitoring has to be timely and the monitoring design has to be a part of the AM plan itself: spell out what going to be monitored, where, how often, how the collected data will be processed to reach a conclusion (for step 3), etc.
 - The AM plan has to specify the control rules in advance. Dr. Goodman and Dr. Miller suggest that the 4 steps can be distilled into 6 bullets on what has to be specified in advance:
 - 1. Specification on what working model will be used and how it will be updated from ongoing data streams and statistical analysis;
 - 2. What action is chosen as the “hypothesis”; including listing the criteria for the chosen action and how the model will be used to initially screen alternatives for the decision;
 - 3. What effect is expected under the hypothesis;
 - 4. What monitoring will be done to verify if the action is having the predicted affect;
 - 5. How and when will it be possible to recognize from the monitoring if the action is not having the predicted effect; the AM plan has to have a power analysis on the monitoring design to determine effectiveness in a timely fashion;
 - 6. *the 6th bullet was not captured in the notes; this will be updated once Dr. Goodman’s presentation has been made available or attendees can assist with the details of this bullet - mjl*
- The additional augmentation data requested at the December 2010 meeting was briefly discussed. It appears that a location field (identifying release site by river mile) was omitted from the most recent spreadsheet. This will be corrected and the data redistributed. The use of the Service’s monitoring data to emulate ASIR-type data was briefly

discussed; it is assumed that this would be a feasible task. Dr. Goodman and Jason Remshardt will continue discussions on how to use the Service's monitoring data to emulate ASIR-type data.

- Mick Porter then updated the work group on the 3-Level Habitat Inventory. Corps' staff has been reviewing a number of past studies to put together a summary with a focus on what is known about habitat in the active channel and what is known about mesohabitat in the MRG. He cautioned that the studies are just "snap shots" and there is no trend data since each study was only 1 or 2 consecutive years. As part of the Corps' inundation study, HECRAS work alluded to some general trends of channel narrowing and lowering with very little change in the water surface elevation (1-3%). Suggestions to explore trends included: (1) replication of Jason Remshardt's study started in 2003 covering 9 sites; or (2) use HECRAS with 1972 data to try to tease out general trends in channel geometry; or (3) revisit the Service's sites for mesohabitats to determine changes over the last 7 years; or (4) start a new study.
- Dr. Miller updated the work group on his analysis of the URGWOM outputs and use in the PVA models. Fundamentally, the URGWOM outputs have the type of information and data that the PVA models need. We can get information on the inflow and outflow at each reach and subreach level to get predictive values that can inform spring flow and can be used for predictive recruitment for fish. Information on the various subreach inflow data could be aggregated across each reach to get a rough estimate of the amount of monthly drying per reach. Once the maximum extent of drying is estimated then the added mortality of the reach specific drying can be better understood. The questions on how to integrate the hydrology information into the PVAs remain since there was lack of resolution at the December meeting. Attendees briefly discussed URGWOM's "all or none" indications of drying on the 8 mile scale and the fact that "drying" does not necessarily mean the entire area is completely dry (ex. pools, or small flow out of wasteways). It is the range between 100% dry and 100% wet that will need to be expressed as a functional equation to determine how much of that reach to count. Attendees also discussed the RAMAS model use of the monthly information compared to the FORTRAN use of daily information. Attendees discussed whether or not it would be valuable to reconcile the RiverEyes information with the URGWOM estimates of reach drying. One caveat to consider is the quality of the gages. Attendees also briefly discussed how much impact the rewetting events have on the minnow population and if that could be characterized.
- Rich Valdez presented on Estimates of Silvery Minnow Survivability in Isolated Pools. Using Reclamation's 2008 Experimental Operations report (*which can be found on both SWCA's and Reclamation's websites*) Rich compiled the data into a spreadsheet – the species name is in Column B and the other columns represent dates of the month. The total number of each fish species captured on a given day is recorded. The sampling was done from July into the first of October. There may be some inference of survival based on the numbers of fish caught. However, it was pointed out that there was no standard sampling protocol and fish were returned to the pool possibly resulting in repeated recapture. While there is hesitancy to use this data in this way, the information on the pool geometry – size, shape, depth, location/juxtaposition, persistence, etc. – could be useful in determining which pools have higher survivability and why and might be useful in predicting which reaches have better refugial pools.
- In his update to the work group, Dr. Miller shared that the status of the RAMAS model is fundamentally the same as it was in December. The same data needs remain – (1) how to best address the linkage of the hydrology and biology information and (2) how to relate flow to habitat availability in terms of carrying capacity. The carrying capacity issue could be addressed by (1) omitting it altogether or (2) making it large enough that it is not a constraint - instead using the flow as the constraint to demographic parameters. Dr. Miller expressed concern and discomfort with the lack of progress on the integration of the hydrology component. It is unknown how much hydrologic detail (or complexity) will available by the end of the first model iteration defined by the March deadline. The current implementation of URGWOM won't deal adequately with the periodicity of the hydrologic data. The PVA work group will need to decide if this is going to be acknowledged as an unresolved complexity for now or figure out how to develop modifications of the existing tools in order to adequately address.
- In his update to the work group, Dr. Goodman presented the statistical testing for the credibility of the "eyeballed" relationships that were presented at the December meeting. He also presented new information about the age class distributions in the population data and the replicability of the monitoring data. The replications increase the confidence in the data. Dr. Goodman explained that ultimately a Bayesian analysis is needed but has not been done for presentation today – there are several obstacles and it will take months. Instead, Dr. Goodman used jackknifing and bootstrapping cross validation techniques to support the observed relationships. The logic behind jackknifing is to use new data points not part of the regression to try to calculate it. Bootstrap validation tracks the distribution of the slopes

and how often those change sine. Both techniques were done completely separately. The R^2 value of the jackknife and bootstrap regressions has to be high.

- As was discussed at the December meeting, the San Acacia Reach will have recruitment as long as the mean May flow is above the 1,000/2,000 cfs threshold. The San Acacia Reach responds better to flow increments in terms of ability to generate additional recruitment. If the mean May flow is less than the 1,000/2,000 cfs threshold then no matter what reach, there will almost certainly be poor recruitment.
- One striking fact that became apparent is that the number of recruits (not recruitment rate) can be predicted without knowing the number of spawners. While there is a strong relationship to flow, there is virtually no relationship of recruits to spawners. The implications of this are enormous. The biological speculation (which needs to be pursued in research) is that the fecundity rate is so high that not many spawners are needed to capitalize on all the spawning habitat in any given year. So the number of spawners is always enough to saturate. In terms of management, this means if more recruits are desired – provide more habitat.
- Dr. Goodman also pointed out that there are instances where large schools of Age 2 fish are sampled. Dr. Goodman will distribute a list of the sampling of the Age 2 schools for PVA members to describe other events, locations, activities that might explain this phenomenon.
- In light of discussion today, Dr. Goodman concluded by suggesting that the running of the models might not be as important as “digesting” what the data is indicating. He suggested the Program could move further along than just mechanically running a model. The density dependency indicates that AM needs to consider more in-stream habitat and inundation. He also suggested that actions to begin addressing or teasing apart the information be developed rather than trying to predict things that can’t be adequately predicted yet. If the density dependence situation is correct, then the total population abundance can theoretically be increased with an increase in habitat.
- Attendees discussed the observation that in “big” water years since 2003, the growth rates are smaller in high catch years (2-3 mm/month) compared to the growth rate observed in poor catch years (5-6 mm/month). This is assumed to be related to food supply and availability.

Upcoming Meetings

- AM Plan Development work group meeting: February 1st, 2nd, and 3rd
- PVA: March 29th -
 - PVA Models debut/preliminary outputs
 - Report out on the February AM sessions

PVA Biology Work Group Meeting

December 6-7, 2010;

AAO, U.S. Bureau of Reclamation

555 Broadway Blvd. NE, Albuquerque, NM 87102

January 28th: 8:30 to 4:30

- **Introductions/Review agenda:** Dave Campbell brought the meeting to order and introductions were made. The agenda was reviewed and approved with minor changes in the order: (1) Rich Valdez's presentation was delayed to 1:00pm - the corrected title is "Estimates of Minnow Survivability in Isolated Pools; (2) Dr. Miller's model status update will be moved earlier in the agenda, to just before lunch; and (3) the adaptive management (AM) discussion will also be moved up in the agenda as a priority issue
- **Work group Business:**
 - *Review of May Action Items:*
 - ✓ David Gensler will attend the PHVA meeting on Wednesday, December 8th to help communicate the PVA data needs to PHVA. – *complete;*
 - Due to scheduling conflicts the PHVA work group has not been able to make a joint meeting. The PHVA is moving forward on the 10-year model runs and some members express hope of getting to 50-year sequences. In fact, ISC has already strung some of the 10-year sequences together to achieve this. However, other members are not as optimistic that the 50-year sequences can be done now and express that it might be done some time in the future.
 - ✓ Phil Miller will review the URGWOM outputs already provided to attempt to determine how the results could be/will be used in a stochastic PVA model. – *complete; will be discussed later today*
 - ✓ Dan Goodman will post a copy of his model presentation from the December 6th PVA meeting to his website. – *complete;*
 - ✓ Thomas Archdeacon will share the request for augmentation data with Jason Remshardt. – *complete;*
 - ✓ Stacey Kopitsch will make the suggested changes to the 2010 PVA Accomplishments and the 2011 PVA work plan and will distribute the revised versions for review. – *complete; these will be on the February EC agenda for approval*
 - ✓ Rich Valdez will review the salvage work report and will write up a first draft of suggested/requested modifications to the salvage protocol that might provide additional data useful to PVA modeling efforts. – *complete; this will be presented later in today's meeting*
 - ✓ Rich Valdez will write a first draft project description/activity summary for the 3-level habitat inventory project. – *complete; Mick Porter will lead discussion on the habitat issue later in today's meeting*
 - ✓ Peter Wilkinson, Mickey Porter, Rich Valdez, Rick Billings, and a Service representative will be involved in the development/review of the 3-level habitat inventory activity description for discussion at the January 2011 meeting. – *complete;*
 - ✓ The December 14th Joint ScW/HR/MPT meeting agenda will be distributed to all Program work group and committee members. – *complete;*
 - In a brief report out of the December joint meeting, it was shared that the purpose and main discussion focused on determining what the Program should monitor this year. There will be a greater emphasis on food availability. Unfortunately, there is not a direct or standard measurement of food availability in a given year. The effects of drying and intermittency in rivers on food availability are poorly known. There is periphyton and microinvertebrate information for 2005-2006 but 2005 was a high water year and 2006 was an average year. There was agreement at the joint meeting that there is the need to "get into the weeds" regarding what is relevant to the minnow.
 - Dr. Goodman encouraged PVA members to continue pursuing the food availability issue because the density dependence and survival information from the monitoring data indicates a limiting resource - and it should be known if that limitation is food.
 - SWCA did a study on the suite of what is in the river (not necessarily what the fish were eating, however) from bacteria to algae and diatoms to macrovertebrates. It is assumed that there is a significant "patchiness" to the river that needs to be understood to better inform project designs. The fine scale "patchiness" could set the constraint on how many monitoring samples are needed.

- Dr. Goodman offered to post-process the approximate drying from the inflow for each subreach once the information has been provided to him (instead of the URGWOM tech team having to do the post-processing work). *Note: It is unknown if the PHVA/URGWOM the Team agreed to this offer. – complete;*
 - Attendees commented that the above note that was added to the action item is not really relevant since the outputs “are what they are”. However, it would be good, to the extent possible, to have agreement on what is done with the information/outputs. URGWOM doesn’t currently have a method to translate the head or flow at each subreach. It will come down to what data sets on actual observed drying are available in order to calibrate the relationship.
 - SWCA is trying to reconcile the relationships with RiverEyes information – 2003, 2004, and 2005 are in decent shape but other data has to be reconciled. It was asked if there is protocol in place for present and future RiverEyes data recording that would prevent the need to reconcile. Reclamation is working on protocol so that data is more readily available but the details are still being worked out.

Action: Gary Dean and Rich Valdez will continue discussions regarding the updates to the RiverEyes data collection protocols.

- David Gensler volunteered to draft a document to the PHVA with guidance from Dr. Miller and Dr. Goodman stating concerns about observed climate cycle data and URGWOM model run length. *– on going;*
 - David has a draft but it has not been distributed yet in order get feedback/input from the PVA, Dr. Miller, and Dr. Goodman.
- ✓ The next PVA meeting is planned for January 25th and 26th 2011. Terina Perez will verify that PHVA is able to attend the meeting. *– complete; scheduling conflicts have prevented the PHVA work group to participate*
- Dave Gensler, with assistance from Dr. Goodman and Dr. Miller, volunteered to draft a document expressing concerns regarding the PVA models relationship with AM. *Note: Prior to going to the EC, this draft should be vetted through the PVA work group and the CC. – postponed;*
 - The purpose of the letter was to articulate concerns on the lack of use of the PVA models in the AM process. Dr. Goodman and Dr. Miller have had a series of email exchanges. The next step will be to share the content of the email conversations with the larger group. In addition to talking about the science and method(s) of integrating the types of analysis and discussions into the AM, there is the issue of process and communication/collaboration between the groups.
 - The intent was to draft a letter for the EC since the AM “work group” answers to and is being directed by the executives. Attendees were reminded that there is an appropriate Program process on how to raise issues. However, at some point the “process” issue overshadowed the actual concerns. It was pointed out that there is nothing in bylaws that preclude a work group from giving a document to the EC. There are specifications on vetting documents such as annual reports and work plans through the CC, but there isn’t language that *everything* has to go through the CC. Some members shared the opinion that they don’t think anyone at the EC would be offended by a concerns letter. According to the PMT, the EC doesn’t like surprises and CC members are to keep their executives briefed on what is moving forward and what to expect. Some members expressed concern that there is a disconnect in that not all CC members view the CC’s role as the “filter” for everything. It was cautioned that the work group should not step outside accepted roles especially if doing so could negatively affect the ability to move forward.
 - Yvette McKenna explained that anything a work group wishes to elevate must first be vetted through the work group itself. The only types of documents to go straight from a work group to the EC are things like acknowledgements or recognitions. If the letter will require a decision, then it will first need to be vetted through the CC in order to achieve a consensus recommendation prior to it coming before the EC. Since the AM work group is meeting next week and the PVA has been asked to provide 5 self-nominated representatives to participate, it was recommended that the work group first voice the concerns then. This would be the most efficient way to make sure the work group’s concerns were incorporated into the AM process. The AM “work group” is not a formal Program work group in that it does not have a charter or membership; it is more of a technical working collaborative comprised of interested participants and lead by a contracted entity.
 - The draft agenda and draft work plan for the February 1st meeting will be distributed soon.
 - PVA members discussed that the concerns letter is now moot but today’s discussion is even more important in order for the 5 representatives attending the meeting next week to be adequately prepared to voice the concerns. Some attendees suggested that an official document (or concerns letter) may still have to be produced and elevated to the executives at some point as there is concern with the communication/interaction between the operating groups of the Program. There may also be need for an “overview document” describing what the PVA work group has been and is doing.

- The EC meeting in March may or may not be rescheduled due to spring break and the legislation schedule. The PVA meeting in March will be open to all Program participants especially EC and CC members.
- Since the AM “work group” is not an official work group, it is assumed that the group reports directly to and is monitored by the EC. This assumption is supported by the fact that the interviews were conducted with the executives. There is a contract with an external party to complete this work. Reclamation wrote the task order which was then reviewed by the CC. The proposals that were received were very “tight” indicating that it was very clear what was being asked for. There was a TPEC with multiagency representation that reviewed the proposals. While the details of the TPEC cannot be discussed, it was shared that there was non-federal agreement with the consensus recommendation reached by the 5 committee participants. It was pointed out that the question on the increased cost share due to the increased funding of this project still remains.
- Attendees then briefly discussed the assumptions with the AM contract and apparent lack of desire or interest to include the PVA models in the process. Based on the AM agendas and proposed interactions and expressed desired outcomes, it is assumed that they won’t be “slowing down” to “catch up” with the PVA work; although that may change with the PVA participation in the AM working sessions. The AM contractor is facilitating the development of an AM *process* and it appears that there is a place holder (in the process) for models. This may be where the PVA models fit in. It is assumed that other work groups have similar concerns about the interactions and role of AM (ex. does AM plug into the LTP or vice versa?).
- Jeanne Dye will be working with Dan Goodman to verify that all the Genetics raw data have been received. – *ongoing*;
- *Approval of December 6 & 7 meeting notes:*
 - The approval of the December 6th and 7th 2010 PVA notes was not addressed at today’s meeting.
- **Collaborate Program request for participation in Adaptive Management Planning Session**
 - There are a lot of questions that will hopefully be addressed, at least partially, at the working sessions next week (ex. where in the process is the AM development? Will there be a document produced? How will the AM plan link to the LTP? Is AM cast as a “net” over the rest of the Program or is it an “arm” that provides links? etc.). The AM development process is probably not far enough along to articulate responses to these questions – it is still in the developmental stage. This means there is time for the PVA to participate and affect change.
 - It was suggested that the PMT liaisons could have regular planning sessions with the chairs of all the work groups in order to know expectations and roles/responsibilities and to be able to share work group perspectives as needed.
 - Attendees were reminded that there is an AM development contract with a specific scope of work in place – that scope of work cannot be changed without direction and approval from the EC and then contract modifications. There is not enough information yet to determine what the AM plan’s role will be and whether it will be the “umbrella” over everything else or not. These decisions will be for the EC once the process is farther along and enough information is available.
 - The purpose of the AM technical sessions next week are to display and discuss what has been done in the work process so far, collect additional feedback, and determine next steps. It is information gathering at this point; the plan is at the conceptual stage still with development of the table of content at the technical levels.
 - The same contractor worked on the Platt River process so there may be some parallels to draw from as an example, but it was cautioned that there are significant differences as well. For the Platt River, they developed very specific management objectives to drive a hypothesis testing process. Also, the Platt River experiences a surplus of water every year that could be applied to testing/research.
 - It was suggested that the PMT could make sure that there be continued discussions at all levels within the Program on how all the work groups will be integrated into the AM process (including biological, hydrological, technical, and structural programmatic pieces).

- It was suggested that the 5 PVA representatives to the AM work group be comprised of those who can commit long-term to participating in the process. David Gensler, Mick Porter, Rich Valdez, and Dr. Goodman will all be attending the February 1st, 2nd, and 3rd meetings. Peter Wilkinson, Dave Campbell, and Jason Remshardt will all be able to participate in future meetings. The PVA work group would like the AM meeting schedule to be provided months in advance in order to have more consistent participation.
- **Adaptive Management Presentation – D. Goodman**
 - The first paper on AM was published in 1976. That literature defines AM very technically, very specifically with no ambiguity. The original authors have often had to publish papers with reminders on what AM is. AM started as a technical way to optimize implementation of a process when there is uncertainty; in other words, as a way of dealing with scientific uncertainty. Dr. Goodman referenced NOAA's planning document that provides guidance with respect to recovery plans. This document could be a useful framework to consider because (1) it is agency guidance and (2) the Program is dealing with ESA issues, recovery plans, and an upcoming consultation for a new BO.
 - The web address for the NOAA's Interim Endangered and Threatened Species Recovery Planning guidance document Version 1.3, updated June 2010 is: <http://www.nmfs.noaa.gov/pr/pdfs/recovery/guidance.pdf>
 - From pg. 5.1-18: "...a PVA is based not only on a series of estimates about the vital rates of a species....*criteria describe the conditions under which it is anticipated the PVA would indicate long-term viability.*" The rationale is going to be in using the PVA to show if those conditions are/were met and the PVA predicts the population is stable or safe. Use of PVA in recovery criteria is already contemplated by the agency.
 - AM and Recovery Actions: pg. 5.1-26: "In cases of significant uncertainty, the description of a recovery action within a recovery plan should include an adaptive management plan for the action. This adaptive management plan should include the hypothesis to be tested, how the effectiveness of the action will be monitored, what criteria will be used to determine if the action is effective, and how the action will be adjusted if these criteria are not met... Finally, *it is important to determine up front what actions will be taken if the objective is not reached.*" Anyone experienced in AM should be able to recognize that this guidance document has articulated all the highlights. The point of AM is not to "make it up as we go along" but to have a specific plan with alternatives in place *in advance*. It is a cycle describing what is to be implemented first and how monitoring will occur. It also will describe what the steps are if an action or objective is not being successful. It will also describe what is to be done if the objective is being met. If done correctly, an AM plan is very specific at all steps and levels. AM is a commitment.
 - Dr. Goodman explained that he and Dr. Miller have had an email exchange regarding the AM and produced a very distilled formula/recipe of the essential building blocks of AM. There are 4 main steps that are applied iteratively to get an AM cycle:
 - 1. Adopting an uncertain working model that acknowledges the uncertainty;
 - 2. Use the model to select actions that the model predicts will have the desired affect; all the while implementing that action
 - 3. Monitoring the effects to detect whether the desired effects are materializing; if yes, then it becomes a decision point that the action is no longer a pilot project and can be produced. If the desired effects are not being materialized as predicted, then
 - 4. Revise the choice of action and the model accordingly.
 - The monitoring has to be timely and the monitoring design has to be a part of the AM plan itself: spell out what going to be monitored, where, how often, how the collected data will be processed to reach a conclusion (for step 3), etc. The feedback timescales for actions needs to be known in order to make timely decisions for the next cycle of monitoring. The

implementing agency(s) has to be able to do damage control really quickly - especially for any risky actions.

- The AM plan has to specify the control rules in advance. Dr. Goodman and Dr. Miller suggest these 6 bullets on what has to be specified in advance:
 - 1. Specification on what working model will be used and how it will be updated from ongoing data streams and statistical analysis;
 - 2. What action is chosen as the “hypothesis”; including listing the criteria for the chosen action and how the model will be used to initially screen alternatives for the decision;
 - 3. What effect is expected under the hypothesis;
 - 4. What monitoring will be done to verify if the action is having the predicted affect;
 - 5. How and when will it be possible to recognize from the monitoring if the action is not having the predicted effect; the AM plan has to have a power analysis on the monitoring design to determine effectiveness in a timely fashion;
 - 6. *the 6th bullet was not captured in the notes; this will be updated once Dr. Goodman’s presentation has been made available or attendees can assist with the details of this bullet - mjw*
- **Question:** Who makes the decision whether or not an objective is working?
 - **Response:** This is presuming a “rationale actor” which means the Program will need to determine this. This is extraordinarily important and needs to be taken seriously in the administration of the Program. In general, it has been the recovery team members that provide the analysis of the data and make recommendations as additional information is collected/needed. This is typical for a recovery context. In San Juan, it is the biology committee who makes the recommendations. With the Cochiti deviation, the Corps solicits input from water managers and others, but it is ultimately up to the Corps to make the final decision based on that input.
 - In the context of applying AM for ESA, the decision point is the regulator. Chosen actions will be federal and subject to a BO review and at a minimum require permitting.
- **Comment:** The “driving” question(s) are crucial to the criteria development, AM plan development, and in determining which groups are important in terms of consistent participation. Will implementation of the LTP result in recovery of minnow in some temporal context (10 yrs)? This should be a main driver of the criteria process. And if the answer is “no”, then what is the main driver? What will result in the recovery of the minnow? Based on the AM strategy as originally laid out and the original questions posed in the interviews, there is a disconnect. It appears that the process is more general than this and is not being designed to specifically answer questions about recovery and how to get there.
 - **Response:** That is very consistent with other’s impressions. As for the LTP, there is a division of actions that could be fitted into this cycle - but there are also things that are more exploratory and research oriented that could feed the management cycle on actions. The two categories of actions are: (1) those things that need to be executed and evaluated; and (2) the research/exploratory actions to help develop hypotheses for AM (ex. food habits, predators, etc.).
 - There has to be an iterative process between the LTP, AM, and recovery criteria. Part of the issue is that the Program is retrofitting the AM into an existing Program – this has to be done thoughtfully. There is always resistance to change. But hopefully, if done correctly, it will result in more judicious use of funds.
 - Dr. Goodman restated the formal definition of AM and explained that the earliest papers are very specific and technical. It is interesting to see how the concept of AM has evolved away from that into something more diffuse. The original framework justifies the use of the PVA models in very specific ways but the more formalized concept needs to be approved/accepted by the Program.

- The AM development will depend in part on the directions from either the EC and/or the scope of the contract.
- Rich Valdez recommended review of the Department of the Interior's Technical Guide on Adaptive Management, 2009: <http://www.doi.gov/initiatives/AdaptiveManagement/documents.html> . The phrase "PVA" won't be found in the document but there are references to "models." Summarized, the DOI Tech Guide indicates that models play a key role in representing uncertainty in terms of competing hypotheses about how the resource system works. Each hypothesis should be embedded in resource model that can be used to predict responses to management.
- Dr. Miller, Dr. Goodman, Rich Valdez, Mick Porter, and David Gensler expressed agreement on the importance of the AM steps as presented by Dr. Goodman and acknowledged the need for a rigorous process. The PVA representatives to the AM working session next week were encouraged to introduce the 4 steps and 6 specifications for each action into the process and present the work group's desire to have "rigor" built into the process. Representatives were also encouraged to share the perspective that the Program needs to have clearly stated objectives in order to properly guide where the AM needs to go. This is to avoid the situation where everyone has their own ideas of preferred solutions and people will want to test all those simultaneously. This results in testing scenarios before full evaluation of the previous one has been completed. (This falls into the overall temporal question on how long criteria need to be tested.)
- Returning to his presentation, Dr. Goodman provided an answer to the question "what is the role of PVA in AM?" It is a tool that can be used to address uncertainty and responses in the system.
 - Referencing the email exchanges between himself and Dr. Miller, Dr. Goodman shared:
 - *In the case of the RGSM PVA, we have been developing the PVA as a working model, with acknowledged uncertainties that we are doing our best to identify and explore. It makes sense therefore, to embed use (and further development) of the PVA model in an AM framework. AM has to satisfy ESA, be consistent with the recovery plan, and eventually pass scrutiny in a jeopardy analysis.*
 - *...and future development* – it is implicit that PVAs will help to better inform the plan so they need to be acknowledged as part of a feedback loop. The PVA work group and modelers need a clear picture of how the PVAs are going to be used for the AM and BO. Understanding the AM objectives and process will also help in the further development of the PVAs.
 - Using the data from the Cochiti Deviation, the PVA models could inform how often recruitment flows need to be supported, either naturally or supplementally. How do we best support long-term population stability? The models could be used to test how often a recruitment flow could be missed (ex. miss 2 consecutive years but the population can rebound? Miss 3 consecutive years and the population cannot recover? etc.). The PVA outputs could then be used to support actions or experiments with justifications.
 - **Comment:** There are two statements that need to be made: 1) AM needs to occur above the jeopardy threshold – any action that jeopardizes the species will not be authorized; and 2) implementation of the LTP needs to get us to a temporal trajectory toward recovery – experiments and research over time are all well and good, but at the same time we need actions to ramp up toward recovery. There may be set backs from time to time but there needs to be a positive trajectory over time.
 - **Response:** That is 100% consistent with the original AM definition which includes a risk assessment process using the modeling predictions. If the Program is really organized, systematic, and rigorous then AM can be pursued in way that avoids "trouble" in terms of the jeopardy situation. This is a way to manage the uncertainty.
 - It was commented that it can take a lot of time for recommendations to actually become part of the official operations. For example, an experiment is implemented to test a hypothesis and the results come back positive. The recommendation is then for this action to become part of operations. It may take a long time for that to be realized,

but in the mean time continued sufficient progress toward recovery still has to be reported. AM is good but we have to get past the experimental stage and into implementation.

- *By the same token, development of an AM plan for the RGSM will require a working model whose uncertainties are already understood. The PVA is a logical choice for that model. It makes sense, therefore, to coordinate and to some degree integrate the ongoing AM and PVA efforts of the Collaborative, in order to enhance the progress and usefulness of both activities.*
 - The PVA models are a tool that can cover many applications. For example, the models could be used to help organize the monitoring program.
 - Dr. Miller provided an example (or case study) of the Channel Island Fox and how PVA models were integrated into the long-term planning and AM processes. In summary, analysis identified different biologic parameters that were important in influencing the long-term population viability and population performance. A series of isoclines identifying “quasi-extinction” risk were subsequently developed and assist with intervention implementation. The PVA model was used to identify results that are then compared to the extinction isoclines (or risk map); this identifies where (to best knowledge) in any given point the population can be expected. This also helps to better understand the type of monitoring necessary to detect population changes.
 - In conclusion, Dr. Goodman reiterated the suggested AM structure. Until the AM working session agenda(s) are more clearly articulated, it is unknown what the current purpose or objectives of the AM are. A lot depends on the contract and direction from the EC.
 - It was shared that the purpose of the AM working sessions next week are for the contractor to get to the technical challenges; they are not really dealing with the water management issues at this point but the basic science questions and issues. Their contract is to basically host a series of meeting at the end of which they will develop a suggested AM plan. The deadline is September 2011 (this is extended from the original deadline of March 2011).
 - The Service has stated their preference for the LTP, AM, etc. to all be in place and in the BAs before submittal. However, it is unknown if there is agreement with the Corps and Reclamation for that.
 - **Additional Augmentation Data requested at last meeting- J. Remshardt:** All the augmentation data through September 2010 was provided to the modelers. However, it appears that the previous version of the data had an explicit field for the release locations by river mile but that field is not present in the new data; there is only a comment field of release locations.
 - **Question:** How well can the monitoring data be used to emulate the ASIR protocol? Is there some way to take the by-siene-haul data and aggregate it in a way to see what ASIR might have gotten if they sampled at same locations on the same days?
 - **Response:** It is thought that this “conversion” or reprocessing of data to get equivalents would be possible. However, it was cautioned that the mesohabitat classifications are subjective and ASIR uses different terminology from the Service. It was noted that the mesohabitat classification issue should not be a problem since the ASIR mesohabitat data was not provided. The estimates of sampling area are done the same by both the Service and ASIR. However, the ASIR protocol is to take 10-20 seine hauls at a site; the Service does a flat number of 30. Also, the Service has its own set of specific site locations whereas ASIR doesn’t; this is especially true for pueblo sites due to accessibility.
- Action:** Jason Remshardt will correct the augmentation data through September 2010 by adding the “release location by river mile” field back into the spreadsheet and will distribute the updated data to Dr. Goodman and Dr. Miller.
- Action:** Dr. Goodman and Jason Remshardt will continue discussions on how to use the Service’s monitoring data to emulate ASIR-type data.
- **3-Level Habitat Inventory, presentation and discussion- M. Porter/R Valdez:** At the December meeting, the work group discussed how to gain a better understanding of the habitat issues. The first step was to “get a handle” on habitat studies and what is known about habitat in the active channel. Corps staff has reviewed a number of habitat studies

with the purpose of putting together a summary focused on what we know about mesohabitat in the MRG. Attendees were reminded that the studies are just “snap shots” in history since only 1 or 2 had consecutive years. This means there is no real trend data. Several studies did stand out, however. The URGWOPS that was conducted 8 to 10 years ago had 8 sites (some of which were above Cochiti and some where on the Chama). Only a handful of sites were actually between Cochiti and Elephant Butte. These sites were only surveyed once. Another study worth noting is Jason Remshardt’s study that was started in 2003 and covered 9 sites. This study could bear replication if the work group wanted to look at trends. There were also some one-time studies from Platania and the USGS. As far as existing trend data, the Corps’ inundation study included HECRAS work that alluded to some general trends of channel narrowing and lowering with very little change in the water surface elevation (1-3%). Suggestions to explore trends included: (1) FLO2D models over the last 20 years could be used to estimate spawning habitat; (2) use HECRAS with 1972 data to try to tease out general trends in channel geometry (i.e., establish a baseline and get estimates of how mesohabitats have changed); (3) revisit the Service’s sites for mesohabitats to determine changes over the last 7 years (i.e., a replication of Jason’s study); or (4) develop and implement a new study.

- Returning to the issue of the very dramatic sampling results that are occasionally captured in the population monitoring (in terms of tons of fish found at specific sites at certain points in time), members were asked what is known about those times/locations that would help to explain the phenomena. It was pointed out that some of the locations are near a permanent structure but other locations cannot be associated with a specific landmark. However, there may have been restoration activities in that year that was reflected in the fish population response. It is unknown if a strong association can be made, but it can at least be attempted.
 - The inundation spreadsheet (inundation acres by year by subreach) that Mick Porter provided back in October is the starting place to analyze or link inundation with fish response. It was pointed out that the model doesn’t include in-channelization of bars; only the river edges are included so it is underestimating the areas that could be considered spawning habitat. As part of the spreadsheet analysis, FLO2D was used for the outer banks but HECRAS was used for the point bars and islands. It is a crude analysis to start, but that was acknowledged. One issue is the cut off for the lower threshold for inundation which leads to the proposed question: how can the zone of inundation be quantified (known base flow is between 500-1000 leaving 1500/2000 cfs of potential flows to inundation bars)?
 - Referring to Dr. Goodman’s data analysis, specifically the graph of the fall census (October) as predicted by spring flow (May) in Figures 9 and 10 from the December presentation: there is an inflection in the CPUE indicating something is happening with the flow – this needs to be better understood (i.e., determine what it is). Could it be flow or flow in-channelization? Relating fish to flow has to include discussions of channel function. This example may be illustrating a channel configuration. It was pointed out that the R^2 correlation between the CPUE and May mean flow is 0.79. The first conjecture is that this is related to the river reaching some stage - perhaps overbanking connecting the floodplains. There appears to be some threshold effect – somewhere around 1,000 cfs or so. Exactly what is going on in the river to create this relationship (overbanking, instream flow?) is unknown. It was qualified that the overbanking has a very specific connotation while “inundation of riparian habitat” includes inundation of vegetated bars and islands; the threshold varies depending on the geomorphic characteristics of the reaches.
 - The Cochiti deviations have not yet been used to test any of these hypotheses. The deviations are based on the historic target flows of 3,000 cfs for 5 days. This does not mean the Corps wouldn’t consider trying to “fill in the gap” between 1,000 and 3,000 cfs but it would require a lot of input from the Service before any experiments could be realized. This is a perfect example of an AM-type activity. It would be a valuable piece of information to demonstrate that 1,000 or 1,500 cfs worked nearly as well as 3,000 cfs since the lower volumes are more doable targets over the long-term. In 2004, the egg monitoring picked up only a small number of eggs downstream but surprisingly the population numbers actually increased by 40 fold (2003-2004 saw a significant increase in minnow numbers).
- **Question:** What is the configuration of channel flow during the summer? Spawning is different than recruitment. There needs to be some type of physical channel heterogeneity that has optimum conditions to carry the cohort into autumn. This needs to be better understood in order to get to a potential management tool.

- **Response:** Very specific management options require greater understanding of flow and channel morphology and hydrologic/biologic relationships – these needs have to be built into the prediction process.
- There needs to be better understanding of how to get population responses with even lower flows especially for consecutive difficult years. This goes back to the question of whether or not the population can tolerate 1 year of no recruitment. Or 2 years of no recruitment. What is the threshold for getting good vs. no recruitment? What are the trade offs between the initial survival and the summer survival? These all need to be considered in the AM process.
- **Question:** How do we sustain recruitment over a range of flows for the different reaches to achieve some mean target over time?
 - **Response:** This can be rephrased as “is it possible to get some kind of optimized recruitment in all reaches or does it happen at some reaches for some times depending on the conditions?” This is suggesting there could be reach specific targets.
 - We need a better understanding of what is going on hydrologically/ecologically when there is high flow. Is the minnow responding to just the increase in water? Or is it more complicated – more flow at more locations? In a practical manner, which of these questions does the PVA need to know by the end of March in order to have the kinds of functional relationships built into the models? It may be a case of using best available information.

Action: Dr. Goodman will distribute a list of identified “events” of significant population response at certain locations and circulate to PVA members in order to gather information on other activities taking place in proximity.

- **Analysis of URGWOM output and use in PVA models-P. Miller:** In early November, the URGWOM tech team provided a list of the 192 URGWOM model outputs options. Fundamentally, based on the kinds of information and data the PVA has and is using, we are going to want some reach specific outflow measurements. The question on how to integrate the URGWOM (hydrology) information into the PVAs remains unanswered due to the lack of resolution from the December meeting and the scheduling conflicts that have prevented the PHVA from participating in a joint meeting since then. It should be possible to get the types of inflow and outflow information at the reach and subreach level to get predictive values that can be used to inform the spring flows - that can in turn be used for predictive recruitment for the fish. It should also be possible to get the various estimates of subreach inflow data that can be aggregated to across the reach to get some rough estimate of the amount of drying on a monthly basis (per reach). Once the maximum extent of drying is better quantified, then estimates on the amount of added mortality with the reach specific drying can be attempted.
 - A brief background on the URGWOM process was provided. URGWOM will predict an amount of inflow water expected for each of the 19 8-mile subreaches. It is not unreasonable to make some quick assumptions/analysis on which reaches lose water at certain rates (ex. 3 cfs per mile). For example, a 20 cfs loss at X loss rate can be used to estimate how far the water will go downstream. These can be added to get a reach total and thus a percentage of reach dry. While URGWOM provides the inflow, the outputs are not as precise as desired but should be close enough for the PVA purposes.
 - It was commented that the percentages of drying (from URGWOM) were almost categorical - on the 8 mile scale, it is “all dry” or “none dry.” Recalling previous conversations about what “drying” means, it was acknowledged that “drying” does not necessarily mean the entire area is completely dry – there can be pools, or several miles kept wet by a wasteway for example. It is probably not unrealistic to accept the “100% dry” or “100% wet” at face value, but it is the range in-between that will need some kind of functional equation to determine how much of that reach to count as wet or dry. It was also pointed out that the RAMAS model is on a monthly timestep which might be simpler since it doesn’t require daily information to qualify intermittency.
 - It was suggested that the reach drying estimates from URGWOM could be reconciled with RiverEyes data. However it was pointed out that drying can vary one day to the next. It was then asked if this is a worth attempting – it is assumed that there is several years of drying data and that has to be linked to a gage. A probability function will need to be developed to get closer to determining how much drying is really going on. It is a worthwhile activity but the caveats are the quality of the gages and the timeframe. The Central Avenue gage is really the only reliable gage that the drying can be tied to.

Isleta drying could probably be tied back to the Albuquerque Gage as well but it is not known if this would work for San Acacia as well (there are other river inputs and pumps there). It was pointed out that the subreach flow information from URGWOM, with the post processing, can inform the maximum extent of drying. For the RAMAS model, it is probably better to use the URGWOM reach data (as only the maximum extent in each reach for each month is needed). For the Fortran Model, the daily time step will need to be tied to the gage inflow.

Action: Rich Valdez will provide Dr. Goodman with daily drying data for every reach for every year as a file or data set.

- **Question:** Jason, how much does rewetting affect the fish population? The PVA might want to consider determining if there is a difference in the population with drying/rewetting events.
 - **Response:** The impact between drying and rewetting relates to the food availability and is an issue of the timing of food availability. Intermittency destroys the food source – the affects can even last for a period of time after rewetting. The extent depends on the time of year, duration, etc. While the URGWOM subreaches were partially determined by gage locations, there will be issues with tying the drying to a gage. With weather changes, the San Acacia reach in particular, never “stabilizes.”
 - The data is available to do an analysis but the question is the time frame on how/when it could be accomplished. One suggested first step was to pull together a conceptual model for Isleta and San Acacia with flow charts of drain operations on some frequency; or using the MRGCD flow chart.
- David Gensler provided a brief background on the URGWOM generated sequences. Paleodata was used to generate 1000 100-year randomly generated flow sequences. These 1000 sequences were then ranked on probability of exceedence - sequences that fell closest to the 10, 30, 50, 70, and 90% exceedence. Years in the historic record – from 1975 to present – that had the closest approximates for the discharge were selected (ex. 1977). The synthetic assemblages were thus created. The suggestion is to take 5 of these 10-year sequences and string them together to achieve 50 year sequences for use in the PVA. The end conditions of the previous sequence will be the initial conditions of the next sequences. There is a random order of the 10-year blocks but each block is internally sequenced and cannot be changed around.

LUNCH

- **Estimates of Silvery Minnow Survivability in Isolated Pools - R. Valdez:** There have been discussions regarding the need to understand survivorship of minnow in isolated pools. There have been no studies designed to specifically research this topic. The closest thing available to date is a Reclamation Experimental Activities report with a 2008 date. In these experimental activities, there was visual assessment/evaluation on the health of the fish found in isolated pools. The data from this report was used with the caveats that there was no standard sampling protocol and the fish were returned to the pool resulting in possible multiple recaptures.
 - Rich compiled the data into a spreadsheet – the species name is in Column B and the other columns represent dates of the month. The total number of each fish species captured on a given day is recorded. The sampling was done from July into the first of October and was started as soon as the pool became isolated. There may be some inference of survival based on the numbers of fish caught.
 - It was pointed out that this was the first year of the experimental activities and the purpose was to research the duration of the pools themselves and not survival. Only those pools that have in the past had good persistence or were large in size were included. While fish were sampled, field identified, and visually assessed for health, no weights, lengths, or other fish measurements were recorded. Water quality was monitored in case there was a need to salvage but the pools always rewet.
 - Tracking the shrinkage in the pools over time, there appears to be some different characteristic drying. There may be value in exploring how the depth, shape, size, juxtapositions, etc. affect pool persistence. This information might be able to eventually predict pool success by reach. It might also inform habitat restoration – where to construct pools, what dimensions to build, etc. to provide optimum refuge for the fish.
 - **Question:** Has there been any work on observing stretches of river to get sense of the frequency, number, distribution, etc. of these types of pools in years for particular levels of drying?
 - **Response:** There are only a handful of pools that don’t dry within a week after isolation – most dry within a week. Some of the pools do stay wet longer due to subsurface flow. The big pools don’t

really change year to year. Most of the big pools are always there; this has more to do with the groundwater at that particular location instead of the shape of the pool. The big pools can be significant for the fish but are small compared to the river itself. For comparison, there are about 100 small pools to every large pool; or 20 to 1 by total area.

- Attendees briefly discussed the Brown Arroyo pool. There isn't access to this pool due to 10 feet of silt. It is also different from other pools in that it is the outflow of an arroyo as opposed to a scour in the river. Its features change from storm event to storm event – scoured at one event, or “mud soup” at the next event, there are depth changes, and it might back up depending on the plug.
- Returning to the presentation, Rich explained that he plotted the numbers of minnow caught on a daily basis for a total of 4 pools and was able to generate 6 sets of information. There was no relationship for the first 2 plots. The other 4 data sets fit the standard negative exponential function. The exponent of the slope is survival; taken to the power of 7 is the weekly survival. Note that the monthly survival rate using CPUE data from standard sampling is 0.76 and these are much lower. Given the caveats with the sampling protocol mentioned earlier, there is reluctance to use the data in this way. However, this is a first approximation only and might inform how important this information may be if even needed. It might also help determine what kind of data is needed and how the data collection needs to be formulated to determine survival of fish in these situations.
 - **Question:** If done with a true depletions sampling methodology, is the monthly survivorship expected to be even lower?
 - **Response:** That's not known. There is risk in stressing the fish and imposing additional mortality. But a same-day depletion with 3 or 4 passes or a single pass on Day 1 with the fish removed in salvaged and then repeated on Days 2 & 3 is probably the safest way to accomplish.
 - **Comment:** There are other fish species that appear to die almost immediately in the pool.
- Regarding the parameters of fish refugium, Mike Hatch noted that the longer, deeper pools with abrupt sides were more stable than other pools. Also, pools adjacent to flowing river segments have a heightened degree of environmental stability; closely-spaced pools aligned with the thalweg and at intervals no greater than 5 to 7 times the active channel width, allow for dispersal of the minnow and serve to reduce mortality from flow disturbances. Areas with long-term flow patterns that rank among the wetter intermediate environmental types provide periodic maintenance of wetted habitat.
- **Comment:** The data on pool longevity is interesting and maybe there is a way to take the information on pool duration, the knowledge of frequency, and ease of pool reconnection to make some general statements on assumed survivorship. For example, based on survivorship data and understanding of pool decline in size, if a pool declines to less than 20% of the original size then it is assumed that all the fish within the pool will not survive. However, if the pool is reconnected within a certain period of time then those fish will be considered “survivors” and will be counted in the population. This might be one way to avoid trying to get daily survivorships. Another way to approach this could be to use the length of pool isolation – the longer a pool is isolated, the more likely to have decreased survivorship. Maybe the salvage data from the smaller pools could be used to get density estimates that could be extrapolated for the larger pools; then, when a given number of pools of a given size dry x number of fish will be lost.
 - **Response:** Unfortunately, densities of fish in pools vary because the fish try to escape the drying. The conditions that lead to the formation of the pools (over night versus managed receding) will also affect the number of fish isolated.
 - The survival is expected to be low but there are management implications that might be done to offset mortality. For example, it might be possible to do something with the channel in a way that creates areas that will have persistent water through drying events and would be able to carry over some portion of the population.
 - Questions to consider/explore: (1) is X% survival based on/related to pool size? (2) Are the fish in the pools important to the population or not? If yes, by how much? If no, then 0% percent survival could be assumed in dried sections regardless of the number or size of pools. (3) how many of the fish

survive the isolated pool only to die a day or 2 later. Stressed out fish might not be able to recover even when reconnected. Extensive toxicology tests would be needed to measure survival after stress.

- There is a complicated dynamic with the rewetting and stranding events of the fish. Crowded fish, water quality issues, food source issues, predators (birds and other fish), etc. all impact survivorship. If the pool is large enough then the water quality might not fluctuate as much. To achieve the “string of pearls” then there needs to be more and deeper pools. But it first has to be decided what proportion of the population it will help if at all.
- While there is hesitancy to use this data in this way, the information on the pool geometry – size, shape, depth, location/juxtaposition, persistence, etc. – could be useful in determining which pools have higher survivability and why and might be useful in predicting which reaches have better refugial pools.
- **Status of RAMAS model for March Presentation-P. Miller:** In his update to the work group, Dr. Miller shared that the status of the RAMAS model is fundamentally the same as it was in December. The same data needs remain – (1) how to best address the linkage of the hydrology and biology information and (2) how to relate flow to habitat availability in terms of carrying capacity. The carrying capacity issue could be addressed by (1) omitting it altogether or (2) making it large enough that it is not a constraint - instead using the flow as the constraint to demographic parameters. Dr. Miller expressed concern and discomfort with the lack of progress on the integration of the hydrology component. It is unknown how much hydrologic detail (or complexity) will be available by the end of the first model iteration defined by the March deadline. The current implementation of URGWOM won't deal adequately with the periodicity of the hydrologic data. The PVA work group will need to decide if this is going to be acknowledged as an unresolved complexity for now or figure out how to develop modifications of the existing tools in order to adequately address. This needs to be addressed if the models will be ready by the end of March.
 - Even if 5 10-year sequences are strung together, it is unknown how the URGWOM outputs will look - will there be 5 separate output files?
 - **Question:** Dr. Miller, you previously presented on Summer Drying and Minnow Demography from Dudley's analysis on ISC's 2003-2006 river drying data. His estimate of quarterly survivorship from July to October was based on calculations of the maximum extent of drying in San Acacia. The RAMAS model had a “routine” whereby some probability of drying over the number of model runs was invoked and gave the maximum extent of drying as reflected by 2003; and basically assigned a 0 survival rate in that area. Is this the function that will replace that?
 - **Response:** This is under consideration, yes – as a possible mechanism to evaluate annual survival basically as a function of quarterly survivorships some of which are influenced by spawning/spring flow and by maximum extent of drying. URGWOM predicted values of spring flow (mean flow, days above flow, etc.) can be used to estimate survivorship within a quarter and maybe even indicate *something* that provides a drying variable that can then in turn be used to get to the relationship between overall reach survivorship and drying. The aggregate would be the annual survival. Remember, however, that this is based only on 5 years of data and there is much uncertainty.
- **Continued Statistical Analysis of Pop. Monitoring Data in relation to PVA models – D. Goodman:** In his update to the work group, Dr. Goodman presented the statistical testing for the credibility of the “eyeballed” relationships that were presented at the December meeting. He also presented new information about the age class distributions in the population data and the replicability of the monitoring data. The replications increase the confidence in the data. Dr. Goodman explained that ultimately a Bayesian analysis is needed but has not been done for presentation today – there are several obstacles and it will take months. Instead, Dr. Goodman used jackknifing and bootstrapping cross validation techniques to support the observed relationships. The logic behind jackknifing is to use new data points not part of the regression to try to calculate it. Bootstrap validation tracks the distribution of the slopes and how often those change sine. Both techniques were done completely separately. The R^2 value of the jackknife and bootstrap regressions has to be high.
 - The techniques applied are intuitive and appealing but not necessarily mathematically as correct [as a Bayesian analysis]. Of the 2 validations, jackknifing is the more severe filter. Bootstrapping is less tough as a filter.
 - In review, Dr. Goodman re-presented Figure 1 from his December presentation. He explained that the data points are based on processing the ASIR population monitoring data. In the 2007 example graph, the

- *Role of Reproduction and Survival in the October Census* - Rather than using the census numbers in a regression and bearing in mind that the October census does vary, the cohort reconstruction curves (not the raw census data but the regression graphs to pick the intersection of the regression line to the reference time) can be used. This method eliminates the diffusion of sampling dates (i.e., months were skipped in some years) and cancels out any noise.
- *Mean flow as a predictor of recruitment on August 1* – Figure 6. We've seen the ability of May flow to predict recruitment. The threshold break between 1,000 and 2,000 cfs is still there and is in fact stronger. The R^2 is 0.5 which indicates an even more significant relationship. For May mean flow below 1,000 cfs, there will be poor recruitment. If we throw out the 5 point cluster, then yes, the regression pattern with prediction R^2 is higher than 0.5 and had a slightly steeper slope of 0.018. Thus our visual impression is confirmed with more rigorous analysis – it is justifiable to break the regression at the 1,000 to 2,000 cfs threshold.
- *Cohort Reconstruction and Regressions by Reach* - The figures referenced above were for the entire river but the cohort reconstruction and regression can be done reach by reach. In Figure 7, Angostura is red; Isleta is green; blue and magenta are San Acacia with replication based on the 2 different gages (to see if one was a better predictor in terms of flow versus relationship but both are about the same). Superficially, there is a stronger slope in Isleta than in Angostura meaning there is more additional recruitment per more additional flow. This is even more so for San Acacia than in the other reaches.
- *Significance of Regressions by Reach* - Table 1 is a summary of the significance of regressions by reach. Remember, regardless of reach, if flow is below 1,000 cfs there will almost certainly be poor recruitment. Above the 1,000 cfs threshold, there will be some recruitment - the relationship is least reliable for the Angostura Reach. The flow relationship is strongest for the San Acacia Reach. The evidence is that the San Acacia slope is almost 2x that of Isleta and 10x that of Angostura. This means that the San Acacia Reach responds better to flow increments in terms of ability to generate additional recruitment. In Table 1, each reach was regressed to the Albuquerque Gage.
 - It was shared that there is a high degree of incising in San Acacia; there is also a perched channel for much of the way and therefore a little overbanking can provide a lot of inundation. All the regressions in Table 1 were against the Albuquerque gage so the slopes are “apples to apples” comparison and the bootstrapping has significance.
- *Jackknifing* – While jackknifing is a more robust way than other standard statistical methods, we have to think about the assumptions that would have to be met in order to use – such as the validity of the data and whether or not conform to the expectations of using that technique. Sometimes the relationships are derived from each reach gage and other times just from the Albuquerque gage. When asked why it was done one way for one analysis versus different for another analysis, it was explained that Dudley originally tied Isleta and San Acacia October CPUE to Albuquerque flow and saw the same relationships (in terms of the increasing response to flow being greatest in San Acacia and the least response in Albuquerque). There is definitely consistency in the information.
 - Hydrologically, 6,000 cfs at Albuquerque corresponds to 4,000 cfs in San Acacia.
- **Question:** How much of the increase in San Acacia is internal to San Acacia and how much is based on the higher flows washing fish down?
 - **Response:** It may be very difficult to pull out and interpret; it could be a combination of higher rates of reproduction in San Acacia as well as affects from upstream. One way to address would be to graph egg drift against recruitment. Because sampling is sporadic, jackknifing can be used to fill in the missing data predictively.
 - It was shared that 2008 was the most extreme example of the plug formation so water didn't return to the river until 8 or 10 miles downstream but there was a good number of fish all year. 2009 was the first time in 10 years that drying wasn't observed in Isleta. It was also shared that the school of Age 2 fish were assumed to be caught in winter since there is always higher numbers in winter always. Also, October 2007 was the first year that the ISC site downstream of the bridge (a bank lowering project) was inundated; it was also the same year that minnows

were entrapped downstream at a Reclamation site. But it is striking that there are hardly any young of year in these samplings.

- Attendees briefly discussed when/how ASIR flags isolated pools. Some pools may not be flagged as “isolated pools” since there is always a trickle of water coming through the dam. There may need to be additional conversation on the meaning and consistency of the flags for isolated pools.
- Figure 7 shows the prediction of the number of recruits (not recruitment rate) - the number of recruits can be predicted without knowing the number of spawners. The implications are enormous.
 - To investigate this further, Dr. Goodman tried to predict August 1 recruits from the number of May 1 adults. The regression is not exactly inspiring! – it superficially indicates the more adults the fewer the recruits. But this relationship is contaminated by the 1,000/2,000 cfs flow threshold (there will not be any recruits for flow below 1,000 cfs regardless of the number of adults).
 - So then he corrected for the low flow threshold to see if the number of spawners have predictive power to the number of recruits. The results can be found in Figure 9 – the results are borderline at best. The predictive R^2 is 0.08 so it doesn't pass. Dr. Goodman explained that he was not willing to give up on finding the effect of the number of spawners to the number of recruits. So rather than predicting just the number of recruits, he explored the number of recruits per spawner as a function of flow (see Figure 10). The vertical axis is the number of recruits per spawner and the horizontal axis is May mean flow at Albuquerque Gage. The jackknife R^2 is 0.008 even though the correlation is high. If the 5 points below the 1,000/2,000 cfs threshold are “set aside” then the regression gets even worse since there is nothing left but scatter.
 - Next, Dr. Goodman tried a stepwise multi-regression. In the stepwise multiple regression, the first variable is predicting recruits from flow. The residuals from that regression were not correlated to the number of parents. Looking at the coefficients for the bi-variant regression of recruits on flow and the number of parents - the slope is negative.
 - Dr. Goodman shared he could not find any spawner-to-recruit prediction relationship that passed the statistical scrutiny. The variation for recruitment is accounted for almost entirely by flow. The biological speculation (which needs to be pursued in research) is that the fecundity rate is so high that not many spawners are needed to capitalize on all the spawning habitat available in any given year. The spawning habitat present is a function of flow – and is still limited. But the number of spawners we have seems to always be enough to saturate. The bottom line is that if more recruits are desired, then provide more habitat. This is the most plausible explanation at this time and could be an experiment for AM to pursue.
 - Attendees briefly discussed that fact that even with a huge reproductive cohort, the recruits need to *survive*. They need to make it from the nursery habitat back into the river. This is related to the quality, quantity, and types of habitat needed.
- *Survivorship - Remember* that the cohort reconstructions enable the estimation of the survivorship of each cohort. In a regression of the survival rate, the vertical axis is survival of the cohort and the horizontal axis is mean July/Aug/Sept flow. The survival rate is the slope of the processed *Platantia* and *Dudley* data. However, there is a problem with using the July/Aug/Sept flow as there are numerous drying and monsoon events that result in extreme highs and lows over the 3 months. This explains the scatter in the graph. The negative slope, however, is not so logical.
 - This portion of the analysis could be redone with the Aug/Sept/Oct flows since July could be contributing runoff phenomena.
- *Annual Survival Rate* – It has now been argued that the survival rate is kind of pre-determined early in the summer. The biological “story” could be that the spring inundation actually sets the food supply for the year. Even when the water recedes back into the channel it could bring the food supply with it -

this could explain why the summer survival “sticks” for the rest of the season. Remember that we are working with quarterly survival rates and any attempts to reproduce the quarterly survival rates and census could not be done. Summer survival rates are based on the July-September flow. . Confident of regression annual survival based on 3 months of flow?

- When asked if he was confident in the annual survival regression based on 3 months of flow, Dr. Goodman explained that he attempted other regressions as well. Survival rate was regressed on the number of days where the flow at the Albuquerque Gage was below 400 cfs (or basically the number of days with a high probably of drying in Isleta and San Acacia). The result was almost perverse – the more drying days the higher the survival. Dr. Goodman also shared that he is beginning to suspect that it is not necessarily correct to assume that drying is driving low survival. This is a hypothesis that needs to be questioned.
- It was commented that fish biologists have a “conventional wisdom” regarding the accepted depth/velocity parameters that are considered ideal for fish habitat. However, results from a USGS study for the siphon at the San Acacia Diversion Dam fish passage indicated that as flows went down more minnow habitat was produced (because the water was shallower water). There may also be a link to the food supply – as depth decreases, the conditions improve for larger patches of food supply. The study indicated that the flow has be get pretty low – below 150 cfs before the habitat value declined.
 - It was also commented that the survival of young fish seems to be higher for low flow years in other systems as well. (Platania and Dudley’s drying evaluation report was referenced).
 - **Question:** Isn’t there a sampling issue involved here since there is greater probability of obtaining higher CPUE estimates since the flow is lower?
 - **Response:** It is possible that in some situations it would be more likely to catch/sample more fish at lower flow. The use of the June points help address this to some extent. The May catch rates could be much more variable. Using the June through May of the next year means it should be more robust.
 - It was shared that electrofishing techniques in shallow channels can pick up lots of minnow but once the water is slightly deeper then the minnow numbers decline to almost nothing. There appears to be a real selectivity of the minnow for that shallow water for certain times of day.
 - Attendees briefly discussed how catch rates for all different fish species vary depending on the type of water year. There is a “shifting of balance” between the fish species – a bad year for the minnow could mean a good year for a different fish. And once a species is “on top” they are more likely to stay on top.
- *Crowding Affect* - Remember that the spring and summer flows are well correlated – if there is high flow in the spring then higher flows in summer can be expected. Also, if there is high flow in the spring we can expect a large cohort – this might be a sign of density dependence. But a large cohort can result in crowding which can be expected to decrease survival. (*please refer to the “survival rate predicted from August 1 Cohort size” graph in Dr. Goodman’s presentation for details on the crowding affect*).
 - As soon as goes flows increase beyond the 1,000/2,000 cfs threshold, the minnow produce significant numbers of young, even at the expense of a significantly higher mortality rate under significant crowding conditions. It was pointed out that in an unmanaged braided system there may have been much less crowding affects.
 - Habitat is a limiting factor each year but the amount of habitat available changes one year to the next. The amount of spawning habitat seems to be extremely variable each year and depends on the spring runoff flows. Once water has receded back into the channel, the amount of habitat available to sustain the fish through the rest of year is limiting. A boom/bust cycle

can be created in spawning but no matter how many fish spawn, they all have to “squeeze through the same key hole” in terms of summer habitat.

- Attendees discussed survival by reach. Considering the habitat limitation on survivorship, it would be interesting to research survivorship over the past 20 years to see if there has been a decline since the Angostura channel is narrowing and deepening.
 - The Angostura Reach imposes a more stringent density dependence in survival than is seen in the other 2 reaches. The “key hole” is tighter in the Angostura Reach.
 - The size of the “key hole” is not predicted at all by the spring flow.
 - However, if depth is an alluding factor to food supply, then there is the need to tease out the differences between the reaches. The Program is more motivated now to pursue the food issue more assiduously than has been done before.
 - It was observed that in the big water years since 2003, the growth rates are smaller in high catch years (2-3 mm/month) compared to the growth rates in poor catch years (5-6 mm/month).
 - In a discussion on the minnow diet, it was shared that the minnow basically eat whatever is available - including some sand.
 - Shallow, exposed edges of the shore line are conducive to food production. In the summer months in Albuquerque, the depth can be over 12 inches. In the spring in other reaches, the depth can be less than 6 in. Joel Lusk (FWS) has done a lot of work on primary productivity. It appears that the first organisms to react to a sudden change in flow (i.e., different water surface elevation) are the diatoms which colonize within a few days; but they tend to colonize where there isn't a shifting substratum. This may explain why the fish go to certain places at certain times in response to changing river elevations. After the diatoms, the algal species are the next to return. The invertebrate species are much slower to come back.
 - There is a chronology in the recovery of those species. Diatoms are almost always present, even after drying. Diatoms are very important. In an example it was shared that at the Route 66 high flow channels large microinvertebrate communities returned after a drying event. But the Rio Grand Nature Center a few miles up was almost devoid – the possible reasons are still being explored. Theories include the oxbow being a source of invertebrates or that the shifting sand bottom prevents colonization (i.e., lack of root wads).
- *Conclusions* - In light of today's discussions, Dr. Goodman shared his opinion that that the running of the models might not be as important as “digesting” what the data is indicating. He suggested the Program could move further along than just mechanically running a model. The density dependency indicates that AM needs to consider more in-stream habitat and inundation. He also suggested that actions to begin addressing or teasing apart the information be developed rather than trying to predict things that can't be adequately predicted yet. If the density dependence situation is correct, then the total population abundance can theoretically be increased with an increase in habitat.
 - New research data will be needed to determine where the fish are surviving during and what the qualities of good refugia are. The Program will probably have to brainstorm how to engineer habitat to produce the necessary food supply and develop some habitat experiments to test.
 - Dr. Goodman suggested letting the EC know where the PVA work group is and explain that it wasn't exactly where the group thought they'd end up. The group is learning very interesting things and the implications are thought to be significant. The PVA models could be used to address questions that could lead to real management actions. While the functioning models aren't available yet, there are a lot of new encouraging ideas. Most of those ideas have been around for a while but we are finally able

to show some proof thus making it more comfortable for all to believe. At the very least, it is important to share the “story” that the graphs and charts are telling and let the CC/EC weigh in.

- **Upcoming Meetings and Scheduling:** The AM workshop is next week. The next PVA meeting is Tuesday, March 29th. The regular EC meeting is scheduled for Thursday March 17th but there are spring break and legislative session overlaps so it has been suggested that the executives consider rescheduling. It might be advantageous to have the EC meeting correspond to the next PVA meeting (in order for the executives to be able attend the model debuts).
 - It was suggested that the executives should see Dr. Goodman’s data analysis presentation. The sooner the EC sees the data analysis the better especially if it will inform directives for AM. Even though it is just a presentation on findings, it was advised that the CC be informed of the PVA work group’s desire to present the data analysis to the executives. The CC will meet on February 9th and the PMT liaison will put this as an agenda item for discussion.
- **Discussion of PVA/PHVA interaction, report on Jan. 24 PHVA meeting- D. Gensler**
 - Please see discussion under the action items.
- **Review of genetics Data received to date-J. Dye/D. Goodman:** This agenda item was not discussed.
- **Outstanding data needs for the PVA - Dr. Goodman:** Jeanne to still email outstanding genetic information; pieces missing from the provided data file.
- **Next PVA Meeting: Tuesday, March 29th, 2011**
 - PVA: March 29th -
 - PVA Models debut/preliminary outputs
 - Report out on the February AM sessions

**PVA Meeting Attendees
January 28th, 2011**

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